will be caused by peak flows anywhere upstream in the sewer system. They will also occur whenever the capacity of the downstream wastewater treatment plant is exceeded. The Town has made significant improvements in this area as part of its Phase I CSO abatement program. These efforts include the peak flow upgrade of the treatment plant to 7.5 MGD and the installation of a new screening system at the plant to prevent unnecessary flow backups into the interceptor sewer. Sewer improvements have also been made on East Front Street, Waterville Road, Poplar Street, South Street, Free Street, and Mechanic Street.

In summary, Skowhegan's sewer system contains a large amount of old, leaking clay pipe and is combined with connected catchbasins over the majority of its length. The Town has expended millions of dollars over the past decade to address the CSO discharges caused by excess flows in the sewer system. This has had the positive impact of reducing the active number of CSO points from nine to six. CSO discharge volumes and activation frequency have also been reduced through these efforts.

3.3 RECEIVING WATER CHARACTERIZATION

Skowhegan's six remaining sewer system CSO overflow points discharge into the Kennebec River which has been designated as a Class B receiving water by the State of Maine. The general criteria for the Class B designation are as follows:

- The receiving water must have water quality that is suitable for recreation, fishing, boating, aquaculture, shellfish harvesting, for aquatic life habitats, and for industrial process cooling water.

- The dissolved oxygen levels in the receiving water can not be depleted to less than 7.0 parts per million or below 75 percent of their natural saturation values.

- Between May 15th and September 30th of each year, E. coli bacteria in the river cannot exceed a geometric mean of 64 colonies per 100 milliliters (col/100 ml) or an instantaneous reading of 427 col/100 ml.

- The aquatic life in the river cannot be adversely impacted by any wastewater discharge.

The Kennebec River serves as the receiving water for both the Skowhegan treatment plant's effluent outfall and the Town's nine (six remaining) CSO points. The river's flow is subject to tremendous flushing velocities of over 310 MGD during extreme low flow (1Q10) conditions and over 2.57 billion gallons per day under average low flow (7Q10) conditions. Even higher dilutions occur during the wet weather events that cause CSO activity when the river is flowing at normal or elevated levels. The volume of CSO discharges lost are small compared to the flow volumes in the river. In addition, about half of the Town's CSO events occur between October 1 and May

15 when the Town's treatment plant is not required to chlorinate its effluent. As a result, the adverse effect that these CSO discharges have on the overall water quality of the Kennebec River is partially mitigated. In the long run, however, the removal of these CSO discharges remains in the best interests of the river's environmental quality.

3.4 CSO ACTIVATION FREQUENCY

Each of the Town's CSO structures is monitored to identify days when they become active. Detailed CSO discharges records for the eleven year period between 2001 and 2011 are presented in Appendix B of this report. The total number of CSO events that occurred each year during this period are summarized below in Table 7 for each CSO structure:

TABLE 7: OBSERVED CSO ACTIVATION EVENTS PER YEAR

CSO	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
002 (HESELTON PS)	24	30	36	11	8	6	0	0	0	0	0
006 (DINSMORE PS)	34	43	36	26	29	15	0	0	0	0	0
007 (BUSH ST)	25	26	38	24	36	27	15	0	0	0	0
010 (NORTH AVE)	34	19	27	27	40	31	19	40	7	11	4
003 (FOOTBRIDGE NO.)	34	59	40	49	68	72	52	1	2	3	7
009 (ISLAND PS)	10	52	48	56	65	62	35	20	2	11	12
005 (ELM ST PS)	15	14	16	12	33	9	5	8	6	13	3
008 (FOOTBRIDGE SO.)	17	21	13	7	16	13	10	8	7	11	11
004 (JOYCE ST/POTW)	84	99	63	40	46	17	12	21	11	22	19
TOTAL	277	363	317	252	341	252	148	98	35	71	56
TOTAL INCHES RAINFALL/YEAR	32.70	39.97	45.54	35.68	63.38	48.14	49.59	65.72	52.77	49.92	45.57
INDIVIDUAL CSO DAYS/YEAR	95	115	77	61	81	81	55	58	17	23	21

The data presented above in Table 7 shows the positive benefits that the Town's Phase I and Phase II CSO abatement programs have had on reducing annual CSO activity. This data shows the following:

- Annual CSO events have decreased from a high of 363 per year at the beginning of the program to an average of 54 events per year over the last three years. This represents an 85 percent reduction in CSO discharge frequency.

- Calendar days on which CSO activation occurred has decreased from a high of 115 at the beginning of the program to an average of only 20 days per year over the last three years. This represents a reduction of 95 percent.

- At the beginning of the CSO abatement program, the Town was experiencing a discharge of untreated sewage to the river about every one day in four, or twenty-six percent of all days. This frequency has been reduced to about five percent of the time, or roughly one day in twenty.

- CSO events are heavily influenced by rainfall events. At the beginning of the CSO program, the Town experienced an average of 8.8 annual CSO events per inch of annual rainfall even though the annual rainfall was relatively low at only an average of 36.35 inch/year at the beginning of the program. As a result of the Phase I and Phase II projects, the Town is now averaging only 1.1 CSO events per year per inch of annual rainfall even though rainfall events have increased to an average of 49.42 inches per year in the last three years.

- The Town has effectively eliminated three CSO discharge points at Heselton Street (No. 002), at Dinsmore Street (No. 006) and at Bush Street (No. 007) as a result of its CSO abatement efforts. This represents a reduction of 33 percent in the number of active CSO locations.

- If the average number of CSO events per year are considered prior to 2007 before Phase II was completed as compared to after 2007, the following reductions in CSO activity at each location have occurred:

  - CSO No. 002 (Heselton Street PS) 100% reduction
  - CSO No. 006 (Dinsmore Street PS) 100% reduction
  - CSO No. 007 (Bush Street) 100% reduction
  - CSO No. 010 (North Avenue) 43% reduction
  - CSO No. 003 (Footbridge North) 94% reduction
  - CSO No. 009 (Island Avenue PS) 77% reduction
  - CSO No. 005 (Elm Street PS) 47% reduction
  - CSO No. 008 (Footbridge South) 36% reduction
  - CSO No. 004 (Joyce Street/POTW) 65% reduction

The above data trends demonstrate that the Town is moving in the right direction with the CSO abatement measures that it has implemented to-date. Figure 8 shows the overall downward trend in CSO activity that has occurred over the last decade even though the magnitude of rainfall events has been increasing over that same time period.

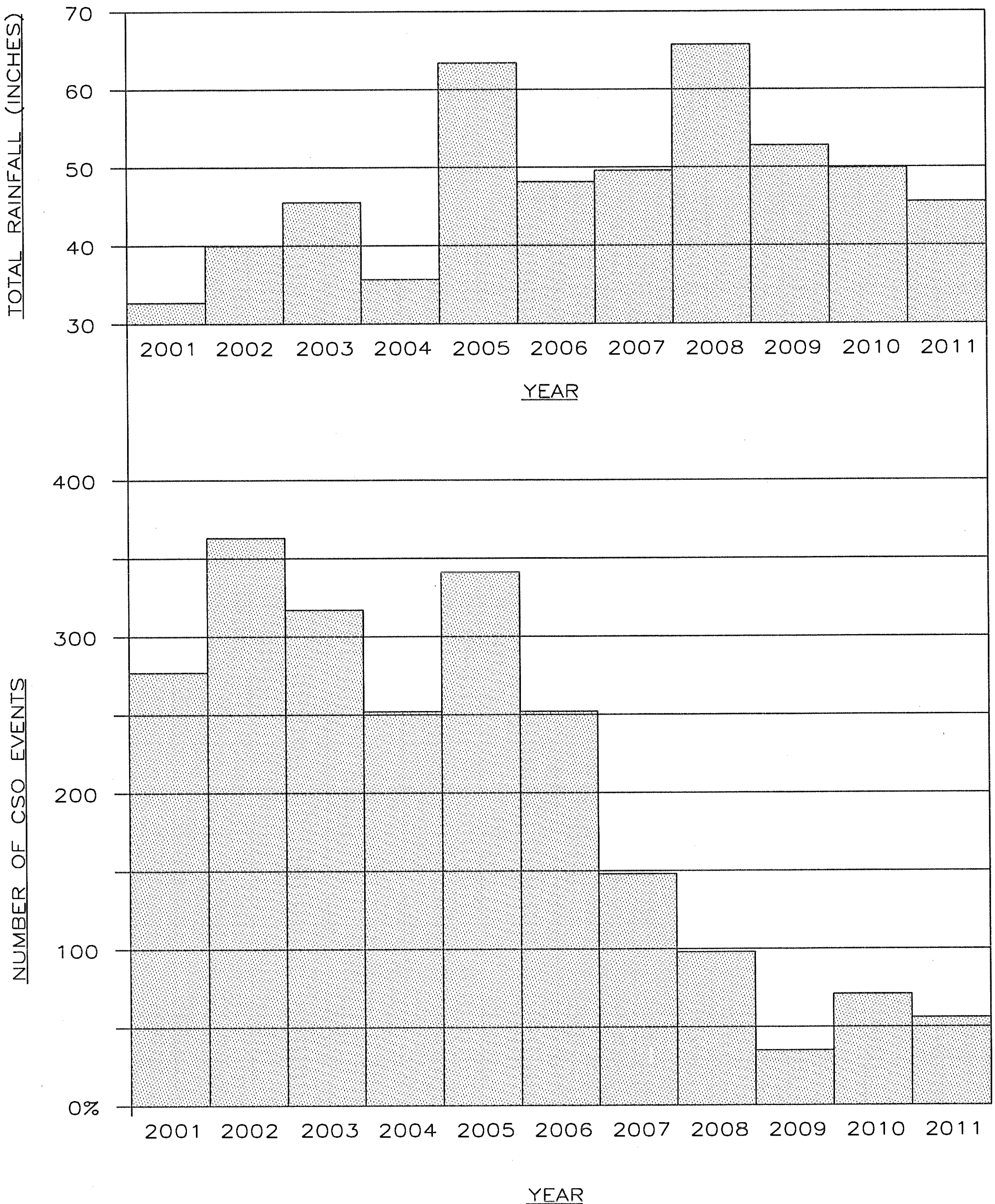
It is useful to consider CSO activity on a monthly basis in order to assess whether infiltration or inflow is of greater significance in a sewer system. Table 8 lists the percent of CSO events that now occur each month in Skowhegan since 2007 when the last of the Phase II projects were completed:

TABLE 8: CURRENT CSO ACTIVATION FREQUENCY BY MONTH

MONTH	PERCENT OF TOTAL CSO ACTIVITY (%)
January	1.45
February	0.73
March	9.78
April	17.03
May	2.54
June	7.61
July	18.48
August	12.32
September	7.61
October	7.97
November	8.70
December	5.78

The data in Table 8 shows that CSO events in Skowhegan are more heavily impacted by stormwater inflow or inflow induced infiltration than by groundwater infiltration. During the coldest winter months between December and February when the ground is frozen and rainfall is at a minimum, low levels of CSO activity occurs. CSO activation increases during the Spring high groundwater period in March and April, but this increase is similar to that which occurs in July and August when the ground is usually at its driest point. This suggests that Spring snowmelt into the connected catchbasins may be having more of an impact on the sewer system than groundwater infiltration during Spring high water table conditions.

During the Fall when the groundwater table often becomes elevated due to heavy rains, the percent of CSO activation remains less than during the Summer when groundwater levels are at their lowest. While groundwater infiltration is a factor in the amount of excess flow that is present in the Town's sewer system, it is apparent that stormwater inflow has a greater impact on CSO activation than infiltration. This observation is consistent with that determined by previous Master Plan studies.



TOWN OF SKOWHEGAN

SKOWHEGAN'S CSO ACTIVITY

FIGURE 8

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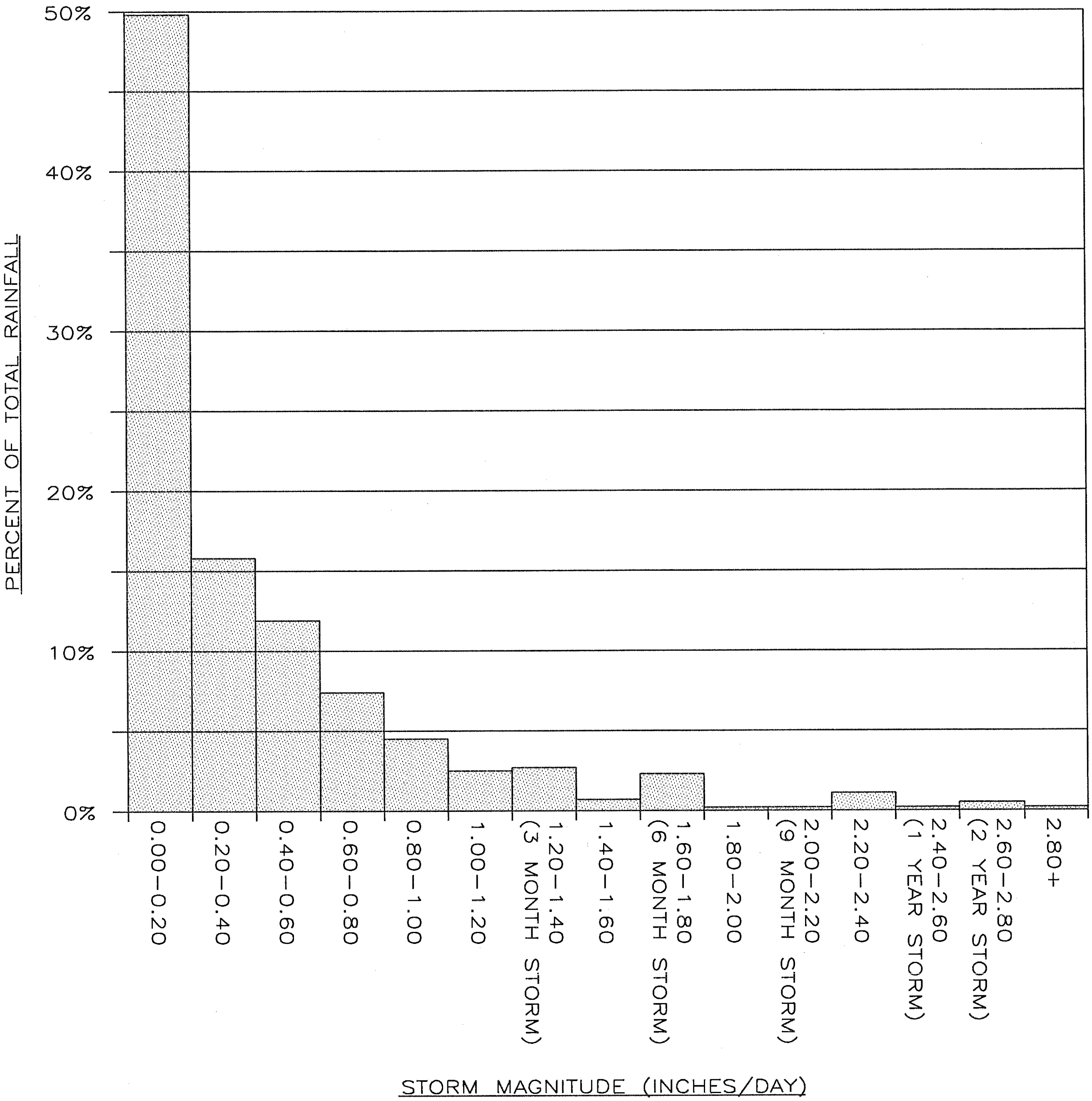
3.5 CSO ACTIVATION CONDITIONS

Since stormwater inflow appears to be the most significant factor that leads to CSO activation in Skowhegan, it is important to review the types of storm events that trigger CSO discharges. EPA and DEP regulations require CSO communities to eliminate all dry weather CSO discharges as well as all wet weather discharges up to a reasonable frequency storm event. Over the past decade, Skowhegan has targeted a one-year frequency storm of 2.40 inches/day as its design threshold. This has been done with DEP approval. As we have noted, DEP does not have a consistent policy on this issue because other Maine communities have been required to meet a higher frequency storm. Some of which were mandated in consent order situations. The impact of selecting a higher design storm would mean that greater levels of CSO abatement will be needed to reach the goal of zero discharges. In our opinion, a one-year storm is not a sufficient threshold because it can still result in relatively frequent CSO activity without a major storm event. This issue will need to be considered in the years ahead as Skowhegan works to address its CSO discharges.

