

Appendix A

i-Tree Hydro Model Results

Appendix A-1
Runoff Reduction for Study Scenarios
2011 to 2012 Precipitation Record

i-Tree Hydro Executive Summary

Project Location: Marlborough, Massachusetts
 Project Time Span: 01/01/2011 - 12/31/2012



Model Parameters

Watershed Area <i>square kilometers</i>	Rainfall <i>millimeters</i>	Total Runoff <i>cubic meters</i>
1.00	2,574.29	1,757,435.78

Land Cover	<i>Base</i>	<i>Alternative</i>
Tree Cover %	1.0	57.0
Shrub Cover %	0.0	0.0
Herbaceous Cover %	27.2	0.4
Water Cover %	0.0	0.0
Impervious Cover %	71.8	42.6
Soil Cover %	0.0	0.0

Subdivision Road Scenario 1 Small Trees, Both Sides of Road

Impervious Flow Events:
 143 Base, 137 Alternative

Streamflow Predictions

	Total Runoff		Baseflow		Pervious Flow		Impervious Flow	
	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>
Total Flow (cubic meters)	1,757,435.8	1,619,498.9	65,604.7	55,601.2	83,632.7	63,520.3	1,608,198.6	1,500,377.2
Highest Flow (cubic meters / hour)	27,913.8	27,767.3	5.0	5.0	5,293.3	5,272.3	22,617.5	22,492.3
Lowest Flow (cubic meters / hour)	1.3	0.9	1.3	0.9	0.0	0.0	0.0	0.0
Highest Flow Date	07/28/12	07/28/12	10/31/11	08/28/11	07/28/12	07/28/12	07/28/12	07/28/12
Lowest Flow Date	06/11/11	08/15/11	06/12/11	08/15/11	01/01/11	01/01/11	01/01/11	01/01/11
Average Flow (cubic meters/h)	100.3	92.4	3.7	3.2	4.8	3.6	91.8	85.6
Number of flow events ABOVE average flow	258.0	237.0	9.0	6.0	11.0	9.0	260.0	239.0
Average length of flow events ABOVE average (hours)	5.8	6.0	1,244.1	1,443.4	9.8	8.7	5.8	6.1
High Flow: Number of flow events ABOVE 1 standard deviation	165.0	156.0	45.0	17.0	11.0	9.0	171.0	159.0
Average length of flow events ABOVE 1 standard deviation (hours)	3.6	3.6	46.3	246.4	6.6	5.4	3.8	3.8
Number of flow events BELOW average flow	259.0	238.0	8.0	5.0	12.0	10.0	261.0	240.0
Average length of events BELOW average (hours)	62.0	67.7	877.9	1,670.2	1,358.6	1,663.9	61.5	67.1

i-Tree Hydro Executive Summary

Project Location: Marlborough, Massachusetts
 Project Time Span: 01/01/2011 - 12/31/2012



Model Parameters

Watershed Area <i>square kilometers</i>	Rainfall <i>millimeters</i>	Total Runoff <i>cubic meters</i>
1.00	2,574.29	1,757,435.78

Land Cover	<i>Base</i>	<i>Alternative</i>
Tree Cover %	1.0	41.1
Shrub Cover %	0.0	0.0
Herbaceous Cover %	27.2	9.0
Water Cover %	0.0	0.0
Impervious Cover %	71.8	49.9
Soil Cover %	0.0	0.0

Subdivision Road Scenario 2 Large Trees, One Side of Road

Impervious Flow Events:
 143 Base, 139 Alternative

Streamflow Predictions

	Total Runoff		Baseflow		Pervious Flow		Impervious Flow	
	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>
Total Flow (cubic meters)	1,757,435.8	1,650,803.1	65,604.7	60,148.8	83,632.7	63,768.1	1,608,198.6	1,526,886.2
Highest Flow (cubic meters / hour)	27,913.8	27,803.0	5.0	5.0	5,293.3	5,281.1	22,617.5	22,519.1
Lowest Flow (cubic meters / hour)	1.3	1.1	1.3	1.1	0.0	0.0	0.0	0.0
Highest Flow Date	07/28/12	07/28/12	10/31/11	10/20/11	07/28/12	07/28/12	07/28/12	07/28/12
Lowest Flow Date	06/11/11	06/22/11	06/12/11	06/22/11	01/01/11	01/01/11	01/01/11	01/01/11
Average Flow (cubic meters/h)	100.3	94.2	3.7	3.4	4.8	3.6	91.8	87.2
Number of flow events ABOVE average flow	258.0	243.0	9.0	7.0	11.0	9.0	260.0	242.0
Average length of flow events ABOVE average (hours)	5.8	5.9	1,244.1	1,536.8	9.8	8.7	5.8	6.0
High Flow: Number of flow events ABOVE 1 standard deviation	165.0	159.0	45.0	24.0	11.0	9.0	171.0	165.0
Average length of flow events ABOVE 1 standard deviation (hours)	3.6	3.6	46.3	145.3	6.6	5.4	3.8	3.7
Number of flow events BELOW average flow	259.0	244.0	8.0	6.0	12.0	10.0	261.0	243.0
Average length of events BELOW average (hours)	62.0	66.0	877.9	1,292.8	1,358.6	1,663.9	61.5	66.2

i-Tree Hydro Executive Summary

Project Location: Marlborough, Massachusetts
 Project Time Span: 01/01/2011 - 12/31/2012



Model Parameters

Watershed Area <i>square kilometers</i>	Rainfall <i>millimeters</i>	Total Runoff <i>cubic meters</i>
1.00	2,574.29	1,757,435.78

Land Cover	<i>Base</i>	<i>Alternative</i>
Tree Cover %	1.0	81.2
Shrub Cover %	0.0	0.0
Herbaceous Cover %	27.2	0.4
Water Cover %	0.0	0.0
Impervious Cover %	71.8	18.4
Soil Cover %	0.0	0.0

Subdivision Road Scenario 3 Large Trees, Both Sides of Road

Impervious Flow Events:
 143 Base, 126 Alternative

Streamflow Predictions

	Total Runoff		Baseflow		Pervious Flow		Impervious Flow	
	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>
Total Flow (cubic meters)	1,757,435.8	1,529,121.9	65,604.7	54,514.7	83,632.7	63,122.4	1,608,198.6	1,411,484.6
Highest Flow (cubic meters / hour)	27,913.8	27,643.3	5.0	5.0	5,293.3	5,256.6	22,617.5	22,384.2
Lowest Flow (cubic meters / hour)	1.3	0.9	1.3	0.9	0.0	0.0	0.0	0.0
Highest Flow Date	07/28/12	07/28/12	10/31/11	11/09/12	07/28/12	07/28/12	07/28/12	07/28/12
Lowest Flow Date	06/11/11	08/15/11	06/12/11	08/15/11	01/01/11	01/01/11	01/01/11	01/01/11
Average Flow (cubic meters/h)	100.3	87.3	3.7	3.1	4.8	3.6	91.8	80.6
Number of flow events ABOVE average flow	258.0	219.0	9.0	6.0	11.0	9.0	260.0	220.0
Average length of flow events ABOVE average (hours)	5.8	6.1	1,244.1	1,382.8	9.8	8.6	5.8	6.1
High Flow: Number of flow events ABOVE 1 standard deviation	165.0	149.0	45.0	14.0	11.0	10.0	171.0	153.0
Average length of flow events ABOVE 1 standard deviation (hours)	3.6	3.5	46.3	314.4	6.6	4.6	3.8	3.6
Number of flow events BELOW average flow	259.0	220.0	8.0	5.0	12.0	10.0	261.0	221.0
Average length of events BELOW average (hours)	62.0	73.5	877.9	1,755.8	1,358.6	1,664.0	61.5	73.2

i-Tree Hydro Executive Summary

Project Location: Marlborough, Massachusetts
 Project Time Span: 01/01/2011 - 12/31/2012



Model Parameters

Watershed Area <i>square kilometers</i>	Rainfall <i>millimeters</i>	Total Runoff <i>cubic meters</i>
1.00	2,574.29	2,210,447.01
Land Cover	<i>Base</i>	<i>Alternative</i>
Tree Cover %	1.0	53.4
Shrub Cover %	0.0	0.0
Herbaceous Cover %	0.0	0.0
Water Cover %	0.0	0.0
Impervious Cover %	99.0	46.6
Soil Cover %	0.0	0.0

