DRAFT

LONG TERM CONTROL PLAN UPDATE
VOLUME 2

Prepared for

City of Portsmouth, New Hampshire

June 4, 2010

This is a draft and is not intended to be a final representation
of the work done or recommendations made by Weston and Sampson/
Brown and Caldwell.
It should not be relied upon; consult the final report.

Weston&Sampson®

100 International Drive, Suite 152
Portsmouth, New Hampshire 03801

Brown AND Caldwell

155 Fleet Street, Suite 209
Portsmouth, New Hampshire 03801

TABLE OF CONTENTS

LIST OF TABLES III

1. 2010 LONG TERM CONTROL PLAN UPDATE 1-1
  1.1 LTCP Regulatory Requirements for CSO Reduction 1-1
  1.2 2005 LTCP 1-2
    1.2.1 Work Completed 1-2
  1.3 Status of Collection System Model and CSO Characterization 1-7
    1.3.1 Collection System Model 1-7
    1.3.2 CSO Characterization 1-9
  1.4 Integration of LTCP and WMP 1-13
    1.4.1 Sizing CSO Abatement Facility for Scenarios 1-14
    1.4.2 Available CSO Abatement Measures 1-15
    1.4.3 Other Technologies 1-20
    1.4.4 CSO Abatement Measures for WWTF Alternatives 1-23
    1.4.5 CSO Abatement Measures for WMP Preferred Alternative 1-24

2. POST CONSTRUCTION MONITORING PLAN 2-1
  2.1 Purpose 2-1
  2.2 Work Plan 2-1
    2.2.1 Program Completion 2-3

APPENDIX A: FLOW ASSESSMENT REPORT .... A

APPENDIX B: COLLECTION SYSTEM MODEL RUNS .... B

LIST OF TABLES

Table 1-1. Completed and Pending Sewer Separation Projects 1-3
Table 1-2. 2008 Flow Metering Program Locations and Dates 1-4
Table 1-3. CSO Activation Summary 1-6
Table 1-4. Overflow Statistics for Select Storms 1-6
Table 1-5. Comparison of Measured versus Calibrated Model Flows 1-9
South Mill Pond CSOs (010A/010B) 1-9
Table 1-6. Comparison of Measured versus Calibrated Model Flows 1-9
Deer St CSO (013) 1-9
Table 1-7. Estimated Impact of System Improvements on CSOs during Summer 2008[1] 1-10
Table 1-8. Estimated Typical Year CSOs Statistics 1-11
Table 1-9. Estimated Typical Year CSO Statistics after Current Planned Improvements[1] 1-13
Table 1-10. Available Peak Instantaneous CSO Abatement Capacity at Peirce Island with Current WWTF Alternatives 1-13
Table 1-11. Characteristics for CSOs 010A/010B Under WWTF Alternatives 1-15
Table 1-12. CSO Abatement Technologies and Practices 1-17
Table 1-13. CSO Abatement Measures Considered for 2010 LTCP Update 1-21

1. 2010 LONG TERM CONTROL PLAN UPDATE

This section of the WMP/LTCP Update will address work completed in relation to the 2010 Long Term Control Plan Update (2010 LTCP). As part of the WMP/LTCP Update work plan, the City has submitted updates to the EPA and NH DES in the form of technical memoranda. Updates pertaining to the LTCP CSO abatement were provided on December 1, 2009 in *Technical Memorandum 4: CSO Abatement Progress and Collection System Model Upgrade* (TM4) on October 30, 2009 and in *Technical Memorandum 5: WWTF Process and Siting and CSO Abatement Evaluations* (TM5) on December 1, 2009. Both of these documents are provided in Volume 3.

1.1 LTCP Regulatory Requirements for CSO Reduction

The City of Portsmouth has been diligently implementing the recommendation of the 2005 LTCP. These have included the several sewer separation projects listed in Table 1-1 along with the upgrade of the Mechanic Street and Deer Street PSs. In addition to these capital projects, the City has been continuously monitoring the discharges at CSOs 010A, 010B and 013 and has continued its Nine Minimum Controls (NMC) program activities.

With regards to NMC, the City submitted its initial NMC documentation plan to EPA and NH DES in January 1997 in accordance with the requirements of the EPA CSO Control Policy; an update was submitted in August 2002. The City also submitted a CSO Status Report to the agencies in June 2004. These two NMC documents, and the 2004 Status Report, were completed prior to the 2005 LTCP. Finally, as required by the City's NPDES Permit, the City also submits a brief annual CSO status report to EPA and NH DES which includes a statement of completed and planned projects and related collection system management activities that occurred during the reporting period.

As will be described in Subsequent sections of the LTCP Update, the projects recommended in the 2005 LTCP that have been completed to date, and ongoing NMC activities have had a very positive effect on CSO reductions. Using the updated collection system model, the 2010 LTCP Update evaluates what additional CSO reduction measures will be required to bring the collection system into compliance with the applicable laws and regulations that were described in *Technical Memorandum 2: Regulatory Requirements Review* (TM2), and as set forth in the 2005 LTCP: the 1-year level of control. It should be noted that since the completion of TM2 in October 2007, the City has entered into a Consent Decree (CD) with EPA. The Consent Decree (CD) reaffirms the requirement to update the 2005 LTCP as part of the WMP, complete the planned sewer separation work, and to continue implementing applicable NMC activities.

With respect to future CSO abatement measures emanating from this 2010 LTCP Update, it is important to note that because the WMP is addressing CSOs abatement in addition to the upgrade to secondary treatment of the Peirce Island sanitary flows, the LTCP and WMP are closely linked and need to be viewed in a comprehensive, system-wide manner. For example, if the new secondary WWTF is located on a site other than Peirce Island, this would free up advanced-primary treatment capacity for additional CSO treatment. Further, the timing of such relocation would impact the schedule for the potential additional CSO treatment. Finally, this additional treatment at Peirce Island could possibly be considered what was referred to in the 2005 LTCP as the "Plus Project"; the project or series of projects that would be required following the completion of the targeted sewer separation and PS upgrades in order to meet the desired level of CSO control.

One final point relative to the tracking of future compliance is the requirement for the development of a Post Construction Monitoring Plan (PCMP). The PCMP, required by the CD, includes monitoring, modeling and related activities aimed at tracking the performance of the recommended CSO abatement facilities and programs as they become operational. This formal process for tracking compliance is a valuable tool for the City of Portsmouth as it provides a means of both modifying operation of the collection and treatment system as well as revising the nature and schedule of future capital expenditures. In essence, the PCMP will allow the City to make decisions on future abatement activities based on the documented effectiveness of what was previously constructed, all with the intended purpose of working toward attaining the CSO control levels that will be negotiated as part of this 2010 WMP/LTCP Update. The PCMP is included in the next section of this LTCP Update.

1.2 2005 LTCP

The 2005 LTCP was an update of an earlier CSO Facilities Plan that was prepared for the City by Whitman & Howard in 1991 in response to a CD in effect at the time. That plan was never officially approved and, following a directive by EPA in 1998, the City embarked upon a formal LTCP process in accordance with the 1994 CSO Control Policy.

The 2005 LTCP built upon earlier system characterization, CSO and ambient monitoring and collection system modeling from the 1991 plan and also contained an updated listing and extensive evaluation of potentially-viable CSO abatement alternatives. The 2005 LTCP also addressed the issue of potential adverse water quality impacts from the discharge of separate storm water resulting from sewer separation.

It should be noted that the City did not remain idle between the 1991 and 2005 CSO plans and began to address problems within the collection system through sewer rehabilitation and targeted separation of combined sewers. The 2005 LCTP documented these earlier collection system improvement efforts including both planning and implementation.

A summary of the plan's recommendations are as follows:

- Continue with targeted sewer separation for both CSO abatement and to address localized flooding and related capacity problems.
- Upgrade the Deer Street and Mechanic Street PSs to maximize wet weather conveyance to the Peirce Island WWTF with its rated peak wet weather capacity of 22 MGD.
- Build and measure: revise the 2005 LTCP following the 15-year targeted sewer separation program.
- If further CSO abatement is warranted following the targeted sewer separation program, a so-called "Plus Project" would be implemented. The Plus Project could include, but not be limited to: in- or off-line storage, satellite CSO treatment, expanded treatment at Peirce Island, or further sewer separation.