Back in Table 3, twenty-four hour precipitation amounts for various storm frequencies were listed. With these levels in mind, Table 9 shows the distribution of storm events that has occurred in Skowhegan over the last four years since the completion of the Phase II CSO abatement projects. Of the 444 measured precipitation events that occurred, about 99.1 percent were less than a one-year storm event and 100 percent were less than a twenty-five year storm. This data is shown graphically in Figure 9.

TABLE 9: DISTRIBUTION OF RECENT SKOWHEGAN RAINFALL EVENTS

STORM MAGNITUDE (INCHES/DAY)		NO. OF EVENTS	% OF TOTAL	ACCUMULATIVE PERCENT (%)
0.00-0.20		221	49.8	49.8
0.20-0.40		70	15.8	65.6
0.40-0.60		53	11.9	77.5
0.60-0.80		33	7.4	84.9
0.80-1.00		20	4.5	89.4
1.00-1.20		11	2.5	91.9
1.20-1.40	Three month storm	12	2.7	94.6
1.40-1.60		3	0.7	95.3
1.60-1.80	Six month storm	10	2.3	97.6
1.80-2.00	Nine month storm	1	0.2	97.8
2.00-2.20		1	0.2	98.0
2.20-2.40	One year storm	5	1.1	99.1
2.40-2.60		1	0.2	99.3
2.60-2.80	Two year storm	2	0.5	99.8
2.80 +		1	0.2	100.0
TOTALS		444	100.0	100.0



TOWN OF SKOWHEGAN

SKOWHEGAN'S TYPICAL RAINFALL DISTRIBUTION

FIGURE 9

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The data presented in Table 9 shows that 99.1 percent of all storms that have occurred in Skowhegan over the last four years were less than a one-year storm threshold. During this time, 119 CSO events occurred, most of which were associated with storms of less than a one-year event. This suggests that Skowhegan has made good progress in reducing the number of its CSO occurrences, but additional mitigation measures will be needed to reach the stated target of a one-year storm.

In order to determine the storm event frequency at which each CSO becomes active, the annual CSO data as shown in Appendix B was evaluated for the four year period between 2008 and 2011. This study period is reflective of current sewer system conditions since the Phase I and Phase II CSO abatement projects were essentially completed by 2007. Table 10 shows the distribution of rainfall events that caused each of the six remaining CSO points to be active. This data is also shown graphically in Figures 10 through 15.

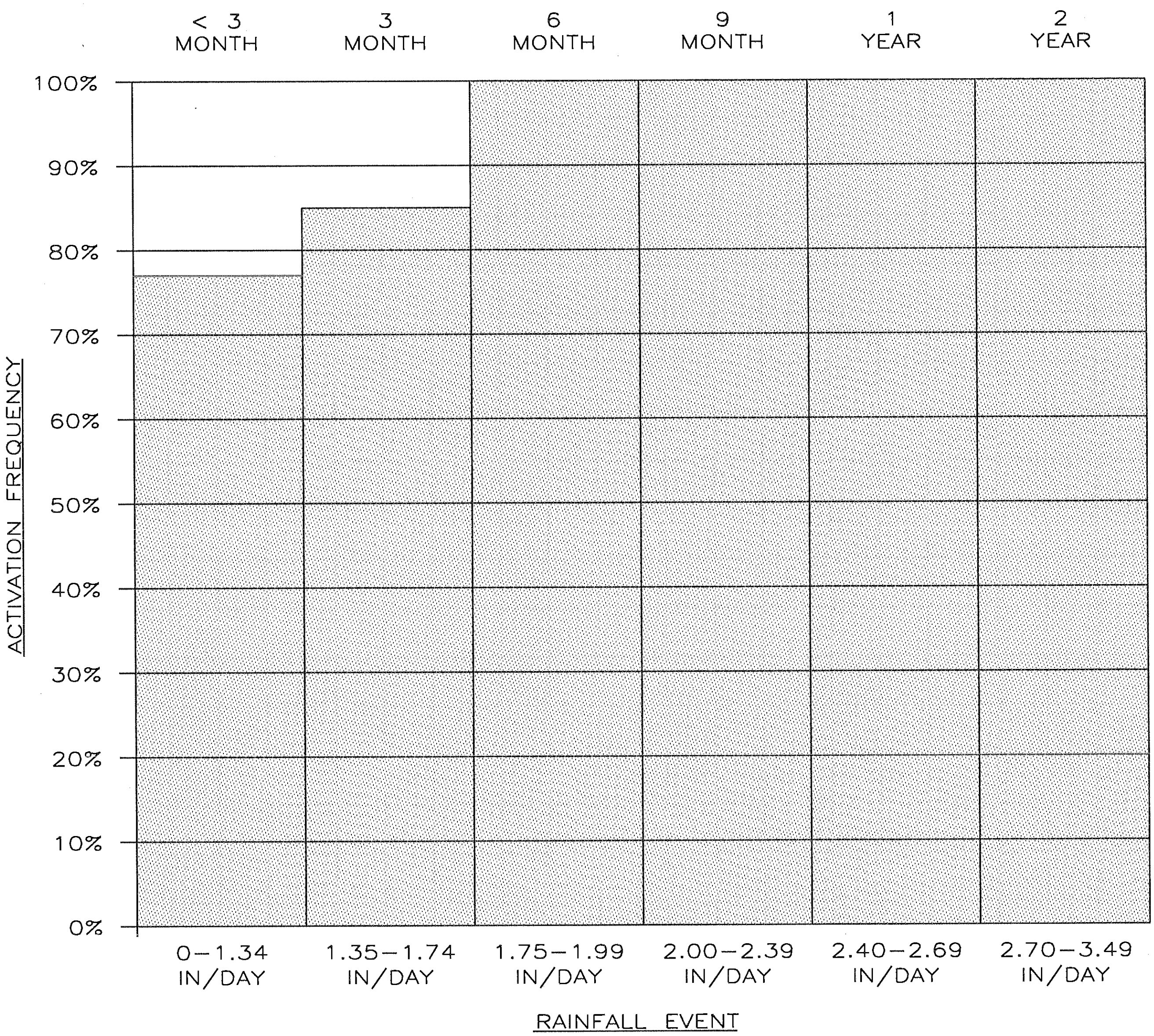
TABLE 10: STORM FREQUENCY ACTIVATION PERCENTILES FOR EACH CSO

	STORM FREQUENCY DURING ACTIVATION					
CSO/ LOCATION	<3 Mth. 0-1.34 (in/d)	3 Mth. 1.35-1.74 (in/d)	6 Mth. 1.75-1.99 (in/d)	9 Mth. 2.00-2.39 (in/d)	1 Year 2.40-2.69 (in/d)	2 Year 2.70-3.49 (in/d)
003						
Percent	77	8	15	-	-	-
Accumulative	77	85	100	-	-	-
004						
Percent	68	14	5	6	3	4
Accumulative	68	82	87	93	96	100
005						
Percent	40	20	12	8	12	8
Accumulative	40	60	72	80	92	100
008						
Percent	50	17	6	14	11	2
Accumulative	50	67	73	87	98	100
009						
Percent	74	7	5	5	7	2
Accumulative	74	81	86	91	98	100
010						
Percent	61	11	11	11	5	1
Accumulative	61	72	83	94	99	100
Total System						
Percent	63	13	7	7	6	4
Accumulate	63	76	83	90	96	100

The data presented above in Table 10 shows the following:

- 96% of all CSO events in Skowhegan are presently occurring at less than a one-year storm with 90% less than a nine-month storm and 63% less than a three-month storm.
- CSO No. 003 at the siphon inlet/North footbridge is the most sensitive CSO location and will activate 100% of the time at a six-month storm of 1.75 inch/day or greater. It will be active at 77% of storms less than a three-month frequency.
- CSO No. 004 on Joyce Street is active 96% of the time below a one-year storm and is active 68% of the time at less than a three-month storm.
- CSO No. 005 at Elm Street is active 92% of the time below a one-year storm and 40% of the time below a three-month storm.
- CSO No. 008 at the South Footbridge is active 98% of the time below a one-year storm and 50% of the time below a three-month storm.
- CSO No. 009 at Island Avenue is active 98% of the time below a one-year storm and 74% of the time below a three month storm.
- CSO No. 010 at the new CSO storage tank on Water Street is active 96% of the time below a one-year storm and 63% of the time below a three-month storm.

The fact that the Skowhegan sewer system still has active CSO events at relatively low storm frequencies should not be viewed in a negative light when compared to the previous levels of CSO activation events that were presented back in Table 7. While it may seem contradictory that CSO activation has been decreasing as shown in Table 7 while activation storm frequencies are still low, this phenomena is easy to explain. Since Skowhegan has been taking a CSO approach that has focused on treatment and storage, the peak flows that are now in the system remain essentially the same as those that were present before the Phase I and Phase II program. What has changed is that there is now downstream storage and treatment capacity available to retain these peak flows before they are discharged to the river. Once the storage and treatment structures are full, the CSO points will become active. Had excess flows been removed upstream in separation projects, it is likely that the threshold storms for CSO activation would have increased to larger storms. Since most of the peak flow still remains in the system, the same low level storms that used to cause CSO activation will still cause CSO activation when all of the storage and treatment capacity is used. As a result, the CSO activation data presented in Table 10 is misleading to the extent that it tends to mask the large CSO activation reductions that were previously shown in Table 7. However, the Table 10 data is still important because it demonstrates that additional storage, treatment or upstream separation will be needed in order to meet at least a one-year threshold storm event before CSO activation occurs.



TOWN OF SKOWHEGAN

NORTH FOOTBRIDGE/SIPHON INLET CSO NO. 003
ACTIVATION THRESHOLD STORM

FIGURE 10

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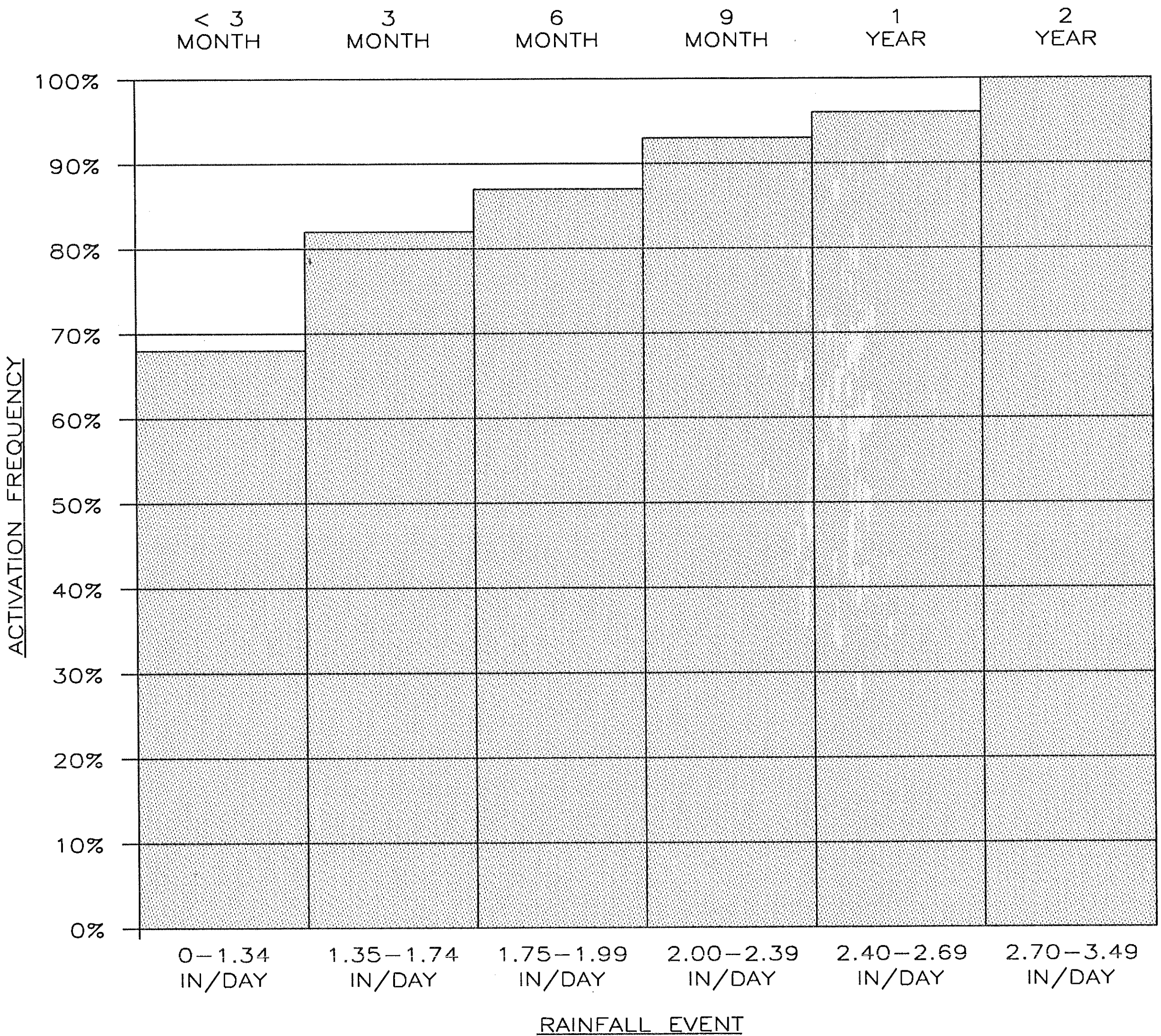