Downtown Streets Scenario 1 Large Trees, Both Sides of Street

Impervious Flow Events:
 140 Base, 136 Alternative

Streamflow Predictions

	Total Runoff		Baseflow		Pervious Flow		Impervious Flow	
	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>
Total Flow (cubic meters)	2,210,447.0	2,016,912.8	0.0	0.0	0.0	0.0	2,210,447.0	2,016,912.8
Highest Flow (cubic meters / hour)	31,069.6	30,839.5	0.0	0.0	0.0	0.0	31,069.6	30,839.5
Lowest Flow (cubic meters / hour)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highest Flow Date	07/28/12	07/28/12	01/01/11	01/01/11	01/01/11	01/01/11	07/28/12	07/28/12
Lowest Flow Date	01/01/11	01/01/11	01/01/11	01/01/11	01/01/11	01/01/11	01/01/11	01/01/11
Average Flow (cubic meters/h)	126.2	115.1	0.0	0.0	0.0	0.0	126.2	115.1
Number of flow events ABOVE average flow	260.0	230.0	0.0	0.0	0.0	0.0	260.0	230.0
Average length of flow events ABOVE average (hours)	5.8	6.2	0.0	0.0	0.0	0.0	5.8	6.2
High Flow: Number of flow events ABOVE 1 standard deviation	171.0	158.0	0.0	0.0	0.0	0.0	171.0	158.0
Average length of flow events ABOVE 1 standard deviation (hours)	3.8	3.7	0.0	0.0	0.0	0.0	3.8	3.7
Number of flow events BELOW average flow	261.0	231.0	0.0	0.0	0.0	0.0	261.0	231.0
Average length of events BELOW average (hours)	61.5	69.9	0.0	0.0	0.0	0.0	61.5	69.9

i-Tree Hydro Executive Summary

Project Location: Marlborough, Massachusetts
 Project Time Span: 01/01/2011 - 12/31/2012



Model Parameters

Watershed Area <i>square kilometers</i>	Rainfall <i>millimeters</i>	Total Runoff <i>cubic meters</i>
1.00	2,574.29	2,210,447.01

Land Cover	<i>Base</i>	<i>Alternative</i>
Tree Cover %	1.0	41.3
Shrub Cover %	0.0	0.0
Herbaceous Cover %	0.0	0.0
Water Cover %	0.0	0.0
Impervious Cover %	99.0	58.7
Soil Cover %	0.0	0.0

Downtown Streets Scenario 2 Small Trees, Both Sides of Street

Impervious Flow Events:
 140 Base, 137 Alternative

Streamflow Predictions

	Total Runoff		Baseflow		Pervious Flow		Impervious Flow	
	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>
Total Flow (cubic meters)	2,210,447.0	2,061,378.6	0.0	0.0	0.0	0.0	2,210,447.0	2,061,378.6
Highest Flow (cubic meters / hour)	31,069.6	30,892.6	0.0	0.0	0.0	0.0	31,069.6	30,892.6
Lowest Flow (cubic meters / hour)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highest Flow Date	07/28/12	07/28/12	01/01/11	01/01/11	01/01/11	01/01/11	07/28/12	07/28/12
Lowest Flow Date	01/01/11	01/01/11	01/01/11	01/01/11	01/01/11	01/01/11	01/01/11	01/01/11
Average Flow (cubic meters/h)	126.2	117.7	0.0	0.0	0.0	0.0	126.2	117.7
Number of flow events ABOVE average flow	260.0	238.0	0.0	0.0	0.0	0.0	260.0	238.0
Average length of flow events ABOVE average (hours)	5.8	6.1	0.0	0.0	0.0	0.0	5.8	6.1
High Flow: Number of flow events ABOVE 1 standard deviation	171.0	159.0	0.0	0.0	0.0	0.0	171.0	159.0
Average length of flow events ABOVE 1 standard deviation (hours)	3.8	3.8	0.0	0.0	0.0	0.0	3.8	3.8
Number of flow events BELOW average flow	261.0	239.0	0.0	0.0	0.0	0.0	261.0	239.0
Average length of events BELOW average (hours)	61.5	67.4	0.0	0.0	0.0	0.0	61.5	67.4

i-Tree Hydro Executive Summary

Project Location: Marlborough, Massachusetts
 Project Time Span: 01/01/2011 - 12/31/2012



Model Parameters

Watershed Area <i>square kilometers</i>	Rainfall <i>millimeters</i>	Total Runoff <i>cubic meters</i>
1.00	2,574.29	2,210,447.01

Land Cover	<i>Base</i>	<i>Alternative</i>
Tree Cover %	1.0	11.6
Shrub Cover %	0.0	0.0
Herbaceous Cover %	0.0	0.0
Water Cover %	0.0	0.0
Impervious Cover %	99.0	88.4
Soil Cover %	0.0	0.0

Downtown Streets Scenario 3 Large Trees, Street Corners Only

Impervious Flow Events:
 140 Base, 141 Alternative

Streamflow Predictions

	Total Runoff		Baseflow		Pervious Flow		Impervious Flow	
	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>
Total Flow (cubic meters)	2,210,447.0	2,170,835.4	0.0	0.0	0.0	0.0	2,210,447.0	2,170,835.4
Highest Flow (cubic meters / hour)	31,069.6	31,023.1	0.0	0.0	0.0	0.0	31,069.6	31,023.1
Lowest Flow (cubic meters / hour)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highest Flow Date	07/28/12	07/28/12	01/01/11	01/01/11	01/01/11	01/01/11	07/28/12	07/28/12
Lowest Flow Date	01/01/11	01/01/11	01/01/11	01/01/11	01/01/11	01/01/11	01/01/11	01/01/11
Average Flow (cubic meters/h)	126.2	123.9	0.0	0.0	0.0	0.0	126.2	123.9
Number of flow events ABOVE average flow	260.0	251.0	0.0	0.0	0.0	0.0	260.0	251.0
Average length of flow events ABOVE average (hours)	5.8	5.9	0.0	0.0	0.0	0.0	5.8	5.9
High Flow: Number of flow events ABOVE 1 standard deviation	171.0	167.0	0.0	0.0	0.0	0.0	171.0	167.0
Average length of flow events ABOVE 1 standard deviation (hours)	3.8	3.8	0.0	0.0	0.0	0.0	3.8	3.8
Number of flow events BELOW average flow	261.0	252.0	0.0	0.0	0.0	0.0	261.0	252.0
Average length of events BELOW average (hours)	61.5	63.8	0.0	0.0	0.0	0.0	61.5	63.8

i-Tree Hydro Executive Summary

Project Location: Marlborough, Massachusetts
 Project Time Span: 01/01/2011 - 12/31/2012



Model Parameters

Watershed Area <i>square kilometers</i>	Rainfall <i>millimeters</i>	Total Runoff <i>cubic meters</i>
1.00	2,574.29	2,106,806.32
Land Cover	<i>Base</i>	<i>Alternative</i>
Tree Cover %	1.0	12.2
Shrub Cover %	0.0	0.0
Herbaceous Cover %	6.2	1.1
Water Cover %	0.0	0.0
Impervious Cover %	92.8	86.7
Soil Cover %	0.0	0.0

Parking Lot Scenario 1 Small Trees at Perimeter

Impervious Flow Events:
 142 Base, 144 Alternative

Streamflow Predictions

	Total Runoff		Baseflow		Pervious Flow		Impervious Flow	
	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>
Total Flow (cubic meters)	2,106,806.3	2,077,359.8	14,790.0	13,149.4	18,846.7	14,580.6	2,073,169.6	2,049,630.0
Highest Flow (cubic meters / hour)	30,350.0	30,315.3	1.1	1.1	1,206.3	1,209.5	29,143.0	29,105.2
Lowest Flow (cubic meters / hour)	0.3	0.3	0.3	0.3	0.0	0.0	0.0	0.0
Highest Flow Date	07/28/12	07/28/12	12/10/12	08/28/11	07/28/12	07/28/12	07/28/12	07/28/12
Lowest Flow Date	06/22/11	06/24/11	06/22/11	06/25/11	01/01/11	01/01/11	01/01/11	01/01/11
Average Flow (cubic meters/h)	120.3	118.6	0.8	0.8	1.1	0.8	118.3	117.0
Number of flow events ABOVE average flow	258.0	254.0	8.0	7.0	11.0	9.0	260.0	253.0
Average length of flow events ABOVE average (hours)	5.8	5.8	1,407.0	1,519.5	9.8	8.7	5.8	5.9
High Flow: Number of flow events ABOVE 1 standard deviation	168.0	169.0	40.0	22.0	11.0	9.0	171.0	170.0
Average length of flow events ABOVE 1 standard deviation (hours)	3.8	3.8	53.2	178.0	6.5	5.4	3.8	3.8
Number of flow events BELOW average flow	259.0	255.0	7.0	6.0	12.0	10.0	261.0	254.0
Average length of events BELOW average (hours)	62.0	63.0	1,018.3	1,310.2	1,358.6	1,663.9	61.5	63.2

i-Tree Hydro Executive Summary

Project Location: Marlborough, Massachusetts
 Project Time Span: 01/01/2011 - 12/31/2012