Collectively, the targeted sewer separation and PS projects were considered the Phase 1 CSO Projects; if needed, the future Plus Project would represent Phase 2. This phased concept represented a good example of "build and measure" and will continue into the 2010 LTCP Update.

The Plus Projects that were identified in the 2005 LTCP, and possibly others, will be revisited as part of this 2010 LTCP Update. Further, as with the earlier 1991 CSO Facilities Plan and 2005 LTCP, the Peirce Island WWTF will remain a key component of this 2010 LTCP Update with respect to further CSO abatement.

1.2.1 Work Completed

The following contains a summary description of the collection system improvements that have been completed to date, along with ongoing and planned projects. These projects, many of which originated from the 2005 LTCP planning process, have resulted, and will continue to result, in significant reductions in the annual volume of untreated CSO discharges at both CSOs 010A/010B at South Mill Pond and CSO 013 at the Deer Street PS and Pistacaqua River. The specific reductions in CSO activity resulting from these improvements are described later in this 2010 LTCP Update.

1.2.1.1 CSO Abatement Activities Following 2005 LTCP

The City of Portsmouth has been very active with respect to CSO abatement activity, both prior to and following the completion of the 2005 LTCP, including a number of ongoing projects. The City has spent more than $25 million since 1997 on CSO abatement activities.

TM4 Figure 4.13 provided in Volume 3 showed the location and extent of the sewer separation and pump station upgrade projects which were constructed from 2000 through 2006 and what is currently in design and ready for construction. Completed or pending sewer separation projects are listed in Table 1-1 along with their linear footage of project length.

Table 1-1. Completed and Pending Sewer Separation Projects

Project	Project Length	Alternative Designation	Status
Thaxter/Fells	4,900 ft.		Completed
Court St. – 1			Completed
Court St. – 2			Completed
Pleasant Point			Completed
South St.	2,200 ft.		Completed
Borthwick Interceptor			Completed
Brackett Rd.	2,200 ft.		Completed
Contract #1	3,600 ft.	Lincoln Ave. #1	Completed
Dennett St.	1,700 ft.		Completed
Contract #2	3,200 ft.	Lincoln Ave. #1A	Completed
State St.			Bid in 2009
Bartlett	3,325 ft.	Islington St. #1	Bid in 2009
Area 3-1	6,500 ft.	Lincoln Ave. #2	Bid in 2010
Cass Area	3,100 ft.	Islington St. #2	Bid in 2011
Area 3-2	8,000 ft.	Lincoln Ave. #2A, 3 and 3A	TBD
Area 3-3	5,900 ft.		

The completed projects for Mechanic Street and Deer Street PSs were intended to bring both stations up to their previously-anticipated peak design capacity.

1.2.1.2 2008 Monitoring Program

An extensive rainfall and flow monitoring program was undertaken in 2008 as part of the WMP/LTCP Update. The program, performed by Flow Assessment Services, L.L.C., of Bedford, New Hampshire, included a combination of rainfall gauges, CSO and pump station metering coupled with the installation of temporary and permanent collection system flow meters.

The program was developed with three intended purposes:

- Establish a hydraulic water balance in, and around, the combined portions of the collection system.
- Track progress with respect to CSO abatement program recommended as part of the 2005 LTCP.
- Provide data to update the collection system hydraulic model that was previously developed for and used in the 1991 Facilities Plan and 2005 LTCP.

A summary of the entire program is contained in the report: "Portsmouth, NH Continuous Flow Monitoring Report, March 2008 to September 2008", prepared by Flow Assessment Services, L.L.C., dated October 6, 2008 which is provided in Appendix A.

The 2008 monitoring program was structured around a similar program that was conducted in 2000 as part of the 2005 LTCP with some of the flow meters placed in the exact or nearly exact location for both programs. Figure 4.2 in TM4 shows the location of metering sites that were used in the 2008 program, including the ongoing CSO meters and key pump stations. The location of the 2000 program flow meter sites is also shown. Where the same two locations were utilized for both the 2000 and 2008 programs, the same designated meter number was utilized.

The pump station data was collected from the existing magnetic meters from the three largest stations that serve, or pump into, the combined collection system: Mechanic Street, Deer Street and Lafayette Road. The meter locations and time frame for the 2008 program are listed in Table 1-2.

Table 1-2. 2008 Flow Metering Program Locations and Dates

Site	Location	Data Range	Meter
5	167 Lincoln Avenue	3/28/08 – 8/14/08	Area Velocity Meter installed in an existing 30-inch circular pipe.
6	Puddle Lane at Strawberry Banke	3/28/08 – continuous	Area Velocity Meter installed in an existing 30-inch circular pipe.
11	Ricci Lumber	3/28/08 – 8/21/08	Area Velocity Meter installed in an existing 36-inch circular pipe.
11A	Islington Street at Elm Court	8/15/08 – 8/27/08	Area Velocity Meter installed in an existing 15-inch circular pipe.
11B	33 Jewel Court	8/15/08 – 8/27/08	Area Velocity Meter installed in an existing 35-inch circular pipe.
11C	Islington Street at Columbia Street	8/15/08 – 8/27/08	Area Velocity Meter installed in an existing 15-inch circular pipe.
11D	Bartlett Street	8/15/08 – 8/27/08	Area Velocity Meter installed in an existing 10-inch circular pipe.
12	Maplewood Avenue	3/27/08 – 8/21/08	Area Velocity Meter installed in an existing 24-inch circular pipe.
13	Franklin Drive	3/27/08 – 8/14/08	Area Velocity Meter installed in an existing 20.6-inch circular pipe.
14	Islington Street Dirt Access Road	4/02/08 – 8/14/08	Area Velocity Meter installed in an existing 17.5-inch circular pipe.

Table 1-2. 2008 Flow Metering Program Locations and Dates			
Site	Location	Data Range	Meter
14A	Islington Street Dirt Access Road	3/27/08 – 4/02/08	Area Velocity Meter installed in an existing 17.5-inch circular pipe.
15	Route 1 Bypass	3/27/08 – 8/14/08	Area Velocity Meter installed in an existing 10-inch circular pipe.
16	Pierce Island Road at Mechanic Street	8/21/08 – continuous	Area Velocity Meter installed in an existing 24-inch circular pipe.
Rain1	Lafayette Road Pump Station	3/27/08 – continuous	Electronic tipping bucket type rain collector
Rain2	City Hall	3/27/08 – continuous	Electronic tipping bucket type rain collector

As noted, two of the collection system meters (Sites 6 and 16) became permanent meters as they are located in key junctures of the collection system between CSOs 010A/010B, the Deer Street PS force main terminus and the downstream Mechanic Street PS.

As shown on Table 1-2, the major portion of the 2008 program occurred over a 4-1/2 month period between March 28 and August 14. During this period, approximately 26.8 inches of precipitation was recorded. The Lafayette Road rain gauge recorded 26.2 inches while the City Hall rain gauge recorded 27.39. This slight difference in total rainfall is not unusual where two gauges are used, and particularly in the summer when high-intensity storms occur. Individual storm-specific differences were even greater.

An intensive, short-term program was also undertaken between August 15 and August 27 in the vicinity of metering Site 11 located on the Deer Street Interceptor off of Islington Street. The purposes of this focused program were as follows:

- Gain a better understanding of the inflow sources upstream of the Deer Street PS following recently-completed sewer separation and rehabilitation projects.
- More accurately predict inflow reduction, and more importantly CSO 013 activity reduction, following the completion of a pending sewer separation project in the Bartlett Street area off Islington Street scheduled for construction in late 2009/early 2010.

While CSO activity occurred, both prior to and following the 2008 monitoring program, this 2010 LTCP Update primarily addresses those events that occurred during the duration of the program when all collection system, CSO and PS meters where active. TM4 Figure 4.3 provided in Volume 3 showed a plot of CSO activity during this period along with the rainfall hyetographs while Table 1-3 contains a summary of the activations at each CSO location. As noted, CSO 010A continues to be the most active of the three with 15 days of activation, about twice that of CSOs 010B or CSO 013.

Table 1-3. CSO Activation Summary		
CSO	**Activation Days**	**Dates**
010A	15	April 28 and 29; May 4, June 11, 15, 20 and 23; July 18, 20, 21, 23, 24, 25 and 31; and August 6
010B	8	June 11, 15 and 23; and July 18, 20, 23, 25 and 31
013	6	June 15 and 23; and July 18, 20, 21 and 23

Seven events in particular were analyzed in detail; the same events were used to update the collection system model as described later in this LTCP Update. The general statistics of these events are presented in Table 1-4.