TOWN OF SKOWHEGAN

JOYCE STREET CSO NO. 004
ACTIVATION THRESHOLD STORM

FIGURE 11

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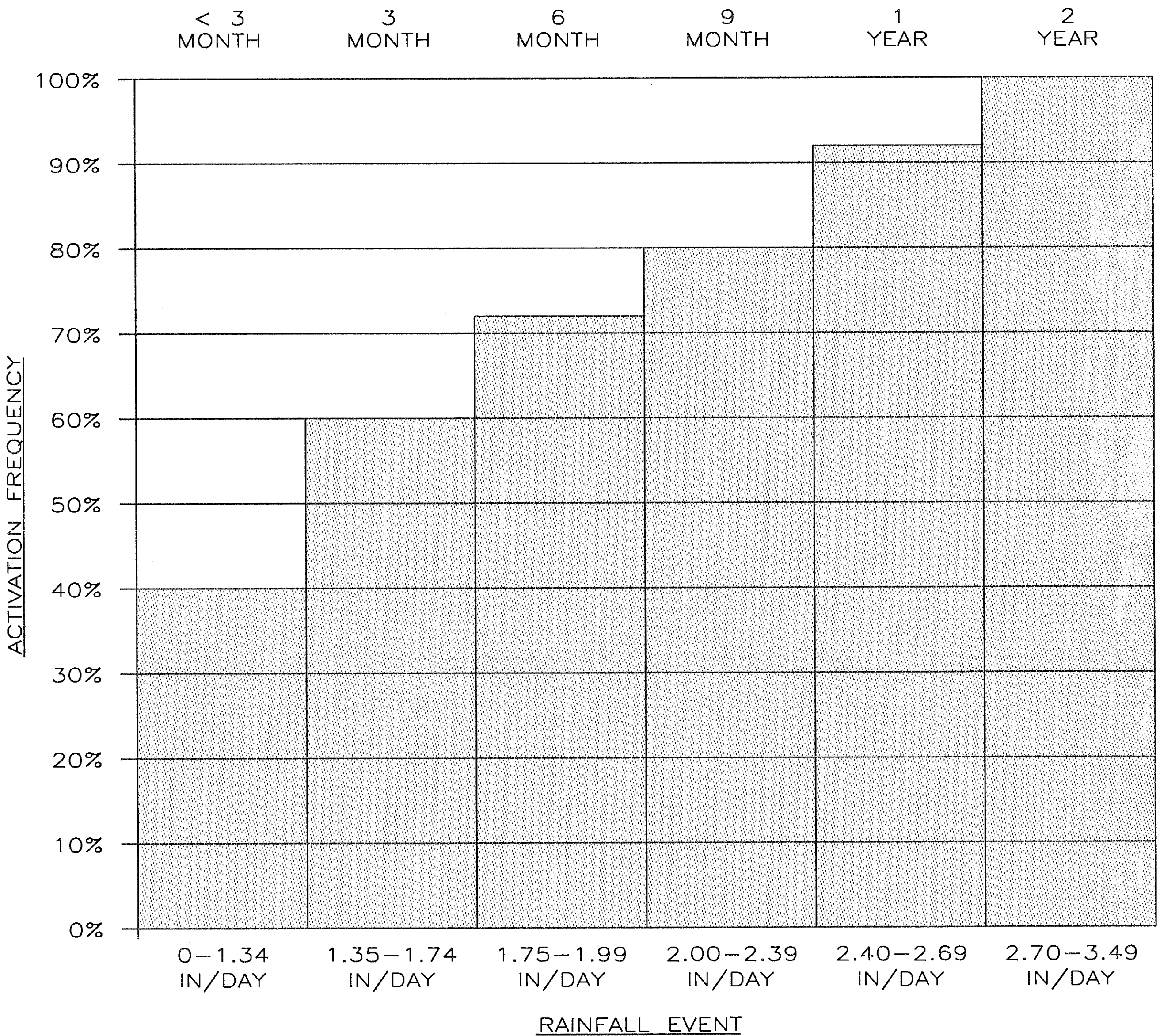

TOWN OF SKOWHEGAN

ELM STREET PUMP STATION CSO NO. 005
ACTIVATION THRESHOLD STORM

FIGURE 12

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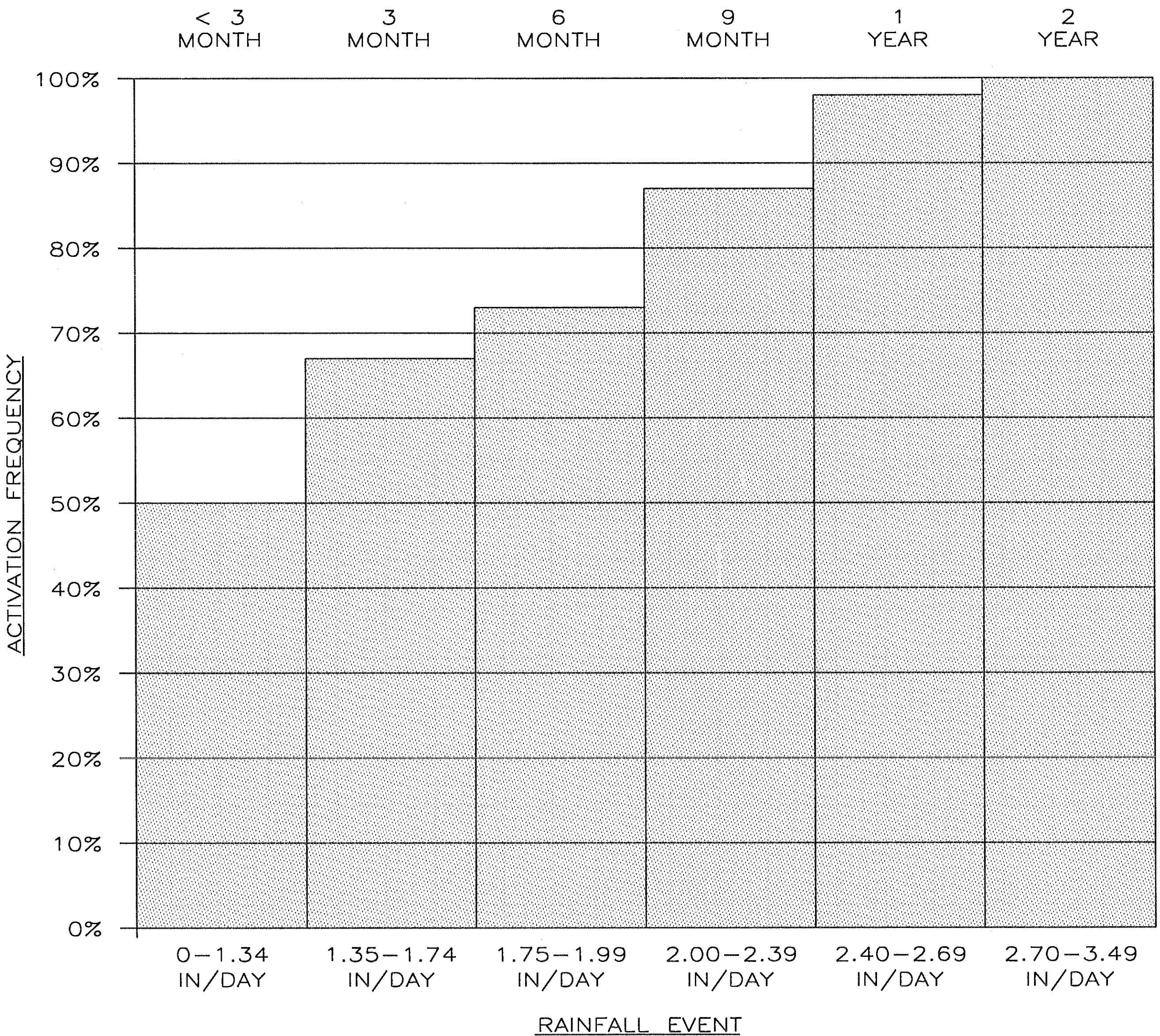

TOWN OF SKOWHEGAN

SOUTH FOOTBRIDGE CSO NO. 008
ACTIVATION THRESHOLD STORM

FIGURE 13

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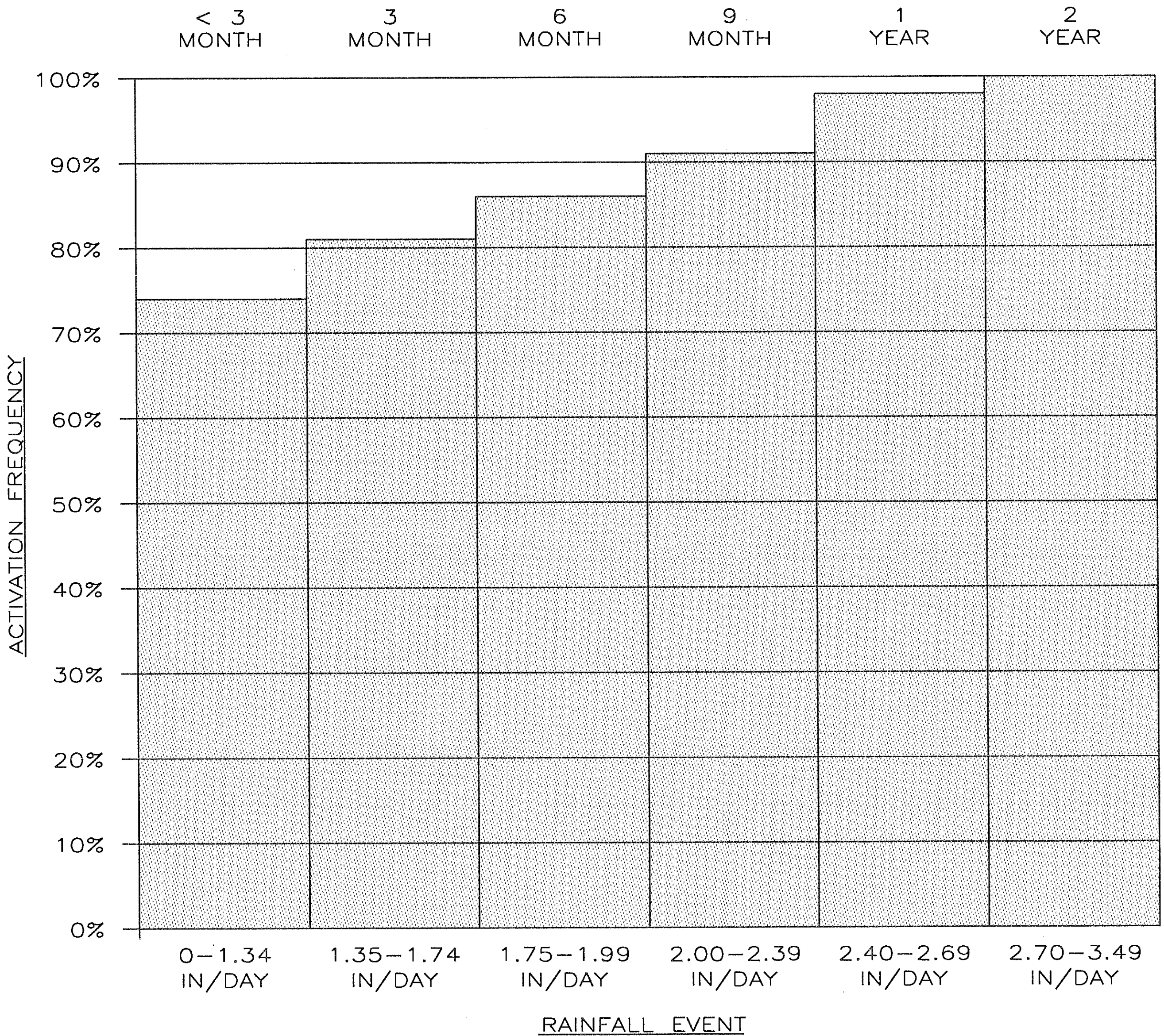