Model Parameters

Watershed Area <i>square kilometers</i>	Rainfall <i>millimeters</i>	Total Runoff <i>cubic meters</i>
1.00	2,574.29	2,056,698.62

Land Cover	<i>Base</i>	<i>Alternative</i>
Tree Cover %	1.0	26.0
Shrub Cover %	0.0	0.0
Herbaceous Cover %	9.2	0.7
Water Cover %	0.0	0.0
Impervious Cover %	89.8	73.3
Soil Cover %	0.0	0.0

Parking Lot Scenario 2 Intermediate Island, Large Trees

Impervious Flow Events:
 142 Base, 141 Alternative

Streamflow Predictions

	Total Runoff		Baseflow		Pervious Flow		Impervious Flow	
	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>
Total Flow (cubic meters)	2,056,698.6	1,986,077.2	22,052.0	18,502.1	27,901.8	21,265.6	2,006,744.9	1,946,309.5
Highest Flow (cubic meters / hour)	30,002.0	29,926.5	1.7	1.7	1,790.1	1,771.9	28,210.8	28,153.7
Lowest Flow (cubic meters / hour)	0.4	0.3	0.4	0.3	0.0	0.0	0.0	0.0
Highest Flow Date	07/28/12	07/28/12	12/10/12	08/28/11	07/28/12	07/28/12	07/28/12	07/28/12
Lowest Flow Date	06/11/11	08/15/11	06/12/11	08/15/11	01/01/11	01/01/11	01/01/11	01/01/11
Average Flow (cubic meters/h)	117.4	113.4	1.3	1.1	1.6	1.2	114.5	111.1
Number of flow events ABOVE average flow	257.0	246.0	9.0	7.0	11.0	9.0	260.0	246.0
Average length of flow events ABOVE average (hours)	5.8	6.0	1,239.0	1,184.5	9.8	8.6	5.8	6.0
High Flow: Number of flow events ABOVE 1 standard deviation	169.0	166.0	41.0	15.0	11.0	10.0	171.0	165.0
Average length of flow events ABOVE 1 standard deviation (hours)	3.8	3.7	50.3	287.3	6.5	4.7	3.8	3.8
Number of flow events BELOW average flow	258.0	247.0	8.0	6.0	12.0	10.0	261.0	247.0
Average length of events BELOW average (hours)	62.2	65.1	883.1	1,431.0	1,358.6	1,664.0	61.5	65.1

i-Tree Hydro Executive Summary

Project Location: Marlborough, Massachusetts
 Project Time Span: 01/01/2011 - 12/31/2012



Model Parameters

Watershed Area <i>square kilometers</i>	Rainfall <i>millimeters</i>	Total Runoff <i>cubic meters</i>
1.00	2,574.29	1,917,034.05

Land Cover	<i>Base</i>	<i>Alternative</i>
Tree Cover %	1.0	38.4
Shrub Cover %	0.0	0.0
Herbaceous Cover %	17.6	1.3
Water Cover %	0.0	0.0
Impervious Cover %	81.4	60.3
Soil Cover %	0.0	0.0

Parking Lot Scenario 3 3 Intermediate Islands, Large Trees

Impervious Flow Events:
 143 Base, 140 Alternative

Streamflow Predictions

	Total Runoff		Baseflow		Pervious Flow		Impervious Flow	
	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>
Total Flow (cubic meters)	1,917,034.0	1,819,936.0	42,364.0	36,092.6	53,912.6	41,052.6	1,820,757.3	1,742,790.8
Highest Flow (cubic meters / hour)	29,027.5	28,924.0	3.2	3.2	3,424.9	3,408.7	25,600.6	25,513.6
Lowest Flow (cubic meters / hour)	0.8	0.6	0.8	0.6	0.0	0.0	0.0	0.0
Highest Flow Date	07/28/12	07/28/12	05/22/12	08/28/11	07/28/12	07/28/12	07/28/12	07/28/12
Lowest Flow Date	06/11/11	08/15/11	06/12/11	08/15/11	01/01/11	01/01/11	01/01/11	01/01/11
Average Flow (cubic meters/h)	109.4	103.9	2.4	2.1	3.1	2.3	103.9	99.5
Number of flow events ABOVE average flow	257.0	245.0	9.0	7.0	11.0	9.0	260.0	244.0
Average length of flow events ABOVE average (hours)	5.8	5.9	1,243.4	1,238.3	9.8	8.7	5.8	6.0
High Flow: Number of flow events ABOVE 1 standard deviation	170.0	164.0	44.0	17.0	11.0	9.0	171.0	165.0
Average length of flow events ABOVE 1 standard deviation (hours)	3.7	3.6	46.2	242.9	6.6	5.4	3.8	3.8
Number of flow events BELOW average flow	258.0	246.0	8.0	6.0	12.0	10.0	261.0	245.0
Average length of events BELOW average (hours)	62.2	65.4	878.6	1,356.3	1,358.6	1,663.9	61.5	65.7

Appendix A-2

Runoff Reduction for Maximum Canopy Scenario Available Annual Precipitation Records

i-Tree Hydro Executive Summary

Project Location: Marlborough, Massachusetts
 Project Time Span: 01/01/2005 - 01/01/2006



Model Parameters

Watershed Area <i>square kilometers</i>	Rainfall <i>millimeters</i>	Total Runoff <i>cubic meters</i>
1.00	1,367.28	915,949.27

Land Cover	<i>Base</i>	<i>Alternative</i>
Tree Cover %	1.0	81.2
Shrub Cover %	0.0	0.0
Herbaceous Cover %	27.2	0.4
Water Cover %	0.0	0.0
Impervious Cover %	71.8	18.4
Soil Cover %	0.0	0.0

Subdivision Road Scenario 3 Large Trees, Both Sides of Road 2005 Precipitation Record

Impervious Flow Events:
 77 Base, 66 Alternative

Streamflow Predictions

	Total Runoff		Baseflow		Pervious Flow		Impervious Flow	
	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>
Total Flow (cubic meters)	915,949.3	820,716.0	29,693.0	24,596.8	17,363.7	14,320.8	868,892.6	781,798.4
Highest Flow (cubic meters / hour)	15,409.5	15,406.8	5.0	5.0	3,515.6	3,513.7	11,970.3	11,969.8
Lowest Flow (cubic meters / hour)	1.5	1.3	1.5	1.3	0.0	0.0	0.0	0.0
Highest Flow Date	10/15/05	10/15/05	04/30/05	10/26/05	10/15/05	10/15/05	10/15/05	10/15/05
Lowest Flow Date	04/23/05	05/23/05	04/24/05	05/25/05	01/01/05	01/01/05	01/01/05	01/01/05
Average Flow (cubic meters/h)	104.5	93.7	3.4	2.8	2.0	1.6	99.2	89.2
Number of flow events ABOVE average flow	133.0	100.0	4.0	3.0	2.0	1.0	133.0	99.0
Average length of flow events ABOVE average (hours)	6.4	7.1	781.3	776.5	13.5	16.0	6.4	7.2
High Flow: Number of flow events ABOVE 1 standard deviation	97.0	94.0	10.0	5.0	2.0	1.0	97.0	93.0
Average length of flow events ABOVE 1 standard deviation (hours)	3.9	3.9	218.1	436.5	10.5	13.0	4.0	3.9
Number of flow events BELOW average flow	134.0	101.0	3.0	2.0	3.0	2.0	134.0	100.0
Average length of events BELOW average (hours)	59.1	80.0	1,465.0	2,595.5	3,440.0	6,891.0	59.1	80.8

i-Tree Hydro Executive Summary

Project Location: Marlborough, Massachusetts

Project Time Span: 01/01/2006 - 01/01/2007



Model Parameters

Watershed Area <i>square kilometers</i>	Rainfall <i>millimeters</i>	Total Runoff <i>cubic meters</i>
1.00	1,191.77	797,319.09

Land Cover	<i>Base</i>	<i>Alternative</i>
Tree Cover %	1.0	81.2
Shrub Cover %	0.0	0.0
Herbaceous Cover %	27.2	0.4
Water Cover %	0.0	0.0
Impervious Cover %	71.8	18.4
Soil Cover %	0.0	0.0

Subdivision Road Scenario 3 Large Trees, Both Sides of Road 2006 Precipitation Record