Table 1-4. Overflow Statistics for Select Storms								
Event			**South Mill Pond**				**Deer St**	
			CSO 010A		**CSO 010B**		**CSO 013**	
Dates	**Rainfall (in)**	**Peak 15-Minute Intensity (in/hr)**	**Total Volume (MGal)**	**Peak Rate (MGD)**	**Total Volume (MGal)**	**Peak Rate (MGD)**	**Total Volume (MGal)**	**Peak Rate (MGD)**
6/14/2008 - 6/15/2008	2.61	1.36	2.09	14.8	0.25	8.1	0.09	1.5
6/23/2008	1.43	1.34	0.72	12.5	0.22	7.9	0.18	3.4
7/18/2008	1.86	3.36	0.82	9.9	0.47	11.1	0.33	5.4
7/20/2008 - 7/21/2008	2.35	1.98	1.14	13.7	0.57	10.2	0.04	4.8
7/23/2008 - 7/25/2008	3.3	1.66	1.48	9.7	0.24	6.3	0.05	1.4
7/31/2008	1.03	1.24	0.34	6.8	0.002	1.2	0	0
8/6/2008	0.98	0.68	0.13	4.5	0	0	0	0

Plots for each of the seven events that were summarized in Table 1-4 were shown graphically in TM4 Figures 4.4 through 4.10 provided in Volume 3. These plots not only show the CSO hydrographs and rainfall hyetographs, but the hydrographs from the collection system and pump station meters as well.

As shown in Table 1-4 and the subsequent figures, these seven events were driven by significant amounts of rainfall, five of which had total volumes ranging from 0.98 inches on August 6 to 2.61 inches on June 14-15. Peak 15-minute intensities were also significant with a low of 0.68 inches/hour on August 6 to a high of 3.36

inches/hour on July 18. Overall, these rainfall events were significantly greater than those captured during the 2000 monitoring program.

With regards to the three overflows, CSO 010A had peak rates of discharge in the 12.5 to 14.8 MGD range while CSO 010B peaked in the 10.2 to 11.1 MGD range; CSO 013 had peaks in the 4.8 to 5.4 MGD range. The volume of discharge, however, does not appear to be significant with the largest recorded volume being 2.09 MGal from CSO 010A on June 14-5. All of the recorded volumes from CSO 010B and 013 had highs in the 0.5 MGal range with the remaining volumes being significantly less.

TM4 Figure 4.11 showed the results of the intensive metering that occurred around Site 11 on the Deer Street Interceptor off Islington Street. As shown in TM4 Figure 4.12, these included metering Sites 11A, 11B, 11C and 11D. These plots, provided in Volume 3, clearly reveal that the vast majority of the inflow observed at Site 11 was emanating from Site 11B, the area earmarked for sewer separation beginning in the fall of 2009. It also revealed that previous rehabilitation and separation work upstream of Site 11, as plotted as Site 11A, were successful in reducing the rate of upstream inflow.

1.3 Status of Collection System Model and CSO Characterization

The following is a description of the current status of the City's combined collection system with an emphasis on:

- Updates that were made to the collection system hydraulic model to reflect the collection system improvements as documented by a comprehensive monitoring program that occurred in 2008.
- Resultant changes in CSO characterization statistics.

The system model and CSO characterization are closely linked: as improvements are made to the collection system, and CSO activity is reduced, the model needs to be updated to reflect both the resultant physical and hydraulic changes in order for it to remain a reliable planning tool for further CSO abatement planning as required for this 2010 LTCP Update. These interdependencies are further described below.

1.3.1 Collection System Model

One of the key elements in revising and updating the 2005 LTCP into the 2010 LTCP Update is the collection system model. The collection system model was originally developed for the 1991 CSO Facilities Plan and later updated for the 2005 LTCP. The model has since been updated to reflect both the numerous physical and hydraulic changes that occurred throughout the collection system. In addition, the model was updated to reflect projected changes in demographics, such as population and employment trends, and their attendant changes in wastewater generation. The latter was presented in TM3 while the update of the model itself was presented in TM4 both of which have been provided in Volume 3.

1.3.1.1 Collection System Model Overview

The objectives of the hydraulic modeling were to:

- Estimate the effectiveness of the collection system improvements completed between 2000 and 2006 in reducing CSO discharges.
- Estimate the impact of the planned sewer separation projects on CSO reductions.
- Support the evaluation of further CSO reductions.
- Support the evaluations involving rerouting of dry- and wet weather flows as part of the overall Master Plan.
- Evaluate the capacity of the collection system under current and future conditions.

The collection system hydraulic model used for this 2010 LTCP Update is based upon the model that was developed and used during the development of the 2005 LTCP. The PCSWMM 2009 software was used to perform the hydraulic modeling. PCSWMM 2009 relies on the U.S. Environmental Protection Agency (EPA) Storm Water Management Model (SWMM) version 5 as a modeling engine. A map of the sewer model is shown in TM4 Figure 4.14 provided in Volume 3.

The flows for the hydraulic model were developed using Brown and Caldwell's Capacity Assurance Planning Environment (CAPE) software. This is the same software that was used to develop the region-wide flows projections presented in TM3, Flows and Loads – Existing and Forecasted Conditions. After developing the flows, CAPE generated flow files which were imported into the PCSWMM model for routing.

1.3.1.2 Collection System Model Updates

For purposes of clarity, the updated model will be referred to as the *Y2008 Model* while the model used by the 2005 LTCP will be referred to as the *Y2000 Model;* 2000 and 2008 are the years in which flow metering data were collected to calibrate the two models. Model Runs for the 2010 LTCP Update are included in Appendix B.

The updates that were incorporated into the Y2008 Model are summarized below:

- Converted the hydraulic model from SWMM version 4.4GU to PCSWMM 2009 (SWMM version 5).
- Georectified the manhole coordinates.
- Increased the Deer Street PS capacity from 9 to 10[1] MGD to reflect improvements completed in 2007.
- Increased the Mechanic Street PS capacity from 18.5 to 21 MGD to reflect improvements completed in 2008.
- Modified pipes and manholes to account for changes in the collection system as a result of the sewer separation projects and added a relief line from Lincoln/Richards Avenue to Parrott Avenue.
- Dry- and wet weather flows were updated to 2008 conditions using CAPE. The calibrations were performed using the flow meter and rain gauge data measured during the spring/summer 2008.

1.3.1.3 Flow Calibration

The dry- and wet weather flows for the Y2008 Model were calibrated using rainfall and flow data collected during the 2008 monitoring program. A comparison of the measured versus calibrated model flows at CSO 010A and 010B were presented in TM4 Figures 4.15 through 4.21 which have been provided in Volume 3. Because these CSOs are co-located and hydraulically interdependent, the sum of the CSO 010A and CSO 010B hydrographs are presented together in the subsequent figures. A comparison of the measured versus calibrated model flows at CSO 013 was presented in TM4 Figures 4.22 through 4.25 which are provided in Volume 3. Tables 1-5 and 1-6 provide a summary of the calibration for the CSO events which occurred from June 1–August 30, 2008, for CSO 010A/010B and CSO 013, respectively. The volumetric difference between the measured and simulated events for CSOs 010A/010B is less than 1% while the modeled volume for CSO 013 was about 17% higher than measured.

[1] The peak flow capacity of the pump station is 12.6 MGD, but is being operated at a peak flow capacity of 10 MGD due to downstream system capacity limitations.