TOWN OF SKOWHEGAN

ISLAND AVENUE PUMP STATION CSO NO. 009
ACTIVATION THRESHOLD STORM

FIGURE 14

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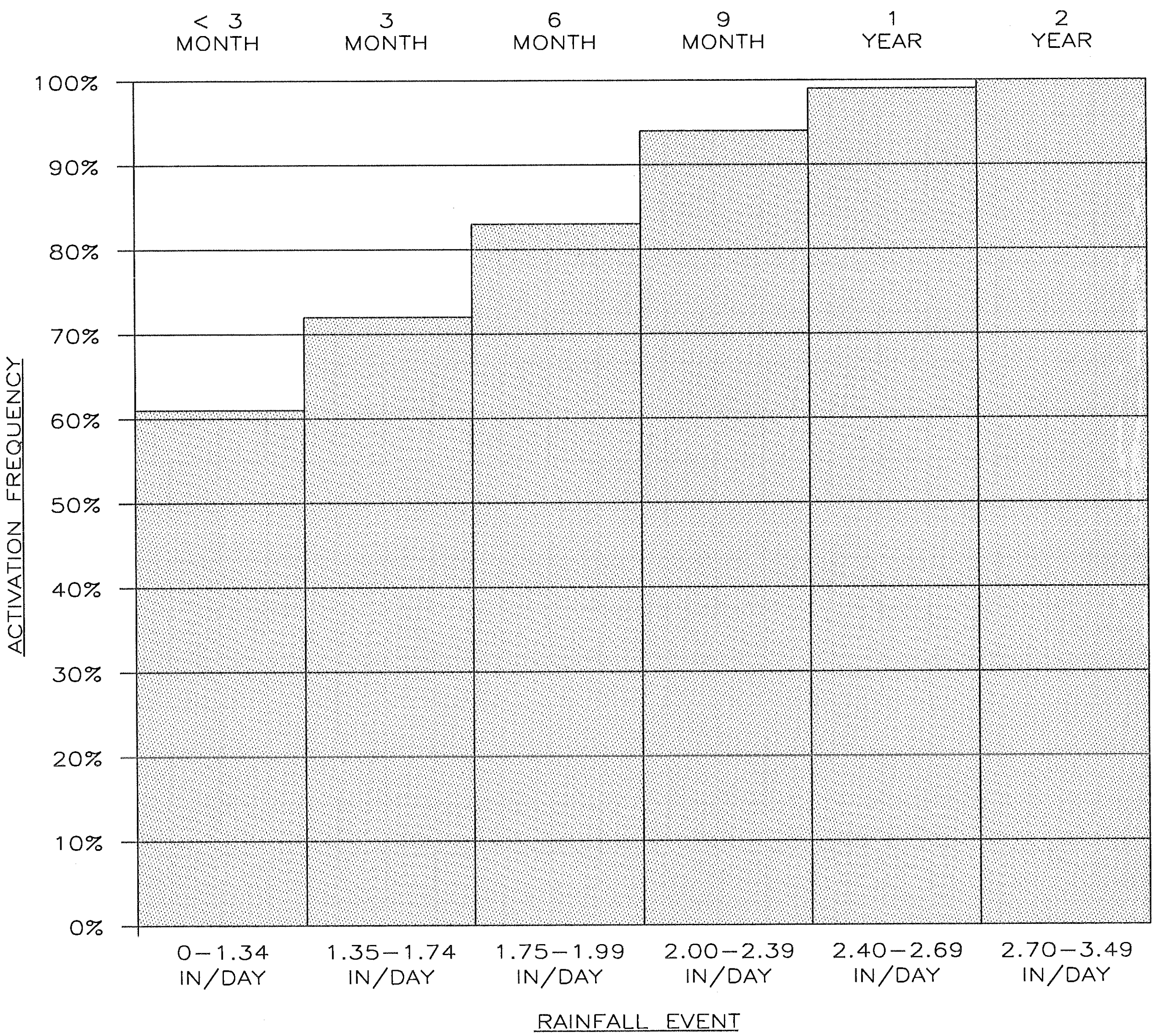

TOWN OF SKOWHEGAN

WATER STREET STORAGE TANK CSO NO. 010
ACTIVATION THRESHOLD STORM

FIGURE 15

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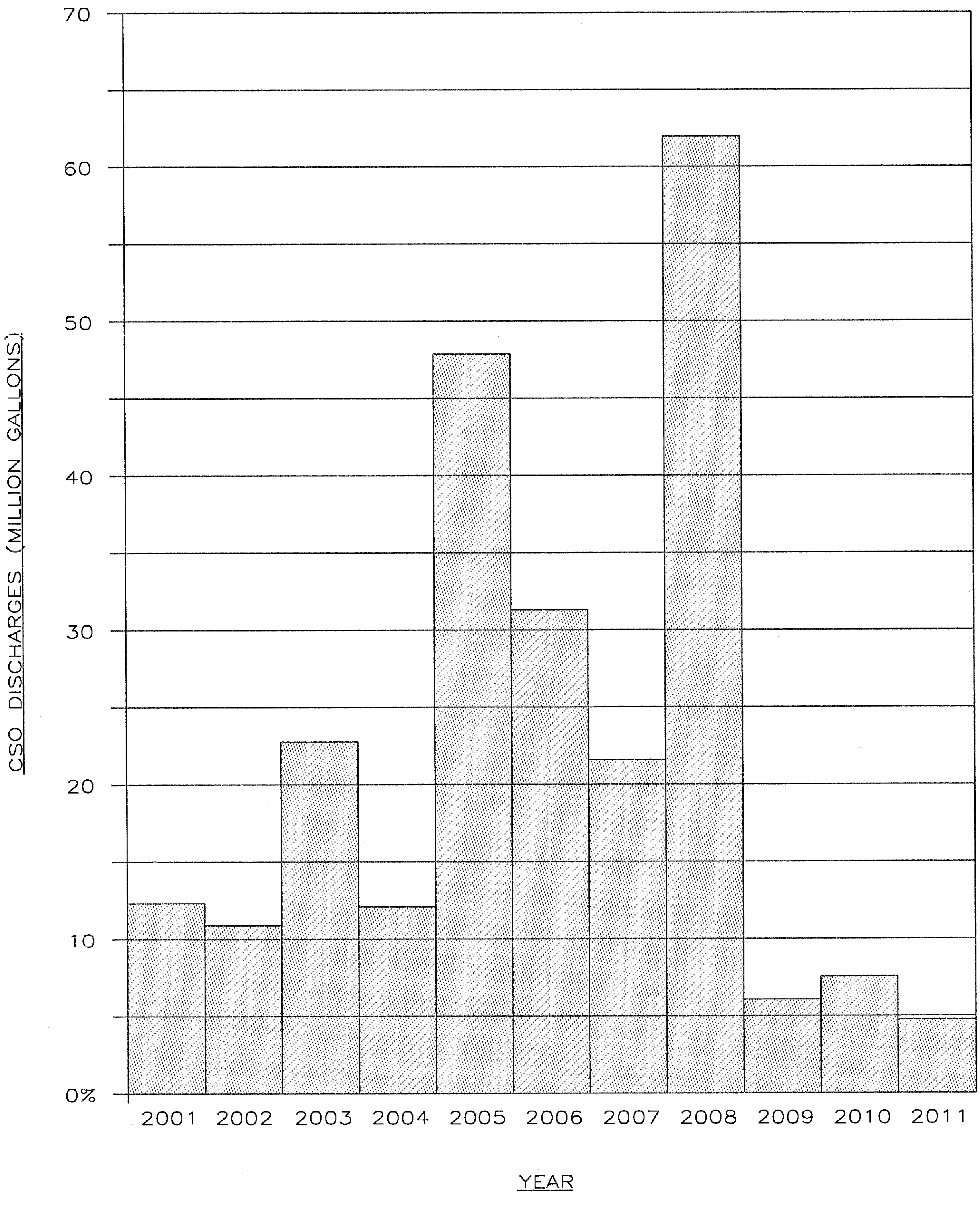
3.6 TYPICAL CSO DISCHARGE VOLUMES

As previously discussed, the Town's CSO abatement efforts to-date have had a positive impact on the reduction of annual CSO discharge events. In addition, the Phase I and Phase II abatement program has also resulted in a significant reduction in the volume of untreated sewage that has been discharged to the Kennebec River through the CSO structures. Table 11 shows the annual gallons of untreated sewage lost through the Town's CSO points over the past decade from 2001 to 2011. Figure 16 shows these results graphically:

TABLE 11: ANNUAL CSO DISCHARGE VOLUMES PER YEAR

YEAR	CSO VOLUME DISCHARGED (MG/YR)	RAINFALL (IN/YR)	UNITIZED DISCHARGE (GAL/INCH OF RAIN)
2001	12,316,000	32.70	377,000
2002	10,883,000	39.97	272,000
2003	22,768,000	45.54	500,000
2004	12,083,000	35.68	339,000
2005	47,873,000	63.38	755,000
2006	31,314,000	48.14	650,000
2007	21,597,000	49.59	436,000
2008	61,963,000	65.72	939,000
2009	6,074,000	52.77	115,000
2010	7,551,000	49.92	151,000
2011	4,758,000	45.57	104,000

As shown by the above data, CSO losses can vary widely from year-to-year. The amount of CSO volume discharged is a function of the rainfall magnitude, intensity and duration, the background groundwater conditions at the time of the rain event, the extent of soil saturation, dry or frozen conditions, and whether or not peak sanitary flows were occurring at the same time as the rain event. Because of these many factors, it is difficult to predict the annual CSO discharge volumes for any given storm or for any given year. Still, a general sense of the sewer system's CSO losses can be estimated with this data as long as the level of variability that can occur is recognized. Since the amount of CSO losses are related, in part, to the rainfall magnitude, unitizing the CSO losses in gal/inch of rainfall is helpful to view long term trends in the data.



TOWN OF SKOWHEGAN

ANNUAL CSO DISCHARGE VOLUMES

FIGURE 16

OLVER ASSOCIATES INC.

ENVIRONMENTAL ENGINEERS

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Despite the data's variability, the CSO volume losses shown in Table 11 provide a good indication of the success of Skowhegan's Phase I and Phase II abatement program. Prior to 2008, average CSO losses averaged 534,000 gallons/inch of rainfall on CSO activation days. Since these projects were completed, these losses have dropped to an average of 123,000 gal/inch of rainfall, a reduction of 77 percent. Total CSO losses have dropped from a high of nearly 62 MG in 2008 when 65.72 inches of rain fell to an average of 6.28 MG per year over the last three years. In the early years of the program, an average of 11.6 MG of CSO loss occurred even during two low rainfall years that averaged only 36.33 inches/year of rain. Over the last years since the completion of the Phase II projects, the average CSO loss has been 6.28 MG/year even though the annual rainfall has increased to 49.42 inches/year. This suggests that average CSO losses have dropped 46% even though rainfall has increased by 36%. This data shows that Skowhegan is moving in the right direction with its CSO abatement program.

Since the unitized data presented in Table 11 is based on the overall sewer system with precipitation buffered over a full year, it is more useful to consider the unitized CSO losses measured at each CSO structure. Table 12 presents the average CSO losses per inch of rainfall on CSO activation days at the six remaining CSO points:

TABLE 12: AVERAGE UNITIZED CSO DISCHARGE AT EACH CSO

CSO/LOCATION	AVERAGE CSO LOSS* (GAL/INCH OF RAINFALL)
003 (North Footbridge)	53,000
004 (Joyce Street/POTW)	22,000
005 (Elm Street PS)	43,000
008 (South Footbridge)	43,000
009 (Island Avenue PS)	4,000
010 (CSO Storage Tank)	650,000
TOTAL	815,000

*Based on highest three-year period since 2008 for illustrative purposes

The data presented in Table 12 shows that 0.82 MG/inch of rainfall will be an average expected loss through all six CSO structures during typical CSO discharge events. This is presented for illustrative purposes, not for final design, because actual discharge volumes will vary due to the numerous factors that were previously discussed. This data suggests that the Island Avenue pump station CSO has the lowest discharge rate of all remaining locations and could possibly be eliminated with an upgrade of the station. The CSO storage tank has the highest discharge volume of any location because flows are being consolidated there. In order to eliminate these losses, additional storage will be needed, treatment must be added, or upstream excess flow sources must be reduced.

The data presented in Table 12 can be used to develop an illustrative estimate of the typical volume of CSO losses that might be expected from various storm events. If all CSO locations discharged the average volumes presented in Table 12, and recognizing the variability of this data and the many factors that can influence CSO discharges, Table 13 provides an approximation of typical CSO losses that might occur for various storm frequencies:

TABLE 13: TYPICAL CSO DISCHARGE VOLUMES AT VARIOUS STORM SIZES

STORM FREQUENCY	STORM SIZE (INCHES/DAY)	TYPICAL TOTAL CSO DISCHARGES (MGD)
3 month	1.35	1.11
6 month	1.75	1.44
9 month	2.00	1.64
1 year	2.40	1.97
2 year	2.70	2.21
5 year	3.50	2.87
10 year	4.10	3.36
25 year	4.70	3.85

The illustrative data presented in Table 13 shows that theoretical estimated CSO losses are higher than those actually observed in recent years. This is due, in fact, to the many factors that impact CSO volumes apart from just the above storm magnitude. It is also due to the fact that 63% of all Skowhegan CSO discharges over the last four years have occurred during storm events that were lower than a three-month frequency as shown on Table 10. More detailed modeling would be needed to develop design data for any future CSO abatement projects such as additional storage volumes.

3.7 ESTIMATED CSO POLLUTANT LOADINGS

The amount of suspended solids (TSS), organic loading (BOD), and bacteria colonies (E. Coli) loss in a typical CSO discharge will be similar to dilute wastewater treatment plant influent on a wet weather day. In order to develop an estimate of potential CSO pollutant losses, DEP 49 Forms for a two-year period were examined. On wet weather days with reasonably large storm events of 0.30 inch/day or more, typical influent BOD averaged 120 mg/l and TSS averaged 150 mg/l. It was assumed that influent E. Coli levels would be too numerous to count (TNTC). This data is summarized below in Table 14:

TABLE 14: TYPICAL CSO DISCHARGE QUALITY

PARAMETER	TYPICAL OBSERVED VALUE
TSS (mg/l)	150
BOD (mg/l)	120
E. Coli bacteria (col/100 ml)	TNTC

The data in Table 14 suggests that typical CSO discharges in Skowhegan will have a TSS of 150 mg/l, a BOD of 120 mg/l and an E. Coli bacteria level that is too numerous to count. If these pollutant contributions are considered to be contained in the CSO discharge volumes previously presented in Table 13, it is possible to estimate the pollutant mass loadings that will be discharged into the Kennebec River from the Town's six remaining CSO points during various sized storm events. This is shown below in Table 15:

TABLE 15: ESTIMATED TOTAL CSO POLLUTANT LOSSES

STORM EVENT	TSS (LBS/DAY)	BOD (LBS/DAY)
3 month	1390	1110
6 month	1800	1440
9 month	2050	1640
1 year	2470	1970
2 year	2770	2210
5 year	3590	2870
10 year	4200	3360
25 year	4820	3850

3.8 SUMMARY OF SKOWHEGAN'S CSO ASSESSMENT

On the basis of the data and discussions previously presented in this Section, the following conclusions can be made regarding the current CSO conditions in Skowhegan:

- Skowhegan presently has six active CSO points, one upstream of the treatment plant, one each at two upstream pump stations, one at the CSO storage tank, and two near the footbridge.

- Typical CSO activity in Skowhegan under normal rainfall conditions can be expected to be between fifteen and twenty-five events per year.