Impervious Flow Events:
66 Base, 61 Alternative

Streamflow Predictions

	Total Runoff		Baseflow		Pervious Flow		Impervious Flow	
	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>
Total Flow (cubic meters)	797,319.1	736,246.3	29,704.0	26,039.8	8,347.4	5,568.5	759,267.6	704,637.9
Highest Flow (cubic meters / hour)	12,831.4	12,828.8	5.0	5.0	2,804.4	2,802.8	10,022.4	10,023.0
Lowest Flow (cubic meters / hour)	1.4	1.2	1.3	1.2	0.0	0.0	0.0	0.0
Highest Flow Date	10/12/06	10/12/06	06/04/06	06/10/06	10/12/06	10/12/06	10/12/06	10/12/06
Lowest Flow Date	05/11/06	06/02/06	05/15/06	06/03/06	01/01/06	01/01/06	01/01/06	01/01/06
Average Flow (cubic meters/h)	91.0	84.0	3.4	3.0	1.0	0.6	86.7	80.4
Number of flow events ABOVE average flow	127.0	109.0	5.0	4.0	5.0	2.0	128.0	109.0
Average length of flow events ABOVE average (hours)	6.0	6.3	642.3	705.3	6.0	6.5	5.9	6.3
High Flow: Number of flow events ABOVE 1 standard deviation	95.0	86.0	10.0	4.0	3.0	1.0	94.0	87.0
Average length of flow events ABOVE 1 standard deviation (hours)	4.3	4.5	199.8	567.0	5.0	6.0	4.4	4.4
Number of flow events BELOW average flow	128.0	110.0	4.0	3.0	6.0	3.0	129.0	110.0
Average length of events BELOW average (hours)	61.9	72.8	1,062.3	1,613.3	1,602.2	4,014.5	61.4	72.8

i-Tree Hydro Executive Summary

Project Location: Marlborough, Massachusetts
 Project Time Span: 01/01/2007 - 12/31/2007



Model Parameters

Watershed Area <i>square kilometers</i>	Rainfall <i>millimeters</i>	Total Runoff <i>cubic meters</i>
1.00	1,017.52	648,862.80

Land Cover	<i>Base</i>	<i>Alternative</i>
Tree Cover %	1.0	81.2
Shrub Cover %	0.0	0.0
Herbaceous Cover %	27.2	0.4
Water Cover %	0.0	0.0
Impervious Cover %	71.8	18.4
Soil Cover %	0.0	0.0

Subdivision Road Scenario 3 Large Trees, Both Sides of Road 2007 Precipitation Record

Impervious Flow Events:
 74 Base, 64 Alternative

Streamflow Predictions

	Total Runoff		Baseflow		Pervious Flow		Impervious Flow	
	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>
Total Flow (cubic meters)	648,862.8	544,392.1	21,812.1	12,241.0	23,140.2	19,120.4	603,910.8	513,030.6
Highest Flow (cubic meters / hour)	16,784.1	16,531.1	5.0	4.4	3,491.9	3,468.5	14,469.9	14,251.4
Lowest Flow (cubic meters / hour)	1.2	0.6	1.2	0.6	0.0	0.0	0.0	0.0
Highest Flow Date	05/16/07	05/16/07	12/30/07	01/01/07	05/16/07	05/16/07	05/16/07	05/16/07
Lowest Flow Date	11/06/07	12/30/07	11/06/07	12/30/07	01/01/07	01/01/07	01/01/07	01/01/07
Average Flow (cubic meters/h)	74.3	62.3	2.5	1.4	2.6	2.2	69.1	58.7
Number of flow events ABOVE average flow	148.0	121.0	3.0	1.0	5.0	3.0	152.0	122.0
Average length of flow events ABOVE average (hours)	5.0	5.3	1,196.5	3,026.0	10.0	10.0	5.0	5.3
High Flow: Number of flow events ABOVE 1 standard deviation	88.0	78.0	4.0	1.0	5.0	3.0	93.0	84.0
Average length of flow events ABOVE 1 standard deviation (hours)	3.1	2.9	522.7	1,348.0	6.2	6.7	3.2	2.9
Number of flow events BELOW average flow	149.0	122.0	2.0	1.0	6.0	4.0	153.0	123.0
Average length of events BELOW average (hours)	54.0	66.6	2,628.0	0.0	1,705.2	1,670.3	52.5	66.0

i-Tree Hydro Executive Summary

Project Location: Marlborough, Massachusetts
 Project Time Span: 01/01/2011 - 01/01/2012



Model Parameters

Watershed Area <i>square kilometers</i>	Rainfall <i>millimeters</i>	Total Runoff <i>cubic meters</i>
1.00	1,543.30	1,084,436.53

Land Cover	<i>Base</i>	<i>Alternative</i>
	Tree Cover %	1.0
Shrub Cover %	0.0	0.0
Herbaceous Cover %	27.2	0.4
Water Cover %	0.0	0.0
Impervious Cover %	71.8	18.4
Soil Cover %	0.0	0.0

Subdivision Road Scenario 3 Large Trees, Both Sides of Road 2011 Precipitation Record

Impervious Flow Events:
 77 Base, 67 Alternative

Streamflow Predictions

	Total Runoff		Baseflow		Pervious Flow		Impervious Flow	
	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>
Total Flow (cubic meters)	1,084,436.5	936,953.8	29,117.5	24,718.0	62,833.7	43,192.6	992,485.5	869,043.0
Highest Flow (cubic meters / hour)	20,670.6	20,650.3	5.0	5.0	4,794.4	4,791.8	17,672.3	17,655.7
Lowest Flow (cubic meters / hour)	1.3	0.9	1.3	0.9	0.0	0.0	0.0	0.0
Highest Flow Date	08/09/11	08/09/11	10/31/11	08/28/11	09/08/11	09/08/11	08/09/11	08/09/11
Lowest Flow Date	06/11/11	08/15/11	06/12/11	08/15/11	01/01/11	01/01/11	01/01/11	01/01/11
Average Flow (cubic meters/h)	123.8	106.9	3.3	2.8	7.2	4.9	113.3	99.2
Number of flow events ABOVE average flow	128.0	114.0	3.0	3.0	7.0	5.0	131.0	115.0
Average length of flow events ABOVE average (hours)	6.5	6.5	594.0	390.5	11.3	9.8	6.4	6.5
High Flow: Number of flow events ABOVE 1 standard deviation	96.0	90.0	16.0	6.0	8.0	6.0	100.0	91.0
Average length of flow events ABOVE 1 standard deviation (hours)	3.5	3.3	131.8	482.8	6.6	4.8	3.7	3.5
Number of flow events BELOW average flow	129.0	115.0	2.0	2.0	8.0	6.0	132.0	116.0
Average length of events BELOW average (hours)	61.9	69.6	2,067.0	2,479.0	848.0	1,193.2	60.4	68.9

i-Tree Hydro Executive Summary

Project Location: Marlborough, Massachusetts
 Project Time Span: 01/01/2012 - 12/31/2012



Model Parameters

Watershed Area <i>square kilometers</i>	Rainfall <i>millimeters</i>	Total Runoff <i>cubic meters</i>
1.00	1,030.99	656,468.31

Land Cover	<i>Base</i>	<i>Alternative</i>
Tree Cover %	1.0	81.2
Shrub Cover %	0.0	0.0
Herbaceous Cover %	27.2	0.4
Water Cover %	0.0	0.0
Impervious Cover %	71.8	18.4
Soil Cover %	0.0	0.0

Subdivision Road Scenario 3 Large Trees, Both Sides of Road 2012 Precipitation Record

Impervious Flow Events:
 64 Base, 58 Alternative

Streamflow Predictions

	Total Runoff		Baseflow		Pervious Flow		Impervious Flow	
	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>
Total Flow (cubic meters)	656,468.3	577,289.3	21,165.8	15,954.9	20,799.0	19,929.8	614,503.4	541,404.6
Highest Flow (cubic meters / hour)	27,911.7	27,641.7	5.0	5.0	5,293.3	5,256.6	22,617.5	22,384.2
Lowest Flow (cubic meters / hour)	0.9	0.7	0.9	0.7	0.0	0.0	0.0	0.0
Highest Flow Date	07/28/12	07/28/12	10/19/12	12/18/12	07/28/12	07/28/12	07/28/12	07/28/12
Lowest Flow Date	08/15/12	10/29/12	08/16/12	10/29/12	01/01/12	01/01/12	01/01/12	01/01/12
Average Flow (cubic meters/h)	74.9	65.9	2.4	1.8	2.4	2.3	70.1	61.8
Number of flow events ABOVE average flow	117.0	102.0	3.0	2.0	4.0	4.0	117.0	102.0
Average length of flow events ABOVE average (hours)	5.6	5.7	653.5	1,997.0	7.3	7.3	5.7	5.7
High Flow: Number of flow events ABOVE 1 standard deviation	71.0	60.0	4.0	3.0	4.0	4.0	76.0	65.0
Average length of flow events ABOVE 1 standard deviation (hours)	3.7	3.7	482.7	526.5	4.3	4.0	3.8	3.8
Number of flow events BELOW average flow	118.0	103.0	2.0	1.0	5.0	5.0	118.0	103.0
Average length of events BELOW average (hours)	68.9	79.8	2,606.5	5,294.0	1,566.3	1,566.3	68.9	79.8