Table 1-5. Comparison of Measured versus Calibrated Model Flows South Mill Pond CSOs (010A/010B)					
		Measured		Calibrated Model Flow	
Date	Rain (in)	Peak Flow (MGD)	Volume (MGal)	Peak Flow (MGD)	Volume (MGal)
6/11/2008	0.61	12.17	0.21	0	0
6/15/2008	2.61	17.91	2.33	16.51	2.27
6/20/2008	0.23	1.98	0.03	0	0
6/23/2008	1.39	20.83	0.93	17.18	1.13
7/18/2008	1.85	24.72	1.29	22.55	1.36
7/20/2008	2.29	27.09	1.72	27.93	2.35
7/23/2008	3.30	20.28	1.73	8.46	0.74
7/31/2008	1.03	10.47	0.34	9.68	0.58
8/6/2008	0.96	4.88	0.13	4.16	0.34

Table 1-6. Comparison of Measured versus Calibrated Model Flows Deer St CSO (013)					
		Measured		Simulated (Y2008 Model)	
Date	Rain (in)	Peak Flow (MGD)	Volume (MGal)	Peak Flow (MGD)	Volume (MGal)
6/15/2008	2.61	1.59	0.09	2.30	0.08
6/23/2009	1.39	4.15	0.18	3.65	0.08
7/18/2008	1.85	6.33	0.33	8.27	0.37
7/20/2008	2.29	5.92	0.39	8.45	0.69
7/23/2008	3.30	1.71	0.05	0.00	0.00

1.3.2 CSO Characterization

Following the update of the collection system model, the CSO characterization was then established to reflect the improvements that were made to the collection system, as documented in the 2008 monitoring program.

1.3.2.1 CSO Reductions from System Improvements (2000 to 2006)

As discussed previously, the City has performed numerous system improvements aimed at reducing CSO activations. This section estimates the impacts of these improvements on the CSOs.

1.3.2.1.1 Simulating Flows for Spring/Summer 2008 with the Y2000 Model

The Y2000 Model represents the conditions in the collection system that existed before the improvements discussed in Section 1.2 were completed. The Y2000 Model was run using rainfall from the 2008 monitoring period. The simulated flows from the model were then compared against measured flows from the 2008 monitoring period. In this manner, it was possible to estimate the level of CSO reduction directly attributable to the system improvements. The results are summarized in Table 1-7.

Table 1-7. Estimated Impact of System Improvements on CSOs during Summer 2008[1]

Location	Volume (MGal)			Number of activations		
	Before system improve-ments[2]	After system improve-ments	% Reduction	Before system improve-ments[2]	After system improve-ments	% Reduction
South Mill Pond CSOs (010A/ 010B)	9.7	8.8	9%	8	8	0
Deer St CSO (013)	5.2	1.0	81%	8	5	38%
Flooding	14.3	1.9[3]	87%	N/A	N/A	N/A
Total	29.2	9.8	66%	16	13	19%

Notes:

1. Covers period from June 1, 2008 – August 31, 2008
2. Estimate developed by running the Y2000 Model with rainfall from the 2008 monitoring period.
3. Flooding estimate based on differences between flows measured at flow meter 16 and the Deer Street Pump Station.

The analysis found that significant flooding would have occurred during the summer of 2008 if the system improvements had not taken place. It is estimated that 14.3 MGal would have been discharged from the collection system. Measurements during that period of time indicate that less than 2 MGal of flooding occurred representing a reduction of approximately 87%.

The analysis found a modest reduction of 9% in volumes discharged from CSOs 010A and 010B. The CSO discharges before the system improvements would have been higher if flows upstream had not been lost to flooding. This is often the case in CSO mitigation as system improvements must remove a certain threshold of flooding before downstream reductions at the CSO discharges can be realized. It appears that the City has crossed this threshold, at least for the magnitude of storms which occurred during the 2008 monitoring program; flow reductions achieved by future separation projects upstream of CSOs 010A/010B should translate into corresponding reduction on the CSOs.

The system improvements upstream of the Deer Street PS have significantly reduced overflow activity at CSO 013. Prior to the system improvements, it is estimated that 5.2 MGal would have been discharged from CSO 013 during the spring and summer of 2008. However, only 1 MGal was measured during that same period of time. This is more than an 80% reduction.

The number of activations at CSOs 010A/010B before and after system improvements remained unchanged. However, it appears that most of the benefits from the improvements upstream of these CSOs have come in the form of flooding mitigation. Further improvements are likely to reduce the frequency of activation.

The number of activations at CSO 013 has decreased due to system improvements. It is estimated that CSO 013 would have activated eight times during the summer of 2008 if the system improvements had not been performed, while only five activations were measured.

1.3.2.1.2 Typical Year CSO Statistics

The previous discussion demonstrated that significant CSO reductions have been achieved due to the system improvements. However, the discussion has so far only focused on the 2008 monitoring period. In order to develop a broader understanding of the CSO reductions, it is necessary to assess the reduction for typical year conditions.

The 2005 LTCP performed long-term simulations using the Y2000 Model to estimate the cumulative CSO volume, highest peak flow, and number of CSO events in a "typical" year. The typical year evaluation was performed by running the model using several years of rainfall and then analyzing the results to come up with averages for a typical year.

Because local, long-term rainfall records were not available, the 2005 LTCP used rainfall from the National Weather Service Durham, NH Station (NOAA 2001). This station had records from 1950–1998, but unfortunately much of the data was missing, or appeared to be inaccurate. Upon further review, it was determined that there were five years of good data which represented conditions close to average conditions. The years selected were 1968, 1988, 1989, 1990 and 1993. In particular, the total annual rainfall for these years was close to 44 inches per year.

Consequently, the 2005 LTCP performed long-term simulations using the Y2000 Model loaded with the five years with "average" rainfall conditions. The simulated flows were then analyzed to determine the typical year cumulative volume, the peak CSO flow and the number of CSO events. These results represent conditions before the system improvements described in Section 1.2 were completed. The results are shown in Table 1-8.

In order to estimate the typical year CSO statistics for conditions after the system improvements were completed, the Y2008 Model was run using the same five years of rainfall data. The simulated flows were then analyzed to calculate the typical year CSO statistics presented in Table1-8.

Table 1-8. Estimated Typical Year CSOs Statistics

Condition	Cumulative CSO Volume (MGal)[3]	
	South Mill Pond CSOs (010A/010B)	Deer St CSO (013)
Before Improvements[1]	9.4	3.7
After Improvements[2]	4.4	0.5
Reduction	53%	86%

Notes:

1. Estimated typical year CSO statistics *before* the system improvements described in Section 4.3 were completed. Results from 2005 LTCP.

2. Estimated typical year CSO statistics *after* the system improvements described in Section 4.3 were completed. Data developed from a long-term simulation performed using the Y2008 Model loaded with the same five years of rainfall data used by the 2005 LTCP long-term simulation.

3. Values rounded to nearest 100,000 MGal.

The results of the long-term simulation indicate that the typical year CSO volume was reduced by approximately 53% at CSOs 010A/010B. These reductions are higher than the ones seen during the summer of 2008 because the storms were generally smaller in magnitude and did not result in as much flooding.

The estimated volume discharged from CSO 013 in a typical year is estimated to have been reduced by 86% due to the system improvements. This reduction is similar to the reduction estimated for the summer of 2008.

In addition to the 8.2 MGal volumetric reduction in typical year CSO discharges there is also a corresponding reduction in pollutants. Using 150 mg/L as a typical total suspended solids concentration would equate to roughly 10,500 pounds of solids that are no longer discharged, untreated, to the Piscataqua River and South Mill Pond in a typical year. Also associated with these solids are fractions of organic nitrogen, particulate phosphorus and heavy metals. Thus, the improvements made to the Portsmouth collection system have had positive and measurable impact to the area receiving waters.

1.3.2.2 Forecasted CSO Reductions from Planned Projects

The analysis presented in this section provides an estimate of how the previously-discussed system improvements will impact the CSOs under future conditions. A different version of the Y2008 Model was created to forecast these impacts and will be referred to as the *Y2014 Model* where the 2014 indicates the anticipated year when the City's currently planned system improvements will be completed.

The conditions represented by this model will be referred to as *baseline* conditions because the City is committed to completing the separation projects in the near future. Accordingly, the alternative evaluations will use this model as a starting point, or *baseline*, for evaluating alternatives.

The wet weather flows parameters upstream of CSO 013 were adjusted to reflect impacts of the future separation projects. The wet weather parameters were adjusted based on information gleaned from the intensive flow metering that occurred around Site 11. That data indicated that significant wet weather flow emanates from the area upstream of Site 11B. Future projects will separate this portion of the system, which should result in a significant reduction of wet weather flows to the Deer Street PS. The wet weather parameters were adjusted accordingly.

The wet weather flow parameters upstream of CSOs 010A and 010B were adjusted based on the effectiveness of the projects which took place between 2000 and 2006. The reduction in the wet weather parameters during this period were then extrapolated to the conditions represented by the baseline model.