- Total CSO volume losses through the six CSO points are about 0.82 MGD per inch of rainfall under average conditions.

- CSO activity occurs at rain events below a one-year storm threshold.

- Upstream CSO activity has been reduced by increasing the capacity of several pump stations, expanding the treatment plant, building in-line and off-line storage, and separating several sewers. This has resulted in more water being conveyed to the treatment plant.

- CSO activity in Skowhegan is caused primarily by peak rainfall events of high magnitude and intensity. Snowmelt conditions tend to aggravate CSO activity, but the sewer system has the ability to process normal high spring groundwater infiltration flows without CSO activity.

- The Town has no dry weather CSO events.

The Skowhegan CSO problem appears to be caused by an old combined sewer system that is subject to excessive upstream stormwater inflow and inflow induced infiltration from old clay sewer lines. In order to assess the potential sources of these excess flows, we conducted an Infiltration/Inflow (I/I) study as defined in the following report section.

4. SEWER SYSTEM INFILTRATION/INFLOW ANALYSIS

4.1 EXCESS INFILTRATION/INFLOW CONSIDERATIONS

The present configuration of the Skowhegan sewer system has evolved over the past 100 years. In the years before 1972 when the treatment plant was constructed, the intent of the sewer system was to operate with combined lines that carried both sanitary wastewater, groundwater and stormwater directly to the Kennebec River. With the construction of the treatment plant, the presence of large volumes of excess water in the sewer system above the plant's capacity became problematic. The treatment plant must now process large amounts of excess groundwater infiltration from old leaking clay sewer pipes and stormwater inflow from the combined sewer system. When the capacity of the wastewater pump stations, interceptor sewer and treatment plant is exceeded, raw wastewater is discharged to the river through the CSO points.

The excess flows in the sewer system exist in various forms. Groundwater infiltration is always present at some level, but is typically highest in the Spring and the Fall when the groundwater table is at its maximum elevation. As has been discussed, infiltration does not, by itself, cause CSO discharges at Skowhegan because it generally is present at levels that the system can handle. Because of this, the presence of infiltration has not been flagged as a significant issue in past CSO studies because it is not triggering CSO activity. It is, however, occupying capacity in the sewer system and treatment plant with clean groundwater that does not need to be in the system. Because groundwater infiltration varies seasonally and changes gradually as the water table fluctuates, it is often considered as a background nuisance that can be tolerated. Stormwater inflow has a more dramatic impact on the sewer system and is the primary factor that is responsible for Skowhegan's CSO events. Inflow exists in two forms. Base inflow represents the amount of stormwater that enters the system and that can safely pass through for treatment. Peak inflow is the rapid surge of stormwater that occurs during wet weather events at rates that exceed the hydraulic capacity of the sewer system and lead to CSO discharges.

In order to resolve Skowhegan's CSO problem, the focus must be on reducing, storing or treating peak flows in the sewer system. CSO abatement efforts to-date have focused on storage and treatment with a lesser degree of sewer separation and remediation work. These measures have reduced the frequency and volume of CSO losses in a positive manner, but have yet to reach the goal of zero CSO discharges at a one-year storm level. This is because the majority of the excess flows that were present in the sewer system prior to the Phase I and Phase II projects remain in the system today. As a result, CSO events will still occur at low frequency storm events if the storage and treatment capacity that has been constructed is exceeded. Since stormwater modeling is not an exact science and has many variables that can dramatically alter excess flow amounts both seasonally and between different storms, storage and treatment systems are difficult to size with the certainty that all storm flows will be captured. A greater level of certainty can sometimes be achieved by the removal of excess flows from the sewer system, although the prediction of potential removal rates is also not an exact science. Many of the earliest I/I and CSO planning studies conducted in Skowhegan as much as thirty years ago concluded that excess flow removal would not be cost-effective given the large amount of combined and old sewers in Skowhegan. Some of the studies based the cost analysis to reach that conclusion on the cost to fully replace and separate the entire Skowhegan sewer system. It may not be necessary to do such a widespread sewer project to reduce excess flows to an acceptable level. Now that the Town has constructed both expanded storage and treatment facilities, it may be worthwhile to look more closely at specific sewer separation and remediation projects that might have a positive benefit on downstream CSO activity reduction. The removal of large sources of excess flow from the sewer system may also free up system storage and treatment capacity such that higher frequency storms would be the trigger for CSO activity. As previously discussed, CSO events are still occurring two-thirds of the time at storm frequencies less than a three-month interval. This does not meet the one-year storm threshold that has been established for Skowhegan.

4.2 EXTENT OF EXCESS FLOW PROBLEM

As previously discussed, the Skowhegan sewer system receives excess flow from the following sources:

- Peak groundwater infiltration has been measured at an average of 0.80 MGD during extreme Spring high groundwater and snowmelt conditions.

- Base stormwater inflow has been measured at an average rate of 0.90 MGD per inch of rainfall, although this amount varies over the year depending on numerous factors including storm magnitude, intensity, duration, and groundwater conditions, soil saturation and frozen ground conditions.

- Peak stormwater inflow has been measured at a maximum rate of about 4.25 MGD per inch of precipitation subject to the same factors regarding variability as defined for base inflow. This could generate sewer system peak flows of up to 5.74 MGD during a small three-month frequency storm of as low as 1.35 inches of rainfall/day. The total inflow in the sewer system could increase to as much as 10.20 MGD during a one-year frequency design storm of 2.40 inches/day and to 19.98 MGD during a design storm event of a twenty-five year frequency in which 4.70 inches of rainfall per day might fall. Since the treatment plant can only treat 7.50 MGD of peak flow, all flow volumes above these amounts end up being stored or bypassed to the river untreated at some upstream point in the system.

- Spring snowmelt adds a typical base load of 0.30 to 0.60 MGD to the plant during the two-week period in March or April when temperatures begin to rise above freezing. This gradual reduction of the snowpack will be accelerated if Spring rainfall occurs at the same time which is often the case. Snowmelt manifests itself in the sewer system first as ambient overland inflow into catchbasins and then as inflow induced infiltration into old clay sewers due to elevated Spring groundwater tables.

While all three sources of dilute excess flow present some degree of process challenges to treat, the Skowhegan facility has shown the ability to handle peak groundwater infiltration and the inflow induced infiltration from Spring snowmelt events. The historical peak flow problems in the Town's sewer system are essentially caused by peak wet weather inflow from precipitation or direct snowmelt inflow that occurs at the same time. The impact of these three flow sources can be put in perspective by considering their relative magnitude as shown below in Table 16:

TABLE 16: RELATIVE MAGNITUDE OF VARIOUS PEAK FLOW SOURCES

PEAK FLOW SOURCE	RAINFALL AMOUNT (INCHES/DAY)	SEWER SYSTEM PEAK FLOW (MGD)
Spring groundwater infiltration	0.00	0.80
Spring peak snowmelt	0.00	0.60
Stormwater inflow peak events		
Three-month storm	1.35	5.74
Six-month storm	1.75	7.44
Nine-month storm	2.00	8.50
One-year storm	2.40	10.20
Two-year storm	2.70	11.48
Five-year storm	3.50	14.88
Ten-year storm	4.10	17.43
Twenty-five year storm	4.70	19.98

From the data presented in Table 16, it would appear that little CSO reduction advantage would be gained by focusing on groundwater infiltration issues. The data suggests that the Town should focus on the points in the sewer system where peak wet weather inflow is entering in order to reduce CSO discharges. However, the presence of background infiltration does influence CSO activity because it occupies hydraulic capacity that is no longer available to process inflow. The base infiltration flows also present problems. As shown in Table 17, about 38% of the treatment plant's capacity is consumed by base infiltration with another 17% consumed by base stormwater flows that must be treated along with the sanitary sewage. These flows have a direct impact on the plant during peak wet weather periods, but also linger for days in the sewer system as inflow induced groundwater infiltration. Removing these peak flows would free up infrastructure capacity that the Town may one day need for growing its business base:

TABLE 17: TYPICAL ANNUAL TOTAL WASTEWATER GALLONS TREATED (MG)

MONTH	SANITARY FLOWS	INFILTRATION FLOWS	STORMWATER INFLOW	SNOWMELT FLOWS	TOTAL FLOWS
January	15.07	9.21	2.92	0.00	27.20
February	14.61	6.77	4.62	0.00	26.00
March	19.96	22.85	3.86	4.14	50.81
April	15.95	30.54	3.48	8.90	58.87
May	17.61	13.44	3.27	0.00	34.32
June	14.96	8.07	11.10	0.00	34.13
July	17.26	13.52	3.07	0.00	33.85
August	13.57	8.02	1.54	0.00	23.13
September	12.20	3.17	2.45	0.00	17.82
October	14.20	5.77	9.45	0.00	29.42
November	16.20	19.40	6.90	0.00	42.50
December	18.04	18.60	5.21	0.00	41.85
Totals	189.63	159.36	57.87	13.04	419.90
Percent	45%	38%	14%	3%	100%

The data provided in Table 17 offers the following conclusions:

- The treatment plant processed just under 420 million gallons of water each year during the review period.

- Forty-five percent of the flows treated, or 189.63 MG, represented sanitary sewage.

- Groundwater infiltration accounted for 159.36 MG, or thirty-eight percent, of the plant's flow. The monthly volume reaching the plant was at its greatest in March and April after Spring high groundwater conditions followed by high inflow induced infiltration months that occurred after peak rainfall periods.

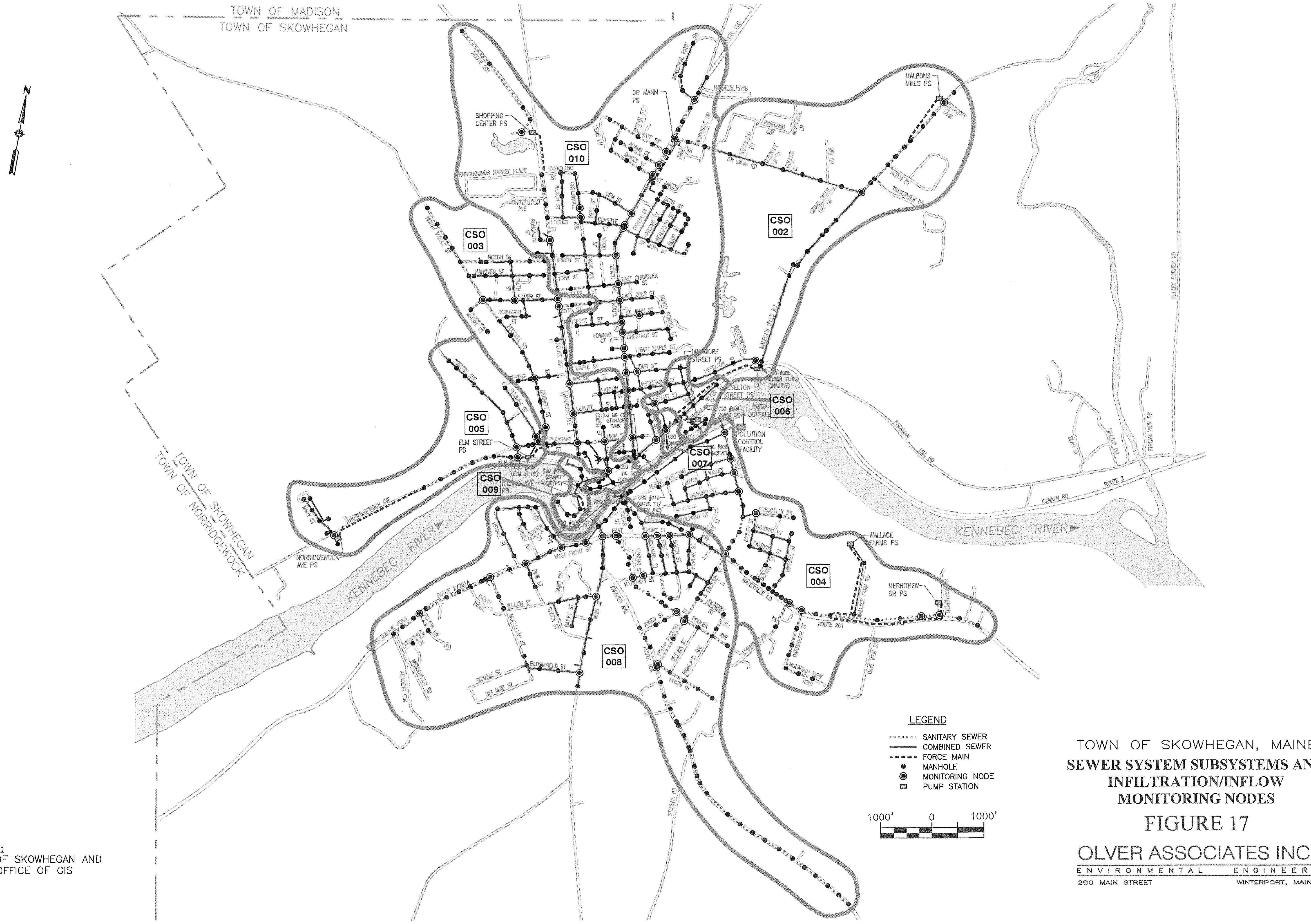
- The combined impact of stormwater inflow and snowmelt was 70.91 MG or seventeen percent. Inflow reached the plant in maximum amounts in April during snowmelt periods and in June after periods of heavy rainfall.

The treatment plant flow loading shown in Table 17 provides an interesting perspective that should be considered in the planning of future CSO abatement projects. While peak stormwater inflow control remains the key to reducing CSO activity, the Town is spending a significant amount of money each year to pass clean groundwater and base stormwater inflow through the treatment plant. Over half (55%) of the annual flow volume that passes through the treatment plant is clean groundwater infiltration and base stormwater inflow that would ideally not be in the sewer system. This should be a consideration when future discussions are made regarding whether to store and treat more excess flows versus conducting upstream excess flow removal projects to accomplish the same goal.

Skowhegan has many miles of old clay sewers that are likely the source of much of the observed groundwater infiltration. It also has many miles of combined sewer that allow large volumes of excess flow to enter the system. While a large percentage of excess flow may also originate from private sources, the Town could reduce the total loading into the sewer system by selective sewer upgrade projects in specific problem areas. If sewer sections that are both combined and constructed of clay pipe are found to have high excess flow rates, their remediation may also have the dual benefit of reducing CSO activity while, at the same time, reducing the amount of water that passes through the downstream wastewater treatment plant.