Appendix A-3
Sensitivity of Runoff Reduction to
Variation in Selected Model Parameters

i-Tree Hydro Executive Summary

Project Location: Marlborough, Massachusetts
 Project Time Span: 01/01/2011 - 12/31/2012



Model Parameters

Watershed Area <i>square kilometers</i>	Rainfall <i>millimeters</i>	Total Runoff <i>cubic meters</i>
1.00	2,574.29	1,758,932.05

Land Cover	<i>Base</i>	<i>Alternative</i>
Tree Cover %	1.0	81.2
Shrub Cover %	0.0	0.0
Herbaceous Cover %	27.2	0.4
Water Cover %	0.0	0.0
Impervious Cover %	71.8	18.4
Soil Cover %	0.0	0.0

Subdivision Roads, Scenario 3A Large Trees, Both Sides of Street Sensitivity Analysis: Leaf Area Index = 3

Impervious Flow Events
 143 Base, 126 Alternative

Streamflow Predictions

	Total Runoff		Baseflow		Pervious Flow		Impervious Flow	
	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>
Total Flow (cubic meters)	1,758,932.1	1,543,060.0	66,897.8	57,740.4	83,636.8	63,227.5	1,608,397.5	1,422,091.9
Highest Flow (cubic meters / hour)	27,914.7	27,700.7	5.0	5.0	5,293.3	5,265.3	22,618.4	22,432.6
Lowest Flow (cubic meters / hour)	1.3	1.1	1.3	1.1	0.0	0.0	0.0	0.0
Highest Flow Date	07/28/12	07/28/12	10/31/11	11/09/12	07/28/12	07/28/12	07/28/12	07/28/12
Lowest Flow Date	05/18/11	06/24/11	05/19/11	06/25/11	01/01/11	01/01/11	01/01/11	01/01/11
Average Flow (cubic meters/h)	100.4	88.1	3.8	3.3	4.8	3.6	91.8	81.2
Number of flow events ABOVE average flow	258.0	222.0	8.0	10.0	11.0	9.0	260.0	221.0
Average length of flow events ABOVE average (hours)	5.8	6.1	1,475.0	962.3	9.8	8.6	5.8	6.1
High Flow: Number of flow events ABOVE 1 standard deviation	165.0	150.0	56.0	24.0	11.0	10.0	171.0	154.0
Average length of flow events ABOVE 1 standard deviation (hours)	3.6	3.5	25.8	164.6	6.6	4.7	3.8	3.7
Number of flow events BELOW average flow	259.0	223.0	7.0	9.0	12.0	10.0	261.0	222.0
Average length of events BELOW average (hours)	62.0	72.5	950.3	928.2	1,358.6	1,664.0	61.5	72.8

i-Tree Hydro Executive Summary

Project Location: Marlborough, Massachusetts
 Project Time Span: 01/01/2011 - 12/31/2012



Model Parameters

Watershed Area <i>square kilometers</i>	Rainfall <i>millimeters</i>	Total Runoff <i>cubic meters</i>
1.00	2,574.29	1,756,782.62
Land Cover	<i>Base</i>	<i>Alternative</i>
Tree Cover %	1.0	81.2
Shrub Cover %	0.0	0.0
Herbaceous Cover %	27.2	0.4
Water Cover %	0.0	0.0
Impervious Cover %	71.8	18.4
Soil Cover %	0.0	0.0

Subdivision Roads, Scenario 3B
 Large Trees, Both Sides of Street
 Sensitivity Analysis:
 Root Zone = 0.05m

Impervious Flow Events:
 143 Base, 126 Alternative

Streamflow Predictions

	Total Runoff		Baseflow		Pervious Flow		Impervious Flow	
	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>
Total Flow (cubic meters)	1,756,782.6	1,543,574.5	74,902.2	69,700.1	73,682.1	62,389.4	1,608,198.6	1,411,484.6
Highest Flow (cubic meters / hour)	27,913.8	27,643.6	5.0	5.0	5,293.3	5,256.6	22,617.5	22,384.2
Lowest Flow (cubic meters / hour)	2.4	2.0	2.4	2.0	0.0	0.0	0.0	0.0
Highest Flow Date	07/28/12	07/28/12	10/31/11	03/12/11	07/28/12	07/28/12	07/28/12	07/28/12
Lowest Flow Date	02/17/11	03/10/11	02/18/11	03/11/11	01/01/11	01/01/11	01/01/11	01/01/11
Average Flow (cubic meters/h)	100.3	88.1	4.3	4.0	4.2	3.6	91.8	80.6
Number of flow events ABOVE average flow	258.0	219.0	23.0	13.0	11.0	9.0	260.0	220.0
Average length of flow events ABOVE average (hours)	5.8	6.1	469.5	794.4	9.7	8.4	5.8	6.1
High Flow: Number of flow events ABOVE 1 standard deviation	168.0	149.0	69.0	43.0	11.0	10.0	171.0	153.0
Average length of flow events ABOVE 1 standard deviation (hours)	3.6	3.5	28.8	71.5	6.5	4.6	3.8	3.6
Number of flow events BELOW average flow	259.0	220.0	22.0	12.0	12.0	10.0	261.0	221.0
Average length of events BELOW average (hours)	62.0	73.5	304.0	623.8	1,358.7	1,664.1	61.5	73.2

i-Tree Hydro Executive Summary

Project Location: Rutland, Massachusetts

Project Time Span: 01/01/2011 - 12/31/2012



Model Parameters

Watershed Area <i>square kilometers</i>	Rainfall <i>millimeters</i>	Total Runoff <i>cubic meters</i>
1.00	2,574.29	1,778,457.86

Land Cover	<i>Base</i>	<i>Alternative</i>
	Tree Cover %	1.0
Shrub Cover %	0.0	0.0
Herbaceous Cover %	27.2	0.4
Water Cover %	0.0	0.0
Impervious Cover %	71.8	18.4
Soil Cover %	0.0	0.0

Subdivision Roads, Scenario 3C Large Trees, Both Sides of Street Sensitivity Analysis: Alternative TI (Rutland, MA)

Impervious Flow Events:
143 Base, 126 Alternative

Streamflow Predictions

	Total Runoff		Baseflow		Pervious Flow		Impervious Flow	
	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>
Total Flow (cubic meters)	1,778,457.9	1,549,006.6	86,503.7	70,436.1	83,635.2	63,138.8	1,608,318.9	1,415,432.0
Highest Flow (cubic meters / hour)	27,914.6	27,643.8	7.5	7.5	5,293.2	5,256.3	22,617.8	22,384.4
Lowest Flow (cubic meters / hour)	1.3	0.9	1.3	0.9	0.0	0.0	0.0	0.0
Highest Flow Date	07/28/12	07/28/12	10/15/11	12/23/11	07/28/12	07/28/12	07/28/12	07/28/12
Lowest Flow Date	05/20/11	08/15/11	05/20/11	08/15/11	01/01/11	01/01/11	01/01/11	01/01/11
Average Flow (cubic meters/h)	101.5	88.4	4.9	4.0	4.8	3.6	91.8	80.8
Number of flow events ABOVE average flow	258.0	221.0	6.0	6.0	11.0	9.0	259.0	221.0
Average length of flow events ABOVE average (hours)	5.8	6.1	1,871.8	1,180.6	9.8	8.6	5.8	6.1
High Flow: Number of flow events ABOVE 1 standard deviation	165.0	149.0	38.0	13.0	11.0	10.0	171.0	154.0
Average length of flow events ABOVE 1 standard deviation (hours)	3.6	3.5	83.9	343.8	6.6	4.6	3.8	3.6
Number of flow events BELOW average flow	259.0	222.0	6.0	5.0	12.0	10.0	260.0	222.0
Average length of events BELOW average (hours)	62.0	72.9	1,269.7	1,876.0	1,358.6	1,664.0	61.7	72.8

i-Tree Hydro Executive Summary

Project Location: Plymouth, Massachusetts

Project Time Span: 01/01/2011 - 12/31/2012



Model Parameters

Watershed Area <i>square kilometers</i>	Rainfall <i>millimeters</i>	Total Runoff <i>cubic meters</i>
1.00	1,880.11	1,248,893.52

Land Cover	<i>Base</i>	<i>Alternative</i>
	Tree Cover %	1.0
Shrub Cover %	0.0	0.0
Herbaceous Cover %	27.2	0.4
Water Cover %	0.0	0.0
Impervious Cover %	71.8	18.4
Soil Cover %	0.0	0.0

Subdivision Roads, Scenario 4 Large Trees, Both Sides of Street Sensitivity Analysis: Plymouth TI and Rainfall