The results of simulating the five years of average rainfall with the 2014 Model are shown in Table 1-9. It is estimated that the volume discharged from CSOs 010A and 010B during a typical year after the planned separation projects will be 2.1 MGal. This represents a further 2.3 MGal/year reduction from the estimated value of 4.4 MGal under current conditions (see Table 1-8). It is estimated that CSO 013 will not be active during a typical-year after the planned separation projects are completed.

Table 1-9. Estimated Typical Year CSO Statistics after Current Planned Improvements[1]

Location	Cumulative CSO Volume (MGal)
South Mill Pond CSOs (010A/010B)	2.1
Deer St CSO (013)	0

Notes:

1. Estimated typical year CSO statistics *after* the planned system improvements described in Section 4.3 are completed.

TM4 Figure 4.26 provided in Volume 3 presented a comparison of the estimated typical year CSO discharges before system improvements, under current conditions, and after the planned system improvements are completed.

1.4 Integration of LTCP and WMP

One of major differences between the 2010 LTCP Update and that of its predecessors, the 1991 CSO Facilities Plan and 2005 LTCP, is that a higher percentage, up to and including the entire 22-MGD peak capacity, of the Peirce Island WWTF could become available for CSO abatement. The extreme scenario of all 22 MGD becoming available for CSO flows would occur should it be determined that secondary treatment of the City's wastewater should take place at the Pease WWTF. Thus, the two parallel planning tracks of WWTF and CSO abatement are closely linked. Taken further, should the Peirce Island WWTF become available exclusively for CSO abatement, it would become a strong candidate for the so-called Plus Project as described in the 2005 LTCP.

As discussed earlier in the WMP, there are two alternatives for the location of the upgraded WWTF, each having a direct impact on the available capacity for continued CSO treatment at the Peirce Island facility. Table 1-10 shows the resultant available peak instantaneous capacities for CSO treatment for each alternative.

Table 1-10. Available Peak Instantaneous CSO Abatement Capacity at Peirce Island with Current WWTF Alternatives

Peirce Island Upgrade	Pease Expansion
10 MGD	22 MGD

The Peirce Island Upgrade essentially represents current conditions, as projected to 2030. With this alternative, no additional capacity would be available for CSO treatment beyond what is currently available. Further, while the 2005 LTCP evaluated increasing the advanced-primary capacity to 36 MGD, space for this expansion would not be available when the WWTF was upgraded for both secondary treatment and nitrogen removal.

The Pease Expansion represents the removal of all non-CSO treatment functions from Peirce Island with the result that all 22 MGD of capacity would be available for CSO treatment. The required collection system and pump station redirection components needed to accomplish each of these scenarios were described earlier in this section.

The available CSO treatment capacities on Peirce Island with these alternatives were the baseline considerations for the CSO abatement measures evaluated below.

1.4.1 Sizing CSO Abatement Facility for Scenarios

An analysis was performed to determine the size of the CSO abatement facilities needed for each of the scenarios. The goal of the analysis was to size facilities for a *reasonable* level of control, applied uniformly across the scenarios. *It is important to note that this level of control is only being used to assist in the selection of a preferred alternative.* Once the preferred scenario has been selected, additional analysis will be performed in future tasks to select an appropriate final level of control for the City's CSO facilities using processes and procedures described under both the Presumptive and Demonstrative Approaches of the 1994 CSO Control Policy, also described in TM2 which has been provided in Volume 3.

A one-year level of control was deemed to be a reasonable level of control for the purposes of evaluating the scenarios. A number of large storm events were witnessed during the flow monitoring period of 2008. The event which occurred on June 15, 2008 produced the largest measured overflow volume during the monitoring period and had intensities and duration consistent with a 1-year storm[2]. This storm was selected for evaluating the sizes of the CSO abatement facilities for the scenarios.

Hydraulic models were developed to represent the alternatives. The hydraulic model for the Peirce Island Upgrade alternative, the alternative under which the collection system remains largely unchanged, corresponds to the model described earlier in this LTCP Update. An additional hydraulic model was developed for the Pease Expansion where all wastewater flow is being diverted to Pease and presumes the availability of the Peirce Island WWTF for treating wet weather flows.

The flows used in the analysis take into account anticipated reductions in combined flows resulting from planned separation projects discussed earlier in this LTCP Update. Aside from the planned wet weather projects, it was assumed that wet weather flows will remain at current levels. This is consistent with the assumption that increases in wet weather flows in the future due to system deterioration will be offset by the City's efforts to reduce and control extraneous flows. The flows correspond to population and commercial/industrial/ institutional development conditions in the year 2030 which is consistent with the WWTF alternatives evaluation

1.4.1.1 Collection System with 2030 Development Conditions

The Y2014 Model was updated to incorporate the 2030 population and employment forecasts discussed in *Technical Memorandum 3: Flows and Loads – Existing and Forecasted Conditions* (TM3) which has been provided in Volume 3.

It was assumed that I/I will remain at the levels forecasted for the 2014 Model. This assumption is consistent with the ones used in TM3 and is based upon the consideration that the City will likely continue to reduce the amount of extraneous flows entering the City's collection system. At the same time the system will continue to age and deteriorate with time, and that this will lead to more wet weather flow entering the system. As a

[2] The total rainfall during the event was 2.5 inches. The storm was consistent with a 1-year storm across a range of durations. It was equivalent to a 1-year storm with a 1-hour duration, an 8-month storm with a 2-hour duration, a 1.5-year storm with a 3-hour duration, and 1-year storm with a 4-hour duration.

result, it is assumed that these two effects will balance the other so that rates of I/I remain relatively unchanged during the planning horizon.

Dry weather flow simulations performed using the Y2014 Model with 2030 development conditions did not find any areas with insufficient capacity to handle the modest growth in flows due to population and employment growth.

Simulations using the five years of average rainfall indicate that CSO 013 will remain inactive during an average year while volumes discharged from CSOs 010A/010B will increase only slightly.

1.4.1.2 2030 Model Results for CSO Facility Sizing

The results of the model runs are shown in Table 1-11. With the Peirce Island Upgrade alternative, CSOs 010A and 010B discharge approximately 2.9 MG and have a peak flow of 18.2 MGD. No CSO discharge is expected with the Pease Expansion as all 22-MGD of wet weather treatment capacity would be available on Peirce Island. Therefore, in order to achieve a 1-year level of CSO control, the only abatement measure required for the Pease Expansion alternative is the conversion of Peirce Island to a wet weather only facility. For the Peirce Island Upgrade alternative, however, additional CSO abatement measures will be necessary to treat the CSO characteristics presented in Table 1-11.

Table 1-11. Characteristics for CSOs 010A/010B Under WWTF Alternatives

WWTF Alternatives	CSO Volume at 010A/010B (MG)	Peak Flow at 010A/010B (MGD)
Pierce Island Upgrade	2.9	18.2
Pease Expansion	0	0

Notes:

CSO characteristics for the June 15, 2008 storm, (equivalent to a 1-year storm) under 2030 development conditions. Flows take into account anticipated reductions from planned separation projects.

CSO 013 was not active.

1.4.2 Available CSO Abatement Measures

1.4.2.1 CSO Abatement Objectives

As was discussed earlier, the goal of this and previous CSO planning efforts was to bring the CSO discharges into compliance with EPA- and NH DES-administered laws and regulations pertaining to CSO abatement and water quality standards. The key pollutants of concern to the CSO discharges in Portsmouth remain the control of floatable solids and fecal coliform bacteria reduction. Thus, as a minimum, all technologies and practices will need to address these pollutants.

As mentioned previously, the control level will be determined using processes and procedures described under both the Presumptive and Demonstrative Approaches of the 1994 CSO Control Policy later in the planning process following the selection of preferred technology. For the purposes of this LTCP Update, the initial targeted abatement goal is the 1-year, 2-hour design storm; it was selected as the starting point for later optimization, using a “knee-of-the-curve” approach.

1.4.2.2 Available Technologies and Practices

CSO abatement technologies and practices are generally grouped by their functional application and fall into the following seven categories:

- Source Control/Volume Reduction Measures
- Sewer Separation
- Floatables Control/Screening
- Storage
- Co-Treatment at a centralized WWTF
- End-of-Pipe (Satellite) Treatment
- Disinfection

Technologies denote a physical and/or chemical treatment process while practices relate to non-technology measures, such as collection system management, operations and maintenance. A comprehensive listing and description of currently-available CSO abatement technologies and practices, grouped by these seven categories, are contained in Table 1-12.