4.3 INFILTRATION/INFLOW (I/I) EVALUATION

As part of this CSO Master Plan Update, an evaluation of excess infiltration and inflow (I/) sources was conducted. The purpose of the I/I study was to assess areas of the sewer system that are subject to high flows. The sewer system was divided into twelve subsystems as shown in Figure 17. These subsystems correspond to the drainage areas of the Town's interceptor pumping stations and CSO areas. Flow measurements were made at various key manhole nodes throughout the sewer system to determine how the system responded to different groundwater infiltration and stormwater inflow conditions.



TOWN OF SKOWHEGAN, MAINE

SEWER SYSTEM SUBSYSTEMS AND INFILTRATION/INFLOW MONITORING NODES

FIGURE 17

OLVER ASSOCIATES INC.
ENVIRONMENTAL ENGINEERS
290 MAIN STREET WINTERPORT, MAINE

SOURCE:
TOWN OF SKOWHEGAN AND
MAINE OFFICE OF GIS

To the extent possible, flow gauging was scheduled in the evening or at night when sanitary flows in the sewer system were at a minimum. Flows were estimated by taking sewer flow depth measurements at steady-state groundwater and rainfall conditions. These flow depths were then converted into flow volume measurements using Manning's equation for full pipe flow as modified by a hydraulic elements analysis. Manhole inspections were conducted in conjunction with this work to trace sewer system peak flow locations, to observe pipe and manhole conditions, and to determine the types and sizes of sewer lines in order to calculate pipe capacity.

The total groundwater infiltration into the sewer system was found to reach a Spring peak of about 0.80 MGD. This value is consistent with the results reflected in the flow records of the downstream wastewater treatment plant. The overall groundwater leakage rate into the Skowhegan sewer system is about 4500 GPD/inch-mile throughout the whole sewer system and is not too excessive for the size and age of the system. However, individual streets were found to have much higher rates as shown below on Table 18:

TABLE 18: UNITIZED GROUNDWATER INFILTRATION BY SEWER SUBSYSTEM

SUBSYSTEM	STREET	INFILTRATION (GPD)	RATE (GPD/INCH-MILE)
JOYCE STREET AREA			
	Joyce Street	41,000	8,500
	Mount Pleasant Avenue	10,000	3,500
	Joyce Valley Sewer	84,000	17,000
	Milburn Street	5,000	2,500
	Cross-country to Waterville Rd.	18,000	7,000
	Dickey Street	25,000	4,500
	Prescelly Drive	5,000	4,500
	Waterville Road	4,000	2,500
	Dartmouth Street	8,000	2,500
NORRIDGEWOCK ROAD AREA			
	Norridgewock Road	35,000	6,500
	Alder Street	6,000	1,500
	Pine Street	3,000	4,000
	McClellan Street	1,000	1,000
	Poulin Drive	1,000	1,000
MAIN STREET AREA			
	Main Street	61,000	10,000
	Willow Street	10,000	6,500
	Bailey Street	48,000	53,000
	Bloomfield Street	6,000	3,000
CURRIER BROOK AREA			
	Pooler Avenue	1,000	500
	South Factory Street	1,500	1,000
	Fairview Avenue	1,500	200
	Union Street	200	200

EAST FRONT STREET AREA		
East Front Street	3,000	500
Mechanic Street	10,000	8,500
Free Street	2,000	1,000
South Street	1,000	800
Poplar Street	1,000	1,000
South Factory Street	1,000	1,500
MARY STREET AREA		
Mary Street	15,000	7,000
ELM STREET AREA		
Coburn Avenue	2,000	500
Summer Street	34,000	2,000
Bennett Street	1,500	1,000
Russell Road	500	200
Spring Street	1,500	1,000
Silver Street Ext.	500	500
North Middle Street	500	200
MADISON AVENUE AREA		
Madison Avenue	80,000	9,000
Leavitt Street	2,000	1,000
Winter Street	30,000	15,000
Dyer Street	500	500
Silver Street	500	300
Smith Street	500	500
COURT STREET AREA		
Court Street	15,000	7,000
NORTH AVENUE AREA		
Lower North Avenue	22,000	3,000
Middle North Avenue	25,000	4,000
Upper North Avenue	2,500	300
East Leavitt Street	20,000	10,000
East Maple Street	5,000	3,000
Prospect Street	500	500
Chestnut Street	4,000	3,000
Chandler/Dane Street	40,000	11,000
Jewett Street	500	500
Cowette Street	7,000	2,000
East Dyer Street	500	500
Industrial Park Road	4,000	2,000
Greenwood Avenue	4,000	3,000
WATER STREET AREA		
Water Street	89,000	35,000
Bush Street	32,000	40,000
Leavitt Cross-country	19,000	10,000
HESELTON STREET AREA		
Heselton Street	10,000	2,000
TOTAL GROUNDWATER INFILTRATION	807,000	4,500

Flow gauging in sewer systems is not an exact science due to the variability in the data and the many factors that can influence the methods that were used. The purpose of the nighttime flow gauging was not to develop exact flow measurements of each sewer. Instead, the goal was to develop a general, comparative balance of the entire system in order to identify the worst areas of the system relative to each other. The flow data developed at each node was balanced proportionately to obtain a relative estimate of various groundwater infiltration flows at each street during Spring high conditions.

For a sewer system of this size, EPA guidelines suggest that leakage rates greater than 3,000 GPD/inch-mile would be considered excessive. This threshold is often difficult to meet in older sewer systems because many old, clay pipes typically leak at these rates or higher. As discussed, the overall leakage rate of 4,500 GPD/inch-mile for the sewerage system at large exceeds EPA guidelines, but it is not unusual given the fact that sixty percent of the system consists of old, substandard clay and asbestos pipe. While it is not practical to upgrade the entire system, selective projects should be considered in the future in areas that have leakage rates higher than 3,000 to 5,000 GPD/inch-mile. In addition, lines that are associated with a rate closer to 3,000 GPD/inch-mile but that are associated with other factors might be given a higher priority for remediation. These factors would include maintenance problems on the line, overall poor structural condition of the pipes, its location upstream of a CSO or pump station, and whether or not the sewer pipe is also the source of peak stormwater inflow or inflow induced infiltration.

Peak wet weather inflow in the Skowhegan sewer system was estimated to be about 4.23 MGD of inflow per inch of daily rainfall. This determination was made by reviewing treatment plant flow records and conducting an analysis of the plant's response to peak flows on days when no overflow occurred. This response was then extrapolated to a database that included a range of storm events including a one-year and a twenty-five year design storm. Flow data was unitized to MGD per inch of rainfall in order to allow inflow volumes for various storm sizes to be determined.

Sewer system flows were also measured during a variety of storms and unitized to similar units of GPD/inch of rainfall. Flows throughout the sewer system were then compared to the modeled value that was predicted at the treatment plant. Minor calibrations and modifications to the sewer system data were made to allow it to mirror the flow response values expected at the treatment plant. Good correlation between the two models was obtained. Once calibrated flow data was determined for each subsystem, upstream sewer flow data was proportioned to allow a mass balance of the system to be conducted. The objective of this procedure was to allow a relative distribution of peak flows to be made based upon field measurements. The goal of this approach was not to obtain absolute measurements of existing flows at each location. Instead, a relative assessment of flow origins was made to allow the major problem areas of the sewer system subject to peak inflow to be identified.

The results of the balanced sewer system inflow data is provided below in Table 19:

TABLE 19: UNITIZED PEAK STORMWATER INFLOW RATES

SUBSYSTEM	STREET	PEAK INFLOW (GPD/INCH)
JOYCE STREET AREA		
	Joyce Street	136,000
	Mount Pleasant Avenue	50,000
	Joyce Valley Sewer	190,000
	Milburn Street	25,000
	Cross-country to Waterville Rd.	120,000
	Dickey Street	14,000
	Waterville Road	6,000
NORRIDGEWOCK ROAD AREA		
	Norridgewock Road	128,000
	Alder Street	33,000
	Pine Street	3,000
	McClellan Street	3,000
	Poulin Drive	6,000
MAIN STREET AREA		
	Main Street	650,000
	Willow Street	31,000
	Bailey Street	72,000
	Bloomfield Street	250,000
CURRIER BROOK AREA		
	Jones Street	3,000
	Pooler Avenue	3,000
	South Factory Street	8,000
	Fairview Avenue	8,000
	Union Street	3,000
EAST FRONT STREET AREA		
	East Front Street	170,000
	Poplar Street	6,000
	Mechanic Street	28,000
MARY STREET AREA		
	Mary Street	45,000
ELM STREET AREA		
	Summer Street	75,000
	Bennett Street	58,000
MADISON AVENUE AREA		
	Madison Avenue	420,000
	Leavitt Street	8,000
	Winter Street	89,000

	Dyer Street	3,000
	Silver Street Ext.	3,000
	Smith Street	3,000
COURT STREET AREA		
	Court Street	110,000
NORTH AVENUE AREA		
	Lower North Avenue	320,000
	Middle North Avenue	128,000
	Upper North Avenue	83,000
	East Leavitt Street	22,000
	East Maple Street	8,000
	Chestnut Street	8,000
	St. John Street	65,000
	Prospect Street	6,000
	East Dyer Street	8,000
	Chandler/Dane Street	170,000
	Jewett Street	8,000
	Waye Street	3,000
WATER STREET AREA		
	Water Street	250,000
	Bush Street	190,000
	Leavitt Cross-country	170,000
HESELTON STREET AREA		
	Heselton Street	35,000
TOTAL STORMWATER INFLOW		4.23 MGD/inch

The data presented in Table 19 is intended to show how the peak inflow rate of 4.23 MGD/inch of rainfall that is observed in the sewer system can be balanced through the system based upon field gauging measurements. The relative ranking of each street in comparison to each other is more useful than assuming that the estimated values reflect actual flows for every storm. This is due to the many factors that influence rainfall events in the sewer system. In addition, the values should be viewed as peak hourly rates, not sustained flows. Peak flows are more important than sustained flows in CSO analysis since peak flows trigger CSO activity. These flow estimates are useful to define upstream sewer remediation projects that should be considered based on the relative ranking of specific projects against each other. They should not be used for storage sizing since sustained flows are needed to size storage reactors.

The data presented in Table 19 can be used to estimate the relative stormwater inflow distribution from different parts of the sewer system by extrapolating the initial flows to various frequency storm events. This is shown in Table 20 for illustrative purposes:

TABLE 20: PEAK INFLOW GENERATION RATES BY SUBSYSTEM (MGD)

	WET WEATHER STORM FREQUENCY						
SUBSYSTEM	3 Mth.	6 Mth.	1 Yr.	2 Yr.	5 Yr.	10 Yr.	25 Yr.
Joyce Street Area	0.73	0.95	1.30	1.46	1.89	2.22	2.54
Norridgewock Road Area	0.23	0.30	0.42	0.47	0.61	0.71	0.81
Main Street Area	1.35	1.76	2.41	2.71	3.51	4.11	4.71
Currier Brook Area	0.03	0.04	0.06	0.07	0.09	0.10	0.12
East Front Street Area	0.28	0.36	0.49	0.55	0.71	0.84	0.96
Mary Street Area	0.06	0.08	0.11	0.12	0.16	0.19	0.21
Elm Street Area	0.18	0.23	0.32	0.36	0.47	0.55	0.63
Madison Avenue Area	0.71	0.92	1.26	1.42	1.84	2.16	2.47
Court Street Area	0.15	0.19	0.26	0.30	0.39	0.45	0.52
North Avenue Area	1.12	1.45	1.99	2.24	2.90	3.40	3.90
Water Street Area	0.82	1.07	1.46	1.65	2.14	2.50	2.87
Heselton Street Area	0.05	0.06	0.08	0.10	0.12	0.14	0.17
TOTAL INFLOW (MGD)	5.71	7.41	10.16	11.45	14.83	17.37	19.91
Rainfall Amount (in/day)	1.35"/D	1.75"/D	2.40"/D	2.70"/D	3.50"/D	1.40"/D	4.70"/D

Based on the field data obtained during the infiltration/inflow study and presented in the preceding discussion, each subsystem can be summarized as follows:

1. Joyce Street area subsystem is located upstream of CSO No. 004. High groundwater infiltration loadings were noted on Joyce Street itself (8500 GPD/inch-mile), in the Joyce Valley sewer (17,000 GPD/inch-mile), in the cross-country sewer between Joyce Street and Waterville Road (7000 GPD/inch-mile), and in the newer adjacent subdivision streets of Dickey Street and Prescelly Drive (both at 4500 GPD/inch-mile). Many of these sewers are constructed of old clay and asbestos cement pipe and are prone to leakage. The sewers in the adjacent subdivision are newer, contain PVC pipe and should not be leaking at this level. The same sewers on Joyce Street, Joyce Valley, and the cross-country line to Waterville Road also exhibit a high total rate of inflow (446,000 GPD/inch of rainfall) between the three lines. Since there are few connected catchbasins to these lines, it is likely that the poor condition of the sewers is allowing inflow induced infiltration to occur. CSO No. 004 has been active an average of 20 times per year over the last two years and has lost an average of 22,000 GPD/inch of rainfall. Addressing the excess flows in these sewer lines would have a beneficial impact on CSO No. 004 although the CSO will still be impacted from all other upstream flows in the sewer system due to its location at the head of the treatment plant. In addition to the older sewers noted above, the Town should investigate the inflow rate of 14,000 GPD/inch of rainfall in the Dickey Street and Prescelly Drive subdivision. The subdivision is supposed to have separated sewers which appear to allow more excess water to reach the Town's sewer system than would be expected.

2. Norridgewock Road area was found to have a measurably high rate of infiltration (6500 GPD/in-mi) as well as inflow (128,000 GPD/inch of rainfall) near the end of the line approaching the High School. This sewer should be checked to determine if roof drains, storm drains, or athletic field drains from the School are tied into the sewer system. The Norridgewock Road sewer system is constructed of clay and could be subject to infiltration and inflow induced infiltration. Alder Street has several connected catchbasins even though the road is next to the river. This is allowing an inflow rate of 33,000 GPD/inch of rainfall to enter. These streets are upstream of CSO No. 008 which overflows an average of 11 times per year at a CSO loss of 43,000 GPD/inch of rainfall. The Norridgewock Road area is currently not as large a factor in activation of CSO No. 008 as is the adjacent Main Street area subsystem.