Impervious Flow Events:
122 Base, 113 Alternative

Streamflow Predictions

	Total Runoff		Baseflow		Pervious Flow		Impervious Flow	
	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>
Total Flow (cubic meters)	1,248,893.5	1,167,863.5	37,032.1	31,781.9	16,710.3	16,039.1	1,195,151.3	1,120,042.4
Highest Flow (cubic meters / hour)	10,632.3	10,540.6	4.4	4.4	2,167.2	2,139.5	10,043.8	9,968.1
Lowest Flow (cubic meters / hour)	1.2	1.1	1.2	1.1	0.0	0.0	0.0	0.0
Highest Flow Date	07/08/11	07/08/11	01/01/11	01/01/11	08/15/11	08/15/11	07/08/11	07/08/11
Lowest Flow Date	04/17/11	09/28/12	04/17/11	09/28/12	01/01/11	01/01/11	01/01/11	01/01/11
Average Flow (cubic meters/h)	71.3	66.7	2.1	1.8	1.0	0.9	68.2	63.9
Number of flow events ABOVE average flow	250.0	209.0	12.0	4.0	8.0	7.0	250.0	209.0
Average length of flow events ABOVE average (hours)	5.3	5.8	915.5	2,260.3	7.3	7.4	5.3	5.9
High Flow: Number of flow events ABOVE 1 standard deviation	183.0	165.0	39.0	12.0	8.0	7.0	183.0	167.0
Average length of flow events ABOVE 1 standard deviation (hours)	3.6	3.8	48.7	388.0	4.5	4.4	3.7	3.8
Number of flow events BELOW average flow	251.0	210.0	11.0	3.0	9.0	8.0	251.0	210.0
Average length of events BELOW average (hours)	64.7	77.9	627.5	3,082.7	1,997.0	2,283.1	64.7	77.9

i-Tree Hydro Executive Summary

Project Location: Marlborough, Massachusetts
 Project Time Span: 01/01/2011 - 12/31/2012



Model Parameters

Watershed Area <i>square kilometers</i>	Rainfall <i>millimeters</i>	Total Runoff <i>cubic meters</i>
1.00	2,153.92	1,406,995.48

Land Cover	<i>Base</i>	<i>Alternative</i>
	Tree Cover %	1.0
Shrub Cover %	0.0	0.0
Herbaceous Cover %	27.2	0.4
Water Cover %	0.0	0.0
Impervious Cover %	71.8	18.4
Soil Cover %	0.0	0.0

Subdivision Roads, Scenario 5 Large Trees, Both Sides of Street Sensitivity Analysis: Pittsfield TI and Rainfall

Impervious Flow Events:
 150 Base, 140 Alternative

Streamflow Predictions

	Total Runoff		Baseflow		Pervious Flow		Impervious Flow	
	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>
Total Flow (cubic meters)	1,406,995.5	1,250,381.8	44,886.4	39,818.6	29,944.1	28,447.1	1,332,164.9	1,182,116.1
Highest Flow (cubic meters / hour)	19,359.3	18,772.0	4.4	4.4	3,801.9	3,787.4	16,344.2	16,022.8
Lowest Flow (cubic meters / hour)	1.1	0.8	1.1	0.8	0.0	0.0	0.0	0.0
Highest Flow Date	08/21/11	08/21/11	01/01/11	01/01/11	08/28/11	08/28/11	08/21/11	08/21/11
Lowest Flow Date	06/14/11	08/27/11	06/14/11	08/28/11	01/01/11	01/01/11	01/01/11	01/01/11
Average Flow (cubic meters/h)	80.3	71.4	2.6	2.3	1.7	1.6	76.0	67.5
Number of flow events ABOVE average flow	303.0	249.0	8.0	4.0	8.0	7.0	303.0	251.0
Average length of flow events ABOVE average (hours)	5.3	5.7	1,140.0	2,379.0	8.1	8.0	5.3	5.7
High Flow: Number of flow events ABOVE 1 standard deviation	202.0	186.0	42.0	18.0	7.0	4.0	209.0	194.0
Average length of flow events ABOVE 1 standard deviation (hours)	3.4	3.2	62.3	234.1	5.9	7.5	3.4	3.2
Number of flow events BELOW average flow	304.0	250.0	7.0	3.0	9.0	8.0	304.0	252.0
Average length of events BELOW average (hours)	52.4	63.7	1,009.1	2,731.0	1,885.4	2,010.9	52.4	63.2

i-Tree Hydro Executive Summary

Project Location: Marlborough, Massachusetts
 Project Time Span: 01/01/2011 - 12/31/2012



Model Parameters

Watershed Area <i>square kilometers</i>	Rainfall <i>millimeters</i>	Total Runoff <i>cubic meters</i>
1.00	2,574.29	2,210,647.67

Land Cover	<i>Base</i>	<i>Alternative</i>
Tree Cover %	1.0	53.4
Shrub Cover %	0.0	0.0
Herbaceous Cover %	0.0	0.0
Water Cover %	0.0	0.0
Impervious Cover %	99.0	46.6
Soil Cover %	0.0	0.0

Downtown Streets Scenario 1A
Large Trees, Both Sides of Street
Sensitivity Analysis:
Leaf Area Index = 3
 # Impervious Flow Events:
 140 Base, 136 Alternative

Streamflow Predictions

	Total Runoff		Baseflow		Pervious Flow		Impervious Flow	
	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>
Total Flow (cubic meters)	2,210,647.7	2,027,394.8	0.0	0.0	0.0	0.0	2,210,647.7	2,027,394.8
Highest Flow (cubic meters / hour)	31,070.5	30,887.0	0.0	0.0	0.0	0.0	31,070.5	30,887.0
Lowest Flow (cubic meters / hour)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highest Flow Date	07/28/12	07/28/12	01/01/11	01/01/11	01/01/11	01/01/11	07/28/12	07/28/12
Lowest Flow Date	01/01/11	01/01/11	01/01/11	01/01/11	01/01/11	01/01/11	01/01/11	01/01/11
Average Flow (cubic meters/h)	126.2	115.7	0.0	0.0	0.0	0.0	126.2	115.7
Number of flow events ABOVE average flow	260.0	232.0	0.0	0.0	0.0	0.0	260.0	232.0
Average length of flow events ABOVE average (hours)	5.8	6.1	0.0	0.0	0.0	0.0	5.8	6.1
High Flow: Number of flow events ABOVE 1 standard deviation	171.0	160.0	0.0	0.0	0.0	0.0	171.0	160.0
Average length of flow events ABOVE 1 standard deviation (hours)	3.8	3.7	0.0	0.0	0.0	0.0	3.8	3.7
Number of flow events BELOW average flow	261.0	233.0	0.0	0.0	0.0	0.0	261.0	233.0
Average length of events BELOW average (hours)	61.5	69.2	0.0	0.0	0.0	0.0	61.5	69.2

i-Tree Hydro Executive Summary

Project Location: Marlborough, Massachusetts
 Project Time Span: 01/01/2011 - 12/31/2012



Model Parameters

Watershed Area <i>square kilometers</i>	Rainfall <i>millimeters</i>	Total Runoff <i>cubic meters</i>
1.00	2,574.29	2,210,447.01

Land Cover	<i>Base</i>	<i>Alternative</i>
Tree Cover %	1.0	53.4
Shrub Cover %	0.0	0.0
Herbaceous Cover %	0.0	0.0
Water Cover %	0.0	0.0
Impervious Cover %	99.0	46.6
Soil Cover %	0.0	0.0

Downtown Streets Scenario 1B Large Trees, Both Sides of Street Sensitivity Analysis: Root Zone = 0.05m

Impervious Flow Events:
 140 Base, 136 Alternative

Streamflow Predictions

	Total Runoff		Baseflow		Pervious Flow		Impervious Flow	
	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>
Total Flow (cubic meters)	2,210,447.0	2,016,912.8	0.0	0.0	0.0	0.0	2,210,447.0	2,016,912.8
Highest Flow (cubic meters / hour)	31,069.6	30,839.5	0.0	0.0	0.0	0.0	31,069.6	30,839.5
Lowest Flow (cubic meters / hour)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highest Flow Date	07/28/12	07/28/12	01/01/11	01/01/11	01/01/11	01/01/11	07/28/12	07/28/12
Lowest Flow Date	01/01/11	01/01/11	01/01/11	01/01/11	01/01/11	01/01/11	01/01/11	01/01/11
Average Flow (cubic meters/h)	126.2	115.1	0.0	0.0	0.0	0.0	126.2	115.1
Number of flow events ABOVE average flow	260.0	230.0	0.0	0.0	0.0	0.0	260.0	230.0
Average length of flow events ABOVE average (hours)	5.8	6.2	0.0	0.0	0.0	0.0	5.8	6.2
High Flow: Number of flow events ABOVE 1 standard deviation	171.0	158.0	0.0	0.0	0.0	0.0	171.0	158.0
Average length of flow events ABOVE 1 standard deviation (hours)	3.8	3.7	0.0	0.0	0.0	0.0	3.8	3.7
Number of flow events BELOW average flow	261.0	231.0	0.0	0.0	0.0	0.0	261.0	231.0
Average length of events BELOW average (hours)	61.5	69.9	0.0	0.0	0.0	0.0	61.5	69.9

i-Tree Hydro Executive Summary

Project Location: Rutland, Massachusetts

Project Time Span: 01/01/2011 - 12/31/2012



Model Parameters

Watershed Area <i>square kilometers</i>	Rainfall <i>millimeters</i>	Total Runoff <i>cubic meters</i>
1.00	2,574.29	2,210,586.71