As part of the WMP process, a CSO Technologies Workshop was held on August 13, 2008, at which time these technologies and practices were discussed with City staff along with representatives from both EPA and NH DES. The formal workshop presentation was included in TM5 Appendix F.

The technologies and practices are further discussed below along with their current application by the City if applicable.

Table 1-12. CSO Abatement Technologies and Practices	
Technology/Practice	Remarks
Source Control/Volume Reduction Measures	*Aimed at volume and pollutant reduction.*
Best Management Practices (BMPs)	BMPs include EPA's Nine Minimum Controls (NMCs).
Sewer Rehabilitation	Aimed at reduction of infiltration/inflow (I/I).
"Green" Construction/Retrofits	Includes low-impact development, green roofs, rain barrels, infiltration basins, etc.
Water Conservation	Such as low-flush toilets; aimed at reduction of base sanitary flow.
Water Reuse	Potential seasonal limitations.
Sewer Separation	*Treatment of resultant storm drain discharges needs to be considered; can include partial (public inflow only) or total separation (public and private inflow).*
New Sanitary Lines	Results in new sanitary sewer infrastructure.
New Storm Lines	Sanitary sewers remain intact unless rehabilitation included.
Floatables Control/Screening	*One of the NMC (No. 6); screening can also be considered end-of-pipe treatment.*
Baffles	Limited data on effectiveness.
Net Bags	Requires labor-intensive operation and maintenance (O&M).
Manual Screens	Must consider possible flooding/backups.
Mechanical Screens	Screenings can be automatically diverted back to sewer/WWTF.
Skimming devices	Site restrictive.
Storage	*Temporary holding of combined flow for later conveyance/treatment.*
Retention/Treatment Basins (RTBs)	Also called Overflow Retention Facilities (ORFs); combination of storage and primary treatment.
In-line Storage	Full utilization of system capacity is also a NMC (No. 2).
Near Surface Conduits for Conveyance/Storage	Combines conveyance with storage.
Tunnels for Conveyance/Storage	Combines conveyance with storage.
Off-line Storage	See also RTBs.

Table 1-12. CSO Abatement Technologies and Practices (con't.)	
Technology/Practice	Remarks
Co-Treatment at WWTF Full Treatment Full Treatment with Process Modification/Optimization Partial Treatment Separate Wet Weather Treatment Facility	*Both within the WWTF and separate treatment at the WWTF site.* Peak wet weather flows from combined sewers do not require full secondary treatment. Such as hydraulic debottlenecking, step feed, contact stabilization, biological contact, etc. Both with and without blending of the effluents. Using one of the end-of-pipe (satellite) technologies in 6; both with and without blending of the effluents.
End-of-Pipe Treatment	*Also considered to be satellite treatment.*
Primary Treatment	As defined by MOP 8 and elsewhere; see also RTBs.
Chemically-Enhanced Primary Treatment (CEPT)	Performance between primary treatment and Ballasted Sedimentation.
Vortex Separation	Aimed at primary treatment equivalency.
Ballasted Sedimentation	Such as Actiflo® or DensaDeg®.
Compressed-Media Filters	Requires equivalent of primary treatment as pretreatment.
Disinfection	*Can be coupled with technologies listed in 3, 4, and 5 plus RTBs.*
Chlorination/Dechlorination	Most common practice due to TSS in treated effluent.
UV	Requires high degree of pretreatment, such as Ballasted Sedimentation or Compressed-Media Filters; will be a challenge for current NPDES limit of 14 colonies FC/100 ml.
Bromochlorodimethylhydantoin (BCDHM)	Dry-powered form of bromine.

1.4.2.3 Current Practices

The City of Portsmouth is currently implementing a number of practices and abatement measures that are listed in Table 1-1 including:

- As was described in TMs 2 and 4, the City is implementing source control measures through its Nine Minimum Control (NMC) program which began in 1997. It has also recently begun to implement "green" retrofits into an ongoing sewer separation project on State Street. Continued implementation of the NMC program and related source controls will be an integral component of the 2010 LTCP Update.
- Targeted sewer separation has been the primary focus of the City's abatement activities prior to and following the completion of the 2005 LTCP. As discussed in TM4, these efforts are continuing and have resulting in significant reductions in annual CSO discharges and localized street flooding. As part of these programs, the City has also installed three storm water treatment systems to reduce the pollutants from the separated storm water discharges; a fourth will be installed as part of an ongoing project.
- Floatables controls, one of the NMC, has been continually implemented through three ongoing programs: BMPs, such as street and sewer cleaning and litter control; downstream storm water treatment systems for recently-separated storm water discharges; and removal and "sanitary" floatables through the actual separation work itself.
- Co-Treatment at the Peirce Island WWTF has been a key aspect of the City's CSO abatement program beginning in the early 1990s when the facility was upgraded to accommodate peak flows up to 22 MGD, well in excess of what was required for the City's base wastewater needs. As described throughout the WMP/LTCP Update, treatment at the Peirce Island WWTF will play a key role due to the necessity of the advance-primary facility to be upgraded to secondary, and the possibility of it being relocating to another site with adequate space for the upgrade.
- Disinfection, a key component of satellite treatment or co-treatment, is practiced at the Peirce Island WWTF.

Technologies that were considered in the 2005 LTCP but are not currently practiced by the City include:

- Storage, both in-line and off-line.
- End-of-pipe or satellite treatment.

Both storage and end-of-pipe treatment will be further evaluated in the 2010 LTCP Update, along with additional sewer separation.

Because of its key to the overall WMP, both with respect to WWTF upgrade and CSO abatement, the following discussion focused on the Peirce Island WWTF.

1.4.2.4 Peirce Island WWTF

The Peirce Island WWTF, a key component of CSO abatement for the City of Portsmouth since it was upgraded in the early 1990s, is the focus of the 2010 LTCP Update. As previously described, it can become the so-called Plus Project as defined in the 2005 LTCP, particularly if all or even a portion of the current dry weather flows are diverted to the Pease WWTF as has been described for the Pease Expansion WWTF alternative in the WMP.

Use of the Peirce Island WWTF for CSO abatement has several advantages, not the least of which includes:

- The facility can accommodate 22 MGD of peak wet weather flow.
- It provides an advanced-primary level of treatment.

- Its disinfection facilities are able to reliably meet the 14 col/100 ml FC limit for marine/shell fishing area discharges.
- The site and facilities are owned by the City.
- The existing Mechanic Street PS has the capacity to convey 22 MGD to the Island.

There are, however, some negative aspects of using Peirce Island for CSO abatement, particularly if dry weather flows are treated elsewhere:

- Certain segments of the public may want all treatment operations removed from the Island.
- Due to its age and condition, the Mechanic Street PS and other required WWTF components will need to be refurbished in order to assure continued reliable operation.
- Grit removal and processing operations will need to remain on the Island for use during treatment events.
- Return flows associated with CSO treatment will need to be conveyed to the new, relocated WWTF for treatment; this includes dilute primary sludge during treatment events and tank cleaning and dewatering flows following treatment events.
- Flows from the Town of Newcastle will also need to be conveyed from the Island to the new WWTF.

The issue of public perception could be mitigated by transforming the site to better match a primarily recreational area. Such actions could include, but not be limited to:

- Removal of all unnecessary buildings and tankage, such as the dewatering building, the above-ground portion (or all) of the filter building, gravity thickener, sludge storage tanks, etc.
- Renovation of the required remaining building and structures to better match New England colonial-era architecture.
- Landscape around required remaining tankage – aerated grit tanks, clarifiers and chlorine contact tanks - to minimize their visual presence.

1.4.3 Other Technologies

In addition to further treatment at the Peirce Island WWTF, there are other viable technologies that were included in both the 2005 LTCP and discussed at the August 13, 2008 CSO Technologies Workshop that were considered for the 2010 LTCP Update. These, along with treatment at Peirce Island, are presented in Table 1-13.

Table 1-13. CSO Abatement Measures Considered for 2010 LTCP Update	
CSOs 010A/010B	CSO 013
Additional Treatment at Peirce Island WWTF	Additional sewer separation (only as warranted following future build-out)
In-line Storage between Parrott Ave. and Mechanic St. PS	
Off-line Storage at Municipal Parking Lot	
End-of-Pipe Treatment/Disinfection with South Mill Pond discharge	
Additional sewer separation	

As was noted earlier, because CSO 013 is not predicted to overflow in a typical year, this technology evaluation will only primarily focus on the South Mill Pond CSOs (010A/010B). However, additional sewer separation remains under the CSO 013 column as additional reductions could be warranted, in the future, following the next build-out of abatement measures.