3. Main Street area subsystem has high groundwater infiltration on Main Street (10,000 GPD/inch-mile) and on Bailey Street (53,000 GPD/inch-mile). Both of these lines are made of clay pipe and likely in poor condition. These two lines also have very high inflow rates with Main Street measured at 650,000 GPD/inch of rainfall and Bailey Street at 72,000 GPD/inch of rainfall. High inflow was observed on the two adjacent streets of Willow Street (31,000 GPD/inch of rainfall) and Bloomfield Street (250,000 GPD/inch of rainfall). All of these streets have combined sewers with connected catchbasins. These streets are a significant contributor to downstream CSO activity at CSO No. 008. There are also trailer parks in this area that could represent private sources of excess flow. The removal, storage or treatment of these peak flows will need to be addressed in order to reduce CSO discharges.

4. Currier Brook area subsystem has had recent sewer improvements done on several streets including the Hospital Valley sewer. No elevated levels of infiltration or inflow were noted in this area.

5. East Front Street area subsystem had elevated groundwater infiltration levels on Mechanic Street (8,500 GPD/inch-mile) even though this sewer was recently separated. Elevated levels of inflow were also recorded on Mechanic Street (28,000 GPD/inch) and on East Front Street (170,000 GPD/inch) even though we understand both areas to have had recent separation work. It may be helpful to inspect these areas by video camera to determine if these flow sources are from the Town's sewer or from private sources. Flows from this area would impact both CSO No. 008 as well as CSO No. 004 on Joyce Street. These flows are not of the same magnitude as those measured in the Joyce Street subsystem which is also upstream of CSO No. 004.

6. Mary Street area subsystem represents a small drainage area that has a disproportionate amount of excess flow. New PVC sewers on the former prison property are leaking at 7,000 GPD/inch-mile with stormwater inflow rates of

45,000 GPD/inch of rainfall. These flows are impacting the downstream Elm Street CSO which was active an average of 8 times per year over the last two years with an average CSO loss of 43,000 GPD/inch of rainfall. The Highway Department recently repaired a broken sewer in this area which should reduce peak flows. Should high flows persist, the Mary Street area should be inspected by television camera, smoke tested and dye tested to isolate and remove any further sources of excess flow.

7. Elm Street area subsystem is receiving high flows from the upstream Mary Street area as well as excessive inflow from Summer Street (75,000 GPD/inch) and Bennett Street (58,000 GPD/inch). These sewers have sections of old clay pipe as well as connected catchbasins. Addressing peak flows in these three areas could effectively end CSO activity at the Elm Street pump station (CSO No. 005).

8. Island Avenue pump station subsystem is served by CSO No. 009 which is active an average of 12 times per year with small losses of 4,000 GPD/inch of rainfall. This station receives very little sanitary flow and may be impacted by surcharged catchbasins from the adjacent area. The old pneumatic ejector station should be upgraded to a higher capacity submersible system. The catchbasin connections, if any, from downtown should be eliminated. With minor modifications, it is possible that all CSO discharges at No. 009 could be stopped.

9. Madison Avenue area subsystem has high groundwater infiltration rates on Madison Avenue (9,000 GPD/inch-mile) and on Winter Street (15,000 GPD/inch-mile). These lines are constructed of old clay pipe and likely in poor condition. High stormwater inflow rates were also measured on these streets with Madison Avenue at 420,000 GPD/inch of rainfall and Winter Street at 89,000 GPD/inch. Both streets have combined sewers with connected catchbasins. Some sections of Madison Avenue appear to have a separate storm drain that ties back into the sanitary sewer downtown. It is not clear if this line could be separated from the system. Flows from Madison Avenue impact the siphon CSO No. 003 and surcharge the Water Street sewer up to the CSO No. 010 storage tank. CSO No. 003 is active an average of five times per year with an average loss of 53,000 GPD/inch of rainfall. CSO No. 010 is active an average of 8 times per year with a loss of 952,000 GPD/inch of rainfall. Madison Avenue is one of the primary causes of CSO activity at both of these locations.

10. Court Street area subsystem has high infiltration flows from Court Street (7,000 GPD/inch-mile) as well as high inflow rates (110,000 GPD/inch). These flows impact both the CSO storage tank (No. 010) and the siphon inlet (CSO No. 003).

11. North Avenue area subsystem had high measured infiltration rates of 10,000 GPD/inch-mile on East Leavitt Street. We understand that this street was rehabilitated in 2007, but private sources could still exist. High infiltration still

remains on Chandler/Dane Streets with measured levels of 11,000 GPD/inch-mile. A greater excess flow impact is the inflow in this area from multiple sources such as North Avenue (531,000 GPD/inch of rainfall) and Chandler/Dane Street at 170,000 GPD/inch. These streets are the major sources of excess flow into CSO No. 003 and CSO No. 010. It will be necessary to address these flows in order to reduce activity at these two CSO locations.

12. Water Street area subsystem has major excess flow sources from Water Street (35,000 GPD/inch-mile of infiltration and 250,000 GPD/inch of inflow), Bush Street (40,000 GPD/inch-mile of infiltration and 190,000 GPD/inch of inflow) and the cross-country sewer from Leavitt Street (10,000 GPD/inch-mile of infiltration and 170,000 GPD/inch of inflow). These flows impact CSO activity at the North Footbridge (No. 003) and at the CSO storage tank (No. 010).

13. Heselton Street area subsystem has high levels of inflow on Heselton Street (35,000 GPD/inch of rainfall). These flows impact downtown CSO points at the North Footbridge (No. 003) and at the CSO storage structure (No. 010). The sewer on Heselton Street is in poor condition and is scheduled to be upgraded in the near future.

Figure 18 depicts the high excess flow area of the Skowhegan sewer system as noted in the above discussion.

TOWN OF SKOWHEGAN, MAINE

IDENTIFIED AREAS OF EXCESS FLOW ORIGIN

FIGURE 18

OLVER ASSOCIATES INC.
ENVIRONMENTAL ENGINEERS
290 MAIN STREET WINTERPORT, MAINE

SOURCE:
TOWN OF SKOWHEGAN AND MAINE OFFICE OF GIS

5. BEST MANAGEMENT PRACTICES FOR CSO MINIMIZATION

5.1 OBJECTIVES OF BEST MANAGEMENT PRACTICES

Skowhegan's present sewer system has evolved to its current configuration over greater than a one-hundred year period. The problems inherent in the system that create CSO activity evolved over that same time period. The implementation of long term CSO abatement measures, including the removal, storage or treatment of peak inflow sources, cannot be accomplished instantaneously. As the Town works to correct the sewer system problems that took over a century to create, it is certain that the full abatement of CSO overflows will require a time period numbering many years. It is with this in mind that both EPA and DEP require the Town to implement Best Management Practices (BMP) for the minimization of CSO activity during the interim period until final, long term corrective actions are completed.

BMP measures are defined as a program of actions that the Town can readily implement to minimize the discharge of pollutants from its CSO points. The complete abatement of CSO pollutant discharges represents a long term goal that will one day result from the ongoing Master Plan implementation. Recognizing that the completion of CSO abatement projects will take many years, BMP are intended to minimize CSO impacts during the interim period. The Town is required to implement interim BMP steps until other permanent measures for CSO control are in-place and has been doing so.

Best Management Practice measures that Skowhegan can implement in its sewer system can be found in the nine minimum CSO controls developed by EPA and previously presented. These controls are summarized in Table 21:

TABLE 21: EPA'S NINE MINIMUM CSO CONTROLS

CONTROL NUMBER	DESCRIPTION AND ELEMENTS
1	Proper Sewer System Maintenance • Sewer flushing and cleaning • Proactive pump station maintenance
2	Maximize Sewer System Storage • Eliminate roof and cellar drains • Utilize excess sewer storage volume

3 Implement Industrial Pretreatment Program

- Minimize high strength pollutant losses
- Regulate industrial effluent quality with permits

4 Maximize Wet Weather Flow to Plant

- Expand wastewater treatment plant capacity
- Provide primary treatment and disinfection to peak flows

5 Eliminate Dry Weather CSO Discharges

- Verify that no dry weather CSO discharges occur

6 CSO Discharge Floatables Control

- Install treatment at CSO outlets

7 Promote Pollution Prevention

- Promote water conservation
- Require industrial spill prevention plans

8 Encourage Public Participation

- Hold public hearings and meetings
- Utilize media for public education
- Include information in sewer billing mailers

9 Continue CSO Monitoring

- Continue flow monitoring of CSO activity
- Compare completed project results with master plan objectives
- Periodically update Master Plan
- Report CSO overflows to EPA/DEP each year

This section summarizes the Best Management Practices which have been proposed to mitigate CSO activity in Skowhegan as required by the Town's treatment plant discharge license and EPA's nine minimum CSO controls. The BMP program defines measures the Town has taken to reduce the potential of pollutant loss through the sewer system's six active CSO points. Because of the magnitude of the Town's CSO problem, implementation of this BMP program will not, in itself, eliminate the loss of pollutants through the CSO outfalls. It will, however, reduce any CSO discharges that may be occurring unnecessarily. With the aggressive implementation of the BMP measures defined herein, Skowhegan's remaining CSO discharges will consist of only those events requiring long term action measures for their abatement.

As the Town implements its BMP plan, detailed records of each measure taken should be retained. These documents will become part of the treatment plant's operating record and will be subject to review during all future regulatory inspections of the plant.

5.2 SEWER MAINTENANCE BEST MANAGEMENT PRACTICES

5.2.1 GENERAL CONSIDERATIONS

Untreated pollutants are discharged to the river through the sewer system's CSO structures any time that the flow into the system is greater than the hydraulic carrying capacity of the downstream pump stations, siphon, sewer lines and treatment plant. When an interceptor sewer is full and can accept no further volume, the excess flow backs up over the CSO control structures and discharges directly to the river.

Sewer maintenance steps taken as part of the BMP program strive to maximize the sewer system's flow carrying capacity such that CSO discharges are minimized. If sediments settle in the sewers, their carrying capacities may be reduced significantly. This may lead to the loss of sewer system storage during peak inflow periods and the subsequent loss of pollutants through CSO structures. These discharges are minimized by preventing sediment deposition in the sewers through periodic sewer flushing.

Similarly, the proper, proactive maintenance of pump stations whose failure could lead to bypass activity is an important BMP measure. The implementation of sewer maintenance BMP practices addresses the requirements of both the plant's discharge license and the EPA nine minimum CSO controls.

5.2.2 SEWER FLUSHING AND CLEANING

Some areas of the Town's sewer system are characterized by flat slopes that lead to solids deposition on the sewer bottom during low flow periods. Periodic high flow events, or deliberate sewer flushing by Town crews, convey the settled deposits downstream to interceptor sewers. Excessive solids that accumulate remove potential storage capacity from the sewer system which can be used to reduce CSO activity during peak flow events. These CSO discharges can be prevented, or at least reduced, by additional sewer flushing to keep these lines clear.

The frequent flushing of flat collector and interceptor sewer lines may reduce CSO activity. It is recommended that these lines be flushed every Spring and as needed thereafter. Continued monitoring should be conducted to determine the exact frequency of flushing depending on how rapidly sediments are observed to accumulate. Upstream sewers leading to these sewers should also be flushed regularly as needed.

High priority sewer cleaning and flushing areas to minimize downstream CSO activity are listed in Table 22:

TABLE 22: HIGH PRIORITY SEWER FLUSHING AREAS

LOCATION	REASON
South Side Interceptor	Maximize in-line storage
West Front Street sewer	Maximize in-line storage
Water Street sewers	Maximize in-line storage
Main Street sewer	Reduce first flush in high flow area
Madison Avenue sewer	Reduce first flush in high flow area
North Avenue sewer	Reduce first flush in high flow area

All other sewer sections should continue to be flushed periodically as needed as a matter of good practice. This helps to maximize sewer system storage as required by EPA. Diligent cleaning of the sewers defined in Table 22 may produce some benefit in reducing CSO pollutant loss.

5.2.3 PUMP STATION MAINTENANCE

Proactive maintenance of the Town's five major pump stations at CSO locations will prevent downtime that can lead to CSO discharges through station bypasses. Continued maintenance priorities at these locations will prevent CSO activation that could result due to pump station failure. Table 23 summarizes the Town's key pump stations where continued proactive maintenance efforts may help prevent CSO activity:

TABLE 23: HIGH PRIORITY PUMP STATION MAINTENANCE LOCATIONS

LOCATION	REASON
Heselton Street Pump Station	Prevent CSO No. 002 reactivation
Dinsmore Street Pump Station	Prevent CSO No. 006 reactivation
CSO Storage Tank Pump Station	Minimize CSO No. 010 activity
Elm Street Pump Station	Minimize CSO No. 005 activity
Island Avenue Pump Station	Minimize CSO No. 009 activity

5.2.4 CSO ACTIVATION SURVEYS

The DEP discharge license, and EPA's nine minimum CSO controls, require the Town to conduct periodic surveys of the CSO structures to ensure that no dry weather sanitary discharge is occurring. The Town is presently conducting these inspections given the fact that it maintains permanent flow metering stations on its CSO structures. As a result, all CSO activity is monitored by Skowhegan continuously.

5.2.5 DRY WEATHER OVERFLOW ELIMINATION

EPA requires that all dry weather CSO points be eliminated. As previously discussed, Skowhegan has no dry weather CSO discharges and is in compliance with this requirement.

5.3 SEWER REGULATION BEST MANAGEMENT PRACTICES

5.3.1 GENERAL CONSIDERATIONS

CSO discharges allow untreated pollutants to enter the river where they may have an adverse effect on water quality. This effect can be minimized by regulating sewer users to control the volume and strength of wastewater constituents entering the Town's sewers. Enforcement of Skowhegan's existing sewer user ordinance serves as the basis of such an approach.

5.3.2 CONTROL OF UNPOLLUTED DISCHARGES

The EPA CSO guidance requires the Town to enforce its sewer ordinance provisions that prohibit the introduction of non-contaminated water into the municipal sewer system. The present ordinance prohibits the discharge of stormwater, surface water, groundwater, roof drains, cellar drains, cooling water or unpolluted industrial process water into municipal sewers. The entry of roof and cellar drains should be discouraged in areas where separate storm sewers do not exist.