Land Cover	<i>Base</i>	<i>Alternative</i>
	Tree Cover %	1.0
Shrub Cover %	0.0	0.0
Herbaceous Cover %	0.0	0.0
Water Cover %	0.0	0.0
Impervious Cover %	99.0	46.6
Soil Cover %	0.0	0.0

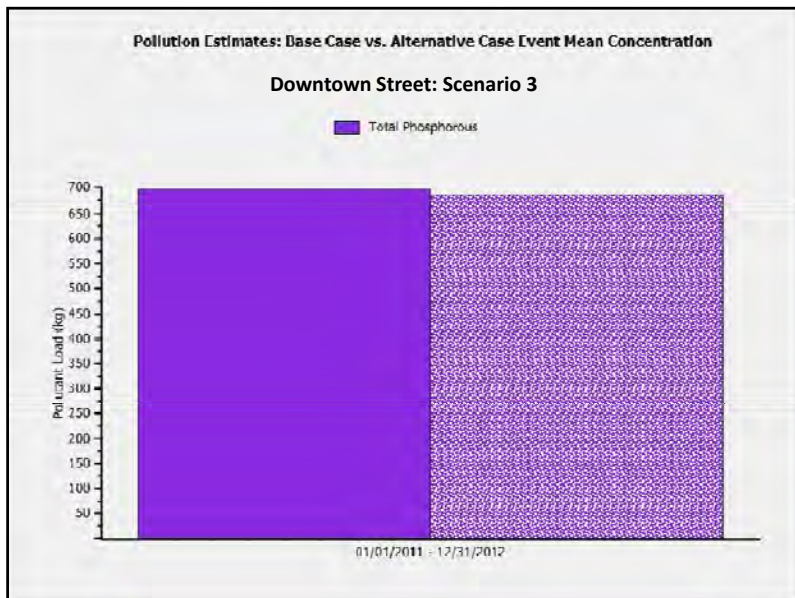
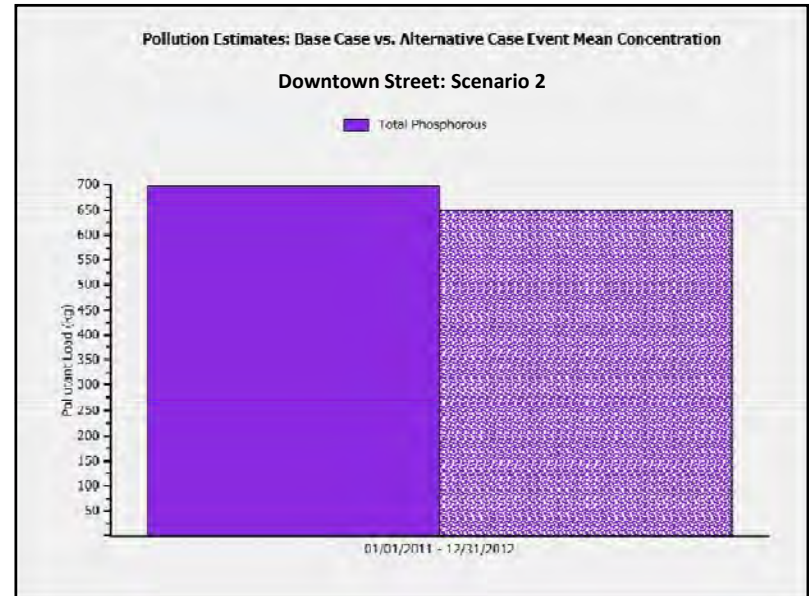
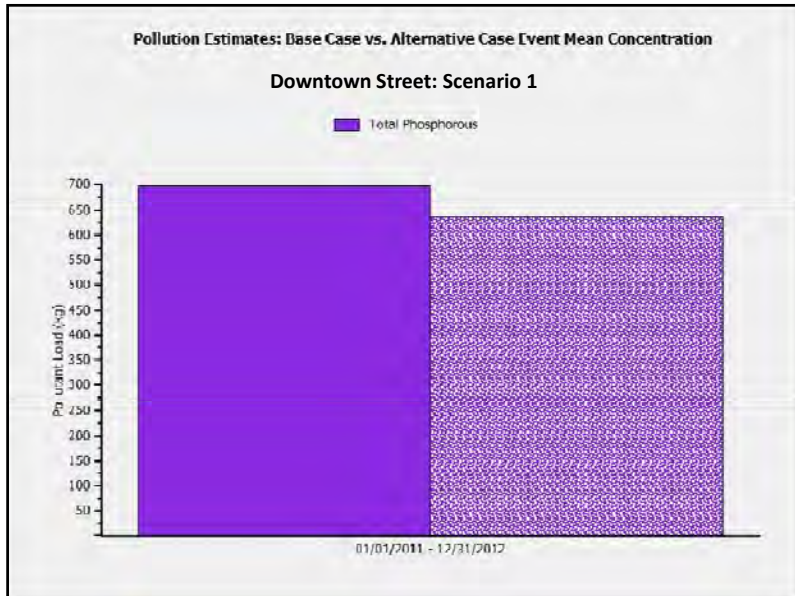
Downtown Streets Scenario 1C Large Trees, Both Sides of Street Sensitivity Analysis: Alternative TI (Rutland, MA)