Each measure is further discussed below.

1.4.3.1 Additional Treatment at Peirce Island WWTF

The hydraulic model revealed that the Peirce Island WWTF, if dedicated for CSO treatment per the Pease Expansion Alternative, would abate the overflows at South Mill Pond CSOs (010A/010B) to the 1-year level of control with the addition of downstream hydraulic debottlenecking. While there would be no need for CSO abatement components if the Peirce Island Upgrade Alternative was implemented because CSO required improvements would be covered in the plant upgrade, the Pease Expansion would include the need for some additional work on Peirce Island including:

- The aerated grit tanks and processing systems would remain in service but refurbished as generally described in a Memo to Steven Clifton, UEI, from Steven Freedman, Brown and Caldwell, on the Peirce Island WWTF Headworks Evaluation, dated March 7, 2006. This memo was included in TM5 Appendix G which has been provided in Volume 3.
- The primary clarifiers and disinfection system, including chemical systems, would remain in service, but require some minor refurbishment.
- All sludge processing systems (gravity thickener, storage tanks, etc.) and their support facilities and structures would be abandoned and could be demolished at a convenient time.
- During treatment events, unthickened or diluted primary sludge would be continually pumped back to a new dry weather Mechanic Street PS.
- Following a treatment event, the aerated grit tanks, clarifiers and disinfection tanks would be dewatered and cleaned with the contents pumped back to a new dry weather Mechanic Street PS.
- Flow from the Town of Newcastle would also be continually pumped from Peirce Island to a new dry weather Mechanic Street PS.
- The previously described Peirce Island PS would perform these three pumping functions – dilute primary sludge, tank dewatering and Town of Newcastle.

1.4.3.2 In-line Storage

In-line storage was considered in the 2005 LTCP for both the South Mill Pond and Piscataqua River CSOs. It remains a viable measure for the 2010 LTCP Update and could be designed into the new debottlenecking line between the South Mill Pond CSOs (010A/010B) and the Mechanic Street PS under Scenarios 2 and 3. As noted above, the upsized line, primarily for conveyance purposes versus in-line storage, would be 54-inches in diameter.

The new or upsized line could be further enlarged to provide in-line storage and also reduce or shave the peak flow rates upstream of the new flow diversion structure as part of the new dry weather Mechanic Street PS, required for the Pease Expansion Alternative.

1.4.3.3 Off-Line Storage

In accordance with the 2005 LTCP, off-line storage was considered for the open-air Municipal Parking Lot off of Parrott Avenue for CSOs 010A/010B. The components of an off-line storage tank facility for CSOs 010A/010B would include:

- New or modified CSO regulator chamber.
- Conduit from the new CSO regulator chamber to the off-line storage tank.
- Enclosed underground tank equipped with automatic flushing system consisting of tipping buckets or flushing gates and odor control.
- Pumps to dewater the tank and convey flow back into the Parrott Avenue sewer following the storage event.

The updated model revealed that a 2.9 MG storage tank would be necessary to reduce the overflows to a 1-year level of control under the Peirce Island Upgrade WWTF alternative. A layout of a 2.9 MGD off-line storage facility at the open-air parking lot was shown in TM5 Figure 5-44 provided in Volume 3.

1.4.3.4 End-of-Pipe Treatment

End-of-pipe-treatment, followed by disinfection was considered in the 2005 LTCP for both CSOs 010A/010B and 013 and remains viable for the former. However, because of site constraints, and the desire for the treated effluent to have an effluent quality equal or better than what is discharged from the Peirce Island WWTF, the only satellite treatment process that will be considered for this LTCP Update was ballasted sedimentation, also referred to high-rate clarification (HRC). These would include the proprietary Actiflo® or DensaDeg® processes. These systems, although somewhat complex to operate, have a relatively small footprint and produce a high-quality effluent, nearly approaching that of secondary treatment. As with the 2005 LTCP, end-of-pipe treatment remains viable under all scenarios but primarily for the Peirce Island Upgrade as it represents the most limited capacity available for wet weather treatment at Peirce Island.

The components of a typical HRC facility for CSOs 010A/010B would include:

- New or modified CSO regulator chamber.
- Conduit from the new CSO regulator chamber to the HRC facility.
- Fine screening (1/4-inch openings). The screen may be able to be located at the modified CSO regulator chamber such that the screenings are directed back to the Parrott Avenue sewer such that local handling is avoided.
- HRC units (minimum of two process trains for redundancy) consisting of chemical mixing and maturation tanks and settling tanks.
- Sludge recycle and waste pumps.

- Treated effluent pumps.
- Sludge thickener and liquid sludge storage tank.
- Disinfection system consisting of contact tanks for both chlorination using sodium hypochlorite and dechlorination using sodium bisulfite. Powered BCDHM could be considered as an alternate disinfection chemical during the design process.
- Chemical feed and storage systems for the coagulant (or metal salt such as ferric chloride), polymer, sodium hypochlorite and sodium bisulfite.
- Ballast storage, feed and recovery systems (microsand for Actiflo® only).
- Outfall to South Mill Pond.

For the purposes of the 2010 LTCP Update, it is assumed that the chemically-laden waste sludge would need to be thickened and stored on-site until the end of the treatment event to ensure that it would receive full secondary treatment when it reached the Peirce Island WWTF.

The model revealed that the HTC system would need to be sized for a peak design flow of 18.2 MGD for the Peirce Island Upgrade. A layout of an 18.2-MGD HRC facility in the vicinity of CSOs 010A/010B was shown in TM5 Figure 5-46 provided in Volume 3. There would be two-25-MGD units, the standard size from the manufacturer; one would be used for service and one as a stand-by unit. The facility would include the components listed above and would be located in the vicinity of the two CSOs. As shown, the HRC would be quite intrusive to the open spaces in the vicinity of CSOs as it would require both above- and below-ground structures. For example, while most of the tankage and related equipment – chemical mixing and flocculation, settling, sludge thickening and storage and sludge and effluent pumps - could be below grade, the controls, chemical storage and feed systems for the four required chemicals, odor control, and other processes would be above-grade. Because of these factors, and the large footprint, HRC will not be considered as a viable abatement technology for these CSOs. Another factor for dropping it from consideration would be the need for the treated effluent to remain in South Mill Pond, an already stressed water body.

1.4.3.5 Additional sewer separation

Additional sewer separation is viable for CSOs 010A/010B, and to a lesser extent CSO 013, as both stand-alone measures or in conjunction with other measures should additional abatement be warranted. The degree of additional sewer separation, beyond what the City is currently committed to performing, would be determined following the build-out of the next phases of the CSO abatement program. This build-and-measure approach would be consistent with the City's CSO abatement efforts as documented in the 2005 LTCP and the PCMP prepared for this update.

1.4.4 CSO Abatement Measures for WWTF Alternatives

1.4.4.1 Peirce Island Upgrade – Co-Treatment on Peirce Island and Additional Abatement Measures

In addition to the existing practice of co-treatment of sanitary and wet weather flows at the Peirce Island WWTF, there are other viable technologies that could be used to reduce the frequency of the City's CSOs to a 1-year level of control. These additional measures were considered for the Peirce Island Upgrade WWTF alternative. As was noted earlier, CSO 013 is not predicted to overflow in a typical year. For this reason the technology evaluation focused on the South Mill Pond CSOs (010A/010B). Technologies evaluated included:

- In-line Storage
- Offline-Storage

- End-of-pipe Treatment
- Additional Sewer Separation (in addition to the 2005 LTCP work already underway)

The two control measured deemed appropriate for the Peirce Island Upgrade alternative were off-line storage and additional sewer separation. It was assumed that the level of effort associated with each would be approximately the same.

1.4.4.2 Pease Expansion – CSO Treatment on Peirce Island

The hydraulic model revealed that the Peirce Island WWTF, if dedicated for CSO treatment per the Pease Expansion alternative, would abate the overflows at South Mill Pond CSOs (010A/010B) to the 1-year level of control with the addition of downstream hydraulic debottlenecking.