It is difficult to enforce cellar and roof drain ordinances against existing sewer users because suitable disposal options may not exist in all cases. However, long term progress in this direction should be made. Towards this objective, the following approach is recommended:

- Stronger ordinance language prohibiting unpolluted sewer connections should be considered at some point in the future.

- All new sewer users should be prohibited from connecting cellar and roof drains into the sewer system.

- All new developments should provide separate storm and sanitary sewers.

- The Town should survey industrial and commercial properties to identify roof and cellar drains, or on-site catchbasins, tied directly into the sewer system. Where found, such connections should be removed if possible.

- The Town may eventually need to inspect private residential dwellings to determine the extent of roof and cellar drain connections and begin measures to require their removal. Such measures might include adding a surcharge to the sewer bill of any user having roof or cellar drains. The Town's initial efforts should be focused on sections of the sewer system where large amounts of excess flow have been identified.

The eventual removal of private inflow connections may allow reduced peak flow volumes and less CSO discharges during peak flow events. Eliminating private inflow sources could also help to maximize sewer system storage and minimize CSO activity. However, due to the difficult political and public relations realities to mandate such a program, it is usually left for consideration only after CSO abatement options in the public system are completed.

5.3.3 INDUSTRIAL STRENGTH WASTE DISCHARGE CONTROL

The EPA CSO guidance requires the Town to make a special effort to insure that high strength wastewater and other non-conventional pollutants do not overflow through CSO points. A cursory review of potential industrial sewer users in Skowhegan suggests that there are presently no users impacting any CSO that meet an industrial category. The Town does operate an Industrial Park and could have future development that might pose potential CSO impacts. All future industrial sewer users should be required to submit pollution prevention plans, such as spill control programs, to the Town. Industries should be educated about the impact they could have on downstream CSO pollutant losses.

The Town should continue to conduct ongoing reviews of its sewer user base to determine if permitting needs exist for industrial pretreatment. Future sewer users that are found to generate high strength wastes that could impact the treatment plant or be discharged through the CSO points could be required to pretreat their wastes.

5.3.4 FUTURE INDUSTRIAL SEWER USER SITING

The EPA CSO guidance requires the Town to regulate the addition of new or increased volumes of industrial wastewater into the sewer system in circumstances where their location may result in the loss of waste through a CSO point. This is difficult in Skowhegan since all wastes from the Industrial Park and the Town's commercial areas pass by CSO structures. It will be easier for Skowhegan to accommodate this requirement by eventually eliminating its CSO discharges.

5.3.5 CSO OUTFALL IDENTIFICATION SIGNS

The Town's wastewater discharge license requires that signs be erected at each CSO outfall as part of the BMP program. The signs must notify the public that the outfall is a wet weather CSO discharge point. These signs must be inspected periodically and replaced as necessary. Skowhegan has met this requirement.

5.3.6 URBAN STORM WATER MANAGEMENT

EPA's BMP guidelines require that new development projects upstream of CSO discharge points reduce stormwater peaks by installing detention ponds or other mitigative measures. Currently, all development projects built in Skowhegan are reviewed by the Town's Planning Board. Stormwater mitigation measures have been required on these projects.

5.4 TREATMENT PLANT BEST MANAGEMENT PRACTICES

5.4.1 GENERAL CONSIDERATIONS

The Town is required to operate the wastewater treatment plant in a manner which maximizes the amount of wet weather flow sent to the facility without upsetting the plant's operations or causing discharge license violations. The Town has met this requirement by expanding its treatment plant to a peak flow capacity of 7.5 MGD. Three of the Town's major pump stations at Heselton Street, Dinsmore Street, and Elm Street have been upgraded to pump their maximum capacity before a CSO discharge occurs.

5.4.2 HIGH FLOW MANAGEMENT CONSIDERATIONS

The wastewater treatment plant's discharge license requires the Town to maximize the storage capacity of the sewer collection system and the capacity of the treatment plant during high flow periods. BMP sewer system storage objectives have been met by maximizing the elevation of the CSO control gates, by building a 1.0 MG storage tank, and by upgrading the treatment plant's capacity.

5.5 ADDITIONAL BMP CONSIDERATIONS

With the exception of the public participation and ongoing CSO monitoring requirements, all of EPA's nine minimum CSO controls have been addressed in the preceding BMP measures. Public participation has occurred on all CSO related decisions, expenditures and programs to date by public notice, hearings, and media involvement. The Town is also complying with the ongoing CSO program monitoring and Master Plan Update requirements as is evident by this current update report.

6. ALTERNATIVES FOR FURTHER CSO ABATEMENT

6.1 GENERAL CONSIDERATIONS FOR CSO REDUCTION

The Town of Skowhegan has discharges of raw sewerage out of its remaining CSO points anytime that the peak flow rate and flow volume in the sewer system exceeds the hydraulic capacity of the Town's sewer pipes, pump stations, siphon and wastewater treatment plant. These CSO discharges occur when excess stormwater inflow and inflow induced infiltration enter the sewers during wet weather events. The presence of snowmelt or high groundwater infiltration levels increases the potential for CSO discharges when concurrent precipitation events occur. The Town is required by both federal and state law to work towards the eventual elimination of CSO activity during all wet weather events up to a reasonable threshold storm.

The sewer system conditions that have created excess flows have evolved over the last 100 years. Excess flows enter the Town's sewers from catchbasins and combined sewer lines, from old leaking clay and asbestos cement sewers, and from private sources such as roof drains, cellar drains, foundation drains and sump pumps. As discussed, over sixty percent of the Town's sewer system remains combined and another sixty percent is constructed of clay and asbestos cement pipe, both of which are now considered to be substandard materials that are prone to failure and leakage. Given the magnitude of these excess flow sources, it is not practical or financially feasible for the Town to fully address its CSO problem in a short timeframe. In fact, the Town has been working to resolve this issue for over two decades since the first CSO Master Plan was published in 1990. It is likely that many more years will be needed to fully solve this problem given the large scale of excess flow sources and the high cost to implement solutions.

As the Town continues to address its CSO problem, there are several measures that can be used to judge the success of the ongoing program. Certainly, one measure of success is the reduction in the number of CSO discharge locations. The Town originally had ten CSO points at the beginning its program, but one was consolidated as part of the construction of the North Avenue relief sewer. For the better part of the CSO abatement program, the baseline number of CSO locations has been nine. The long term goal would be to eventually have no CSO discharges at all other than in the event of an extremely large wet weather storm. At the present time, the Town has eliminated two CSO points and has a third sandbagged that may be permanently eliminated after the completion of proposed sewer work. For all practical purposes, Skowhegan currently has six CSO points left. This represents a reduction of thirty-three percent of the original CSO's which is a positive step. As the Town considers alternatives for further CSO abatement, the elimination of even more CSO locations should be a goal. Ultimately, the Town should strive to consolidate its remaining CSO activity to as few locations as possible. Once this is done, further steps can be taken to address CSO impacts at those reduced number of locations.

Another measure of success for both past and future CSO abatement efforts is a reduction in the number of annual CSO events per year. Ideally, the long term goal should be to have zero CSO events per year except during peak wet weather periods that are above a large design threshold. Over the last decade, the Town has reduced its CSO discharge activity from a high of 363 events per year down to an average of 54 events per year over the last three years. This represents a reduction of over eighty-five percent which is a positive step. As the Town considers alternatives for future CSO abatement, it should implement measures that reduce the number of annual CSO events to the lowest number possible and eventually to zero during wet weather events below a design storm threshold.

A continual downward trend in the annual volume of raw sewage discharged to the river from the CSO locations should also be a goal. To date, the Town has reduced the CSO discharge volumes from a high of about 62 MG/year in 2008 down to just over 4.75 MG/year. This represents a reduction of over ninety-two percent which is a very positive step. As the Town considers future CSO abatement alternatives, it should select options that lead to the further reduction of CSO discharge volumes to the river.

The current standard that defines the ultimate success of a municipal CSO abatement program is to eliminate all CSO activity below a threshold design storm. In the past, Skowhegan has used a one-year storm event of 2.40 inches/day as this threshold with DEP concurrence. To-date, 63% of Skowhegan's remaining CSO events are occurring at less than a three month storm frequency of 1.35 inches/day or lower and 90% of all remaining CSO events are still occurring at a storm event that is less than the one-year threshold of 2.40 inches/day. This suggests that while Skowhegan has made tremendous progress with regard to several of the measures of program success defined above, it will need to implement additional measures in the years ahead to fully resolve its CSO issues.

Going forward, the Town should continue to implement CSO abatement alternatives that accomplish the following objections:

- Reduce the number of CSO discharge locations in order to consolidate discharge points.

- Implement measures to resolve the number of CSO activation days per year at those CSO locations that remain.

- Strive to reduce the volume of untreated wastewater that is lost through the remaining CSO structures.

6.2 ALTERNATIVES FOR FURTHER CSO ABATEMENT

In order to further abate CSO discharges down to levels needed to meet Federal and State law, the Town of Skowhegan has five alternatives that it could consider, as well as, different combinations of some of these alternatives, including:

- No-action alternative.
- Remove excess flows at their source.
- Additional in-line storage.
- Additional offline storage.
- Treatment at central plant or at satellite locations.

6.2.1 NO-ACTION ALTERNATIVE

After spending $9.5 million dollars to-date to essentially complete the Phase I and Phase II CSO projects, the Town could choose to pursue the "no-action" alternative. Implementation of this approach would limit CSO abatement efforts to those that the Town has already completed to-date. In earlier CSO planning documents, some estimates predicted the Phase I and Phase II projects might achieve zero further CSO events during a one-year storm or that all but 200,000 gallons of peak flow volume would be removed. As can be the case with CSO reduction predictions due to their uncertainty and variability and the numerous factors that trigger CSO activity, the work done to-date has been beneficial, but has not fully solved the CSO problem.

If the Town were to select the no-action alternative, no additional CSO abatement work would be completed beyond the projects that have already been conducted. The Town would continue to have somewhere in the vicinity of fifty CSO events per year at the remaining six CSO locations. The no-action alternative is not acceptable because this would place Skowhegan in the position of possible regulatory agency enforcement action. It also fails to meet the CSO abatement guidelines summarized in this report and mandated by EPA and DEP regulations. The no-action alternative is, therefore, not a viable option for the Town of Skowhegan at this time.

6.2.2 EXCESS FLOW REMOVAL AT ITS SOURCE

The Town of Skowhegan has over eighteen miles of combined sewer distributed throughout the community. Peak inflow could be greatly reduced by separating the stormwater out of some of these sewers. The Town also has about seventeen miles of 75 to 100 year old clay pipe and inferior asbestos cement pipe located throughout its sewer system. Much of this pipe is beyond its useful life, likely in poor condition and the source of substantial amounts of groundwater infiltration or inflow induced infiltration. The Town could reduce excess flows to the sewer system by replacing sections of old clay and asbestos cement sewer pipe with a focus on areas that have high leakage rates.

Sewer separation and remediation are often a major part of CSO reduction efforts in most communities. There are several advantages to this approach. First, these types of projects remove the excess water from the sewer system permanently. This eliminates the need for the Town to have to store, treat, or risk losing these excess flows out through the remaining CSO discharge points.

Second, as water is removed from the sewer system, the volume of peak flows that remain will also decrease. This tends to increase the threshold storm that might later trigger CSO activity downstream. Without the removal of upstream excess flows, the amount of peak flow in the sewer system does not change. If downstream storage and treatment alone are used to abate CSO discharges, it becomes critical to size the storage and treatment reactors with precision in order to stop CSO discharges. This is a difficult endeavor because of the variability of all the factors that contribute to peak flows including storm magnitude, intensity, duration, groundwater levels, soil saturation, frozen ground conditions, vegetative cover conditions, etc. If peak flow events exceed the storage and treatment capacity that is provided, CSO events will still occur at the same low intensity storms that caused CSO discharges before the storage and treatment reactors were built. This is the case in Skowhegan. Even though the number of CSO locations, events and volume have all decreased in a positive manner, the one-year storm frequency threshold of 2.40 inches/day is not met ninety percent of the time. This is because most of the upstream peak flow still remains in the sewer system. The Town could address this issue by substantially removing excess flows from some of the highest flow areas identified in the present flow gauging study.

Third, after spending millions of dollars on storage and treatment options, the Town will still be left with miles of old clay sewer pipe which will need to be replaced at some point in the future. While the current focus on sewer improvement projects is, by necessity, driven by CSO regulations, the Town will also need to eventually address the age and condition of the clay and asbestos cement lines in the sewer system. If the Town can reduce its CSO discharges by upgrading some of the worst sewer lines, this allows the same project to address CSO issues, while also improving the sewer system with pipes that will provide another 100 years of service.

Sewer separation and replacement has not been selected as the preferred abatement approach in Skowhegan's previous CSO Master Plans dating back as far as 1990. In general, storage and treatment have been selected as the preferred CSO abatement options for several reasons including:

- It was believed that the large amount of combined sewers in Skowhegan could not be cost-effectively separated. It was also believed that it would be less expensive to provide storage and treatment.

- It was indicated that separation would produce additional storm sewer outfalls which may eventually be regulated by EPA stormwater guidelines.

- It was felt that it makes more sense to treat stormwater instead of allowing it to be discharged to the river untreated, especially in the downtown urban areas.

These valid arguments have resulted in the Town's previous CSO reduction efforts focusing on storage and treatment of excess flows versus the upstream removal of flows at their source. Sewer separation and replacement has been conducted on a limited basis in select areas throughout the sewer system. This has proven to be an effective approach for the Town to achieve great success to move the CSO program forward to its present point. However, it may be time to consider additional at-source reduction measures to take the program to the next level of CSO abatement.

Some of the previous cost estimates showing that sewer system separation was not cost-effective appear to have been based on the assumption that the Town's entire sewer system would need to separated or replaced. Now that major infrastructure improvements have been made to upgrade pump stations, build in-line storage, construct a 1.0 MG offline storage tank, and upgrade the wastewater treatment plant's capacity, complete sewer separation will not be needed. It may possible to make major progress towards CSO abatement by constructing a few selected sewer improvement projects in the highest areas of excess flow generation.

While it is true that EPA stormwater regulations must be met by many communities of a specific urban population, or if located on an impaired urban stream, Skowhegan does not meet this criteria at this time. In addition, should stormwater regulations ever become applicable to Skowhegan, the Town already has at least fifty existing stormwater outfalls shown on its sewer map which discharge directly to surface waters. These outfalls would need to be addressed during any mandated stormwater permitting program even if no further separated