Impervious Flow Events:
140 Base, 139 Alternative

Streamflow Predictions

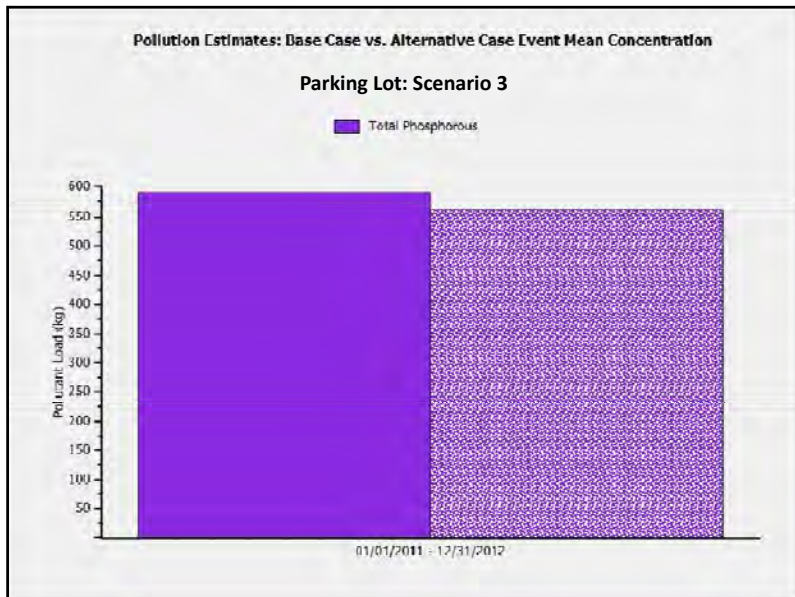
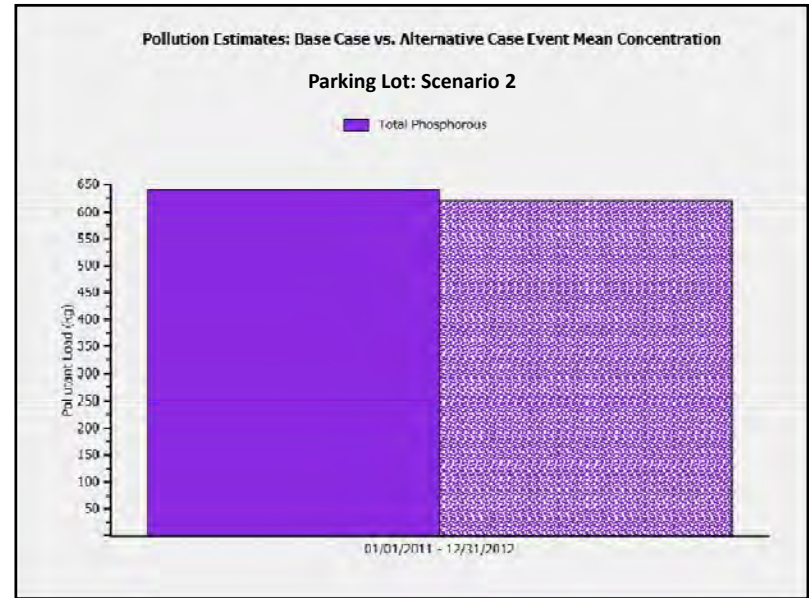
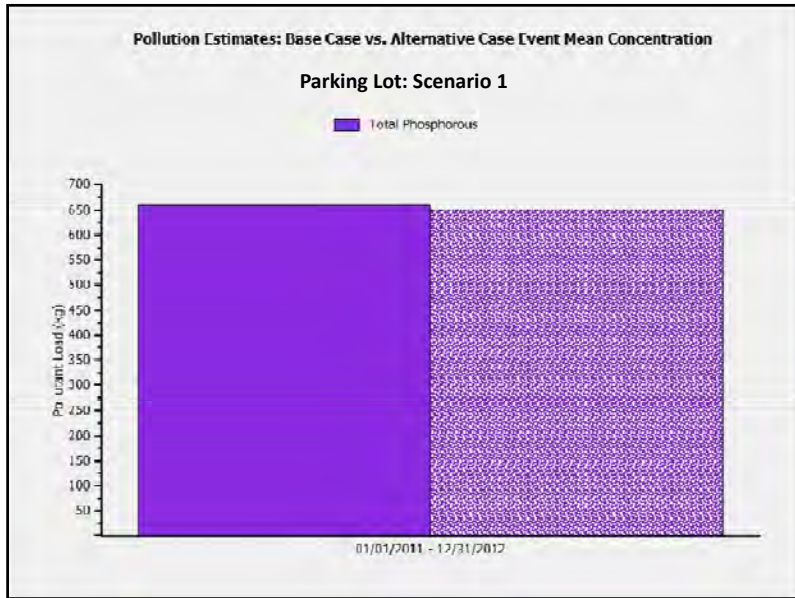
	Total Runoff		Baseflow		Pervious Flow		Impervious Flow	
	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>	<i>Base</i>	<i>Alternative</i>
Total Flow (cubic meters)	2,210,586.7	2,020,827.4	0.0	0.0	0.0	0.0	2,210,586.7	2,020,827.4
Highest Flow (cubic meters / hour)	31,070.0	30,839.8	0.0	0.0	0.0	0.0	31,070.0	30,839.8
Lowest Flow (cubic meters / hour)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Highest Flow Date	07/28/12	07/28/12	01/01/11	01/01/11	01/01/11	01/01/11	07/28/12	07/28/12
Lowest Flow Date	01/01/11	01/01/11	01/01/11	01/01/11	01/01/11	01/01/11	01/01/11	01/01/11
Average Flow (cubic meters/h)	126.2	115.3	0.0	0.0	0.0	0.0	126.2	115.3
Number of flow events ABOVE average flow	260.0	231.0	0.0	0.0	0.0	0.0	260.0	231.0
Average length of flow events ABOVE average (hours)	5.8	6.2	0.0	0.0	0.0	0.0	5.8	6.2
High Flow: Number of flow events ABOVE 1 standard deviation	171.0	160.0	0.0	0.0	0.0	0.0	171.0	160.0
Average length of flow events ABOVE 1 standard deviation (hours)	3.8	3.7	0.0	0.0	0.0	0.0	3.8	3.7
Number of flow events BELOW average flow	261.0	232.0	0.0	0.0	0.0	0.0	261.0	232.0
Average length of events BELOW average (hours)	61.5	69.5	0.0	0.0	0.0	0.0	61.5	69.5

Appendix A-4
Phosphorus Reduction



Phosphorus Reduction by Tree Canopy

Downtown Streets
2-year Rainfall Period
Scenarios 1, 2, and 3

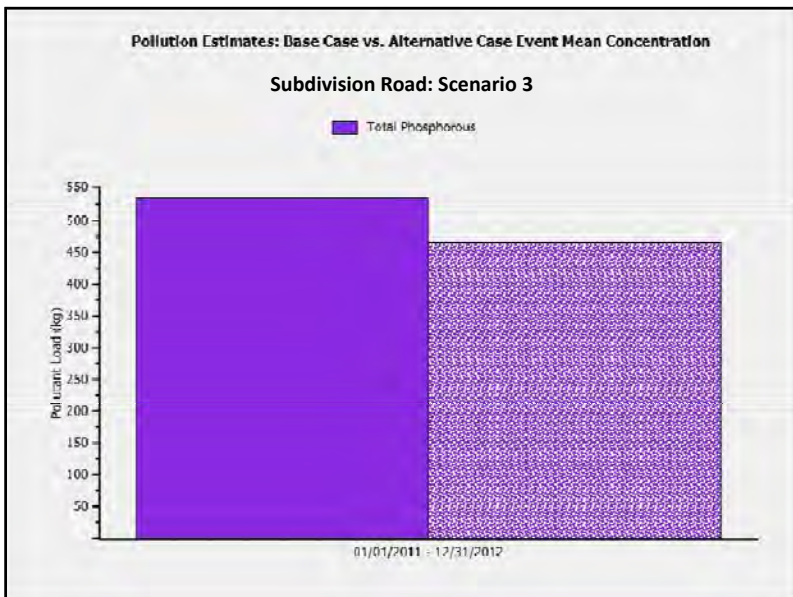
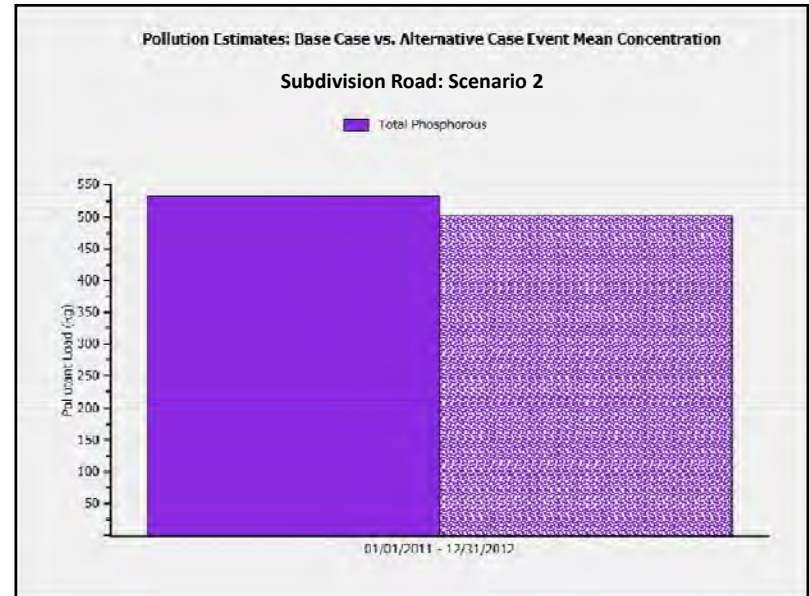
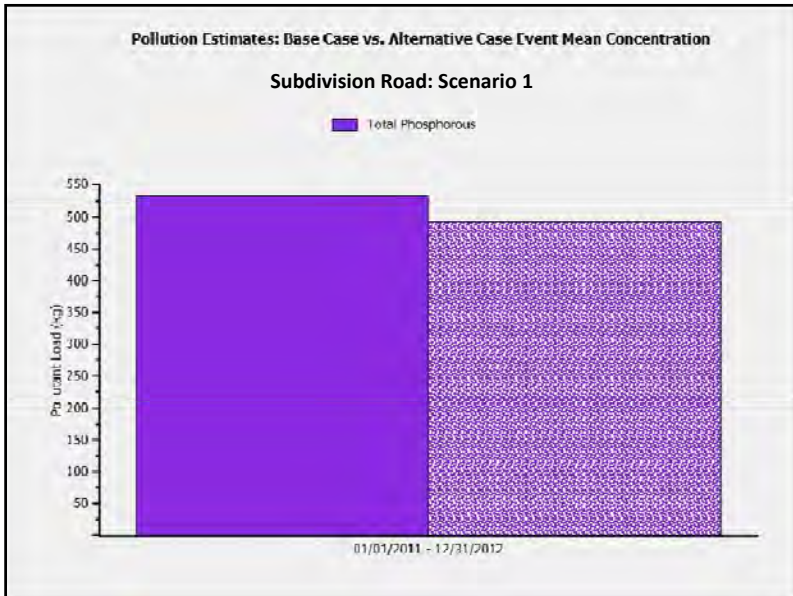


Phosphorus Reduction by Tree Canopy

Parking Lots

2-year Rainfall Period

Scenarios 1, 2, and 3



Phosphorus Reduction by Tree Canopy

Subdivision Roads
2-year Rainfall Period
Scenarios 1, 2, and 3