There are a few modifications to the collection system and the Peirce Island WWTF that would be needed to convert it from a CEPT wastewater facility to a wet weather only facility. The collection system modifications have been described previously. The treatment facility modifications required include:

- The aerated grit tanks and processing systems would remain in service but refurbished as generally described in a Memo to Steven Clifton, UEI, from Steven Freedman, Brown and Caldwell, on the Peirce Island WWTF Headworks Evaluation, dated March 7, 2006. This memo was included in TM5 Appendix G which has been provided in Volume 3.
- The primary clarifiers and disinfection system, including chemical systems, would remain in service, but require some minor refurbishment.
- All sludge processing systems (gravity thickener, storage tanks, etc.) and their support facilities and structures would be abandoned and could be demolished at a convenient time.
- During treatment events, unthickened or diluted primary sludge would be continually pumped back to a new dry weather Mechanic Street PS.
- Following a treatment event, the aerated grit tanks, clarifiers and disinfection tanks would be dewatered and cleaned with the contents pumped back to a new dry weather Mechanic Street PS.
- Flow from the Town of Newcastle would also be continually pumped from Peirce Island to a new dry weather Mechanic Street PS.
- The previously described Peirce Island PS would perform these three pumping functions – dilute primary sludge, tank dewatering and Town of Newcastle.

The unused capacity of the existing Pease WWTF could start receiving sanitary flow from Peirce Island as soon as the Deer Street Pump station has been modified to send flow in two directions as was described in the collection system modification discussion. Removing sanitary flow from Peirce Island will increase the capacity available for CSO treatment and therefore reduce the volume that is discharged at 10A/10B. As the capacity at Pease is increased through phased construction, the CSO treatment capacity on Peirce Island also increases and overflows are reduced.

1.4.5 CSO Abatement Measures for WMP Preferred Alternative

Based on the conclusions of the WPM as presented in Volume 1, the preferred WWTF alternative is the Phased Expansion of the Pease WWTF to ultimately treat all of the City's dry weather flow as discussed in Section 4 of the WMP. Under this alternative, as flow is shed from the Peirce Island WWTF to the Pease WWTF over time additional wet weather capacity will become available on Peirce Island to eventually bring the CSOs into the 1-year level of compliance as discussed throughout this 2010 LTCP Update.

In addition to the collection system work necessary for implementation of the preferred alternative, abatement of the overflows at South Mill Pond CSOs (010A/010B) to the 1-year level of control will be achieved by the following measures which represent the recommendations of this 2010 LTCP Update:

- Continued Sewer Separation – the city is currently in the midst of a sewer separation program which is necessary to achieve the desired level of control.
- Debottlenecking – A new parallel sewer and/or enlargement of the existing sewers would be required to debottleneck the hydraulic capacity of the lines between the South Mill Ponds CSOs on Parrott Avenue and the Mechanic Street PS in order to maximize the full amount of additional available capacity at the Peirce Island WWTF.
- Peirce Island Improvements – Repair of the primary clarifiers and refurbishment of the grit and disinfection systems would be necessary to convert the Peirce Island WWTF to a wet weather only facility. Some repair to the biosolids processing equipment would also be necessary as an interim measure during phasing until the time when all sanitary flow has been shed to Pease.

2. POST CONSTRUCTION MONITORING PLAN

2.1 Purpose

The CD issued by the U.S. EPA in 2007 required the City of Portsmouth to prepare a Post Construction Monitoring Plan (PCMP) as part of the development of this 2010 Update.

The PCMP is intended to document, through a series of studies and evaluations, that the recommended combined sewer overflow (CSO) control measures, as contained in the 2010 LTCP Update, are meeting their intended purpose with respect to: design and performance criteria and compliance with applicable laws and regulations.

It is also required that the PCMP contain a schedule for performing the above-referenced studies and the expected dates for reporting on the collected data and findings.

2.2 Work Plan

The PCPM will be based on the continuation of what was termed "build and measure" from the City's earlier 2005 LTCP Update. That is, as CSO control measures are completed, monitoring of the collection systems and active CSOs will be performed to document progress to date and to assist in the development of alternatives to attain full compliance with the LTCP. The monitoring data will be used as both a direct measure of performance but will also be used to periodically update the hydrologic/hydraulic model of the collection system as a means to normalize the result when compared to both long-term and typical-year statistics. The model will also be used assist in the evaluation and benefits of future control measures.

A comprehensive flow monitoring program was conducted in 2008 as the part of the development of the 2010 LTCP Update and including rainfall, collection system monitors, CSO monitors, and the use of existing magnetic meters at the City's three largest pump stations. This program was invaluable in the development of the recommended control measures of the 2010 LTCP Update, including the prediction that CSO 013 at the Deer Street PS would be controlled to one or less overflows in a typical year following the completion of portions of the City's ongoing sewer separation programs. Similar monitoring programs, supplemented with periodic model updates, will be the key features of the PCMP.

Based on the previous background discussion, the following table contains the elements of the proposed PCMP:

PCMP Elements and Schedule	
Element	**Date**
Implementation of the sewer separation projects identified in the 2010 LTCP Update	Present to 2012
Re-establish monitoring program based on 2008 meter and rain gauge sites	2013
Update of the collection system model that re-calibrated using the 2008 monitoring data	2014
Assessment of progress made towards meeting the goals of the 2010 LTCP Update	2015

Report to EPA and the New Hampshire DES	2015

Each component is discussed below.

2.2.1.1 Implementation of the 2010 LTCP Update

The City will continue to implement those components of the 2010 LTCP Update that were specifically included in the CD, primarily sewer separation projects that were first identified in the 2005 LTCP Update.

CSO control measures that were included in the 2010 LTCP Update beyond these separation projects will be implemented as the WWTF portion of the WMP are implemented. As described in the 2010 LTCP Update, these addition measures are closely linked to the final disposition of the Pierce Island WWTF and cannot be initiated until the issues associated with the location and design of the new secondary treatment facilities are determined.

The sewer separation components of the PCMP are ongoing and will be completed by 2012; the schedule for the later components is yet to be determined but will be incorporated into the Final PCMP.

2.2.1.2 Re-Establishment of Monitoring Program

A comprehensive monitoring program, similar to the one conducted in 2008, will be re-established following the completion of the several sewer separation projects that are ongoing or planned. The data will be used to measure the reductions of CSO activity at CSOs 010A/010B at South Mill Pond and 013 at Deer Street.

In addition to the system monitoring, some minimal level of ambient monitoring may be appropriate for South Mill Pond to measure the impacts of the greatly reduced overflow activity from CSOs 010A/010B. This monitoring, if deemed necessary, would be limited to fecal coliform bacteria and use the ambient locations within, and just below outlet of the pond that were monitoring during the 1991 CSO Facilities Plan.

It is anticipated that the flow monitoring program will occur in 2013. The limited ambient monitoring would also occur during this timeframe.

2.2.1.3 Update the Collection System Model

The data collected in the re-established monitoring program will be used to update the collection system model which will then be used to normalize the data and assist in the development and evaluation of the need for further control measures. The model, first developed for the CSO planning of the early 1990s, has been continually updated to reflect the changes that have occurred within the City's collection system. This process must continue in order that the model accurately reflects the system.

Based on the flow monitoring occurring in 2013, the collection system model will be re-calibrated in 2014.

2.2.1.4 Assess Abatement Progress

Using the re-calibrated model, in conjunction with new monitoring data, an assessment will be made as to whether the predicted level of CSO reduction has actually occurred and what additional measures will be necessary to bring the remaining overflows into compliance the 2010 LTCP Update.

Following the re-calibration of the collection system model in 2014, the assessment of abatement progress will occur in 2015.

2.2.1.5 Reporting

Following the assessment of CSO abatement progress, a report will be prepared summarizing the findings and submitted to both EPA and NH DES. The report will also contain all pertinent data including the flow monitoring results and the model re-calibration plots.

The first report as part of the PCMP will be submitted in 2015. The report will contain a schedule of future submittals including the next update of the LTCP, as applicable.

2.2.1 Program Completion

In accordance with the language in the CD, a Final PCMP will be prepared following the completion of all recommended control measures. The exact timeframe for program completion, and the preparation of the Final PCMP, will be determined sometime in the future as more control measures are completed and the City is better able to determine when compliance can be achieved.

APPENDIX A: FLOW ASSESSMENT REPORT

APPENDIX B: COLLECTION SYSTEM MODEL RUNS