

## Appendix E

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### Site-Specific BMP Concept Cost Estimates Pomperaug River Watershed Based Plan

Pomperaug River Watershed Based Plan  
 Planning-Level Costs for Site-Specific BMP Concepts

Location and Element		Order of Magnitude Cost Range													
		Construction				Planning and Design		Cost Range			Life Cycle				
		Unit Cost	Unit	Quantity	Cost (2018\$)	Allowance	Cost	Total Cost	-30%	50%	Lifespan (yrs)	Annual Cost over Lifespan	O&M (% Cost)	O&M (\$/yr)	Total Capitalized Cost/yr over lifespan
<b>Residential 1</b>															
1	Subsurface Infiltration	\$20.00	cf runoff treated	2,700	\$54,000	30%	\$16,200	\$71,000	\$50,000	\$107,000	20	\$5,220	10%	\$520	\$5,740
Add-on	Permeable Pavement - Replace cul-de-sac	\$3.07	sf	4,300	\$13,201	30%	\$3,960	\$18,000	\$13,000	\$27,000	20	\$1,320	10%	\$130	\$1,450
<b>Total</b>							<b>\$89,000</b>	<b>\$63,000</b>	<b>\$134,000</b>						
<b>Residential 2</b>															
1	Subsurface Infiltration	\$20.00	cf runoff treated	4,400	\$88,000	30%	\$26,400	\$115,000	\$81,000	\$173,000	20	\$8,460	10%	\$850	\$9,310
2	Infiltration Basin, I-84 On-Ramp	\$18.72	cf runoff treated	600	\$11,232	30%	\$3,370	\$15,000	\$11,000	\$23,000	20	\$1,100	10%	\$110	\$1,210
3	Infiltration Basin, Oakdale Road	\$18.72	cf runoff treated	2,200	\$41,184	30%	\$12,360	\$54,000	\$38,000	\$81,000	20	\$3,970	10%	\$400	\$4,370
<b>Total</b>							<b>\$184,000</b>	<b>\$130,000</b>	<b>\$277,000</b>						
<b>Residential 3</b>															
1	Bioretention Area, north	\$35.62	sf	350	\$12,467	30%	\$3,740	\$17,000	\$12,000	\$26,000	20	\$1,250	10%	\$130	\$1,380
2	Bioretention Area, south	\$35.62	sf	1,000	\$35,620	30%	\$10,690	\$47,000	\$33,000	\$71,000	20	\$3,460	10%	\$350	\$3,810
3	Subsurface Infiltration	\$20.00	cf runoff treated	4,000	\$80,000	30%	\$24,000	\$104,000	\$73,000	\$156,000	20	\$7,650	10%	\$770	\$8,420
<b>Total</b>							<b>\$168,000</b>	<b>\$118,000</b>	<b>\$253,000</b>						
<b>Residential/Commercial Mixed 1</b>															
1	Linear Bioretention	\$35.62	sf	900	\$32,058	30%	\$9,620	\$42,000	\$29,000	\$63,000	20	\$3,090	10%	\$310	\$3,400
2	Subsurface Infiltration, Bank	\$20.00	cf runoff treated	1,700	\$34,000	30%	\$10,200	\$45,000	\$32,000	\$68,000	20	\$3,310	10%	\$330	\$3,640
3	Subsurface Infiltration, 460 Heritage Road	\$20.00	cf runoff treated	3,600	\$72,000	30%	\$21,600	\$94,000	\$66,000	\$141,000	20	\$6,920	10%	\$690	\$7,610
4	Infiltration Basin, Village Green	\$18.72	cf runoff treated	8,300	\$155,376	30%	\$46,610	\$202,000	\$141,000	\$303,000	20	\$14,860	10%	\$1,490	\$16,350
5	Infiltration Basin, Heritage and Poverty Roads	\$18.72	cf runoff treated	1,700	\$31,824	30%	\$9,550	\$42,000	\$29,000	\$63,000	20	\$3,090	10%	\$310	\$3,400
6	Vegetated Water Quality Swale	\$10.96	sf	1,600	\$17,536	30%	\$5,260	\$23,000	\$16,000	\$35,000	16	\$1,970	10%	\$200	\$2,170
7	Permeable Pavement	\$3.07	sf	39,750	\$122,033	30%	\$36,610	\$159,000	\$111,000	\$239,000	20	\$11,700	10%	\$1,170	\$12,870
<b>Total</b>							<b>\$607,000</b>	<b>\$424,000</b>	<b>\$912,000</b>						
<b>State Facility 2</b>															
1	Permeable Pavement	\$3.07	sf	59,200	\$181,744	30%	\$54,520	\$237,000	\$166,000	\$356,000	20	\$17,440	10%	\$1,740	\$19,180
2	Bioretention Area, Hartford Hill	\$35.62	sf	1,000	\$35,620	30%	\$10,690	\$47,000	\$33,000	\$71,000	20	\$3,460	10%	\$350	\$3,810
3	Bioretention Area, Constitution Hill	\$35.62	sf	2,500	\$89,050	30%	\$26,720	\$116,000	\$81,000	\$174,000	20	\$8,540	10%	\$850	\$9,390
4	Bioretention Area, Liberty Lane	\$35.62	sf	1,200	\$42,744	30%	\$12,820	\$56,000	\$39,000	\$84,000	20	\$4,120	10%	\$410	\$4,530
5	Vegetated Water Quality Swale, north	\$10.96	sf	1,400	\$15,344	30%	\$4,600	\$20,000	\$14,000	\$30,000	16	\$1,720	10%	\$170	\$1,890
6	Vegetated Water Quality Swale, south	\$10.96	sf	4,500	\$49,320	30%	\$14,800	\$65,000	\$46,000	\$98,000	16	\$5,580	10%	\$560	\$6,140
7	Buffer Restoration	\$12,166.62	acre	1.06	\$12,848	30%	\$3,850	\$17,000	\$12,000	\$26,000	20	\$1,250	10%	\$130	\$1,380
<b>Total</b>							<b>\$558,000</b>	<b>\$391,000</b>	<b>\$839,000</b>						
<b>Golf Course, Public School, and Town Park</b>															
1	Bioretention Areas	\$19.97	sf	1,400	\$27,955	30%	\$8,390	\$37,000	\$26,000	\$56,000	20	\$2,720	10%	\$270	\$2,990
2	Subsurface Infiltration	\$20.00	cf runoff treated	9,539	\$190,780	30%	\$57,230	\$249,000	\$174,000	\$374,000	20	\$18,320	10%	\$1,830	\$20,150
3	Permeable Pavement	\$3.07	sf	4,700	\$14,429	30%	\$4,330	\$19,000	\$13,000	\$29,000	20	\$1,400	10%	\$140	\$1,540
4	Buffer Restoration	\$12,166.62	acre	0.75	\$9,105	30%	\$2,730	\$12,000	\$8,000	\$18,000	20	\$880	10%	\$90	\$970
Add-on	Permeable Pavement - front parking rows	\$3.07	sf	5,800	\$17,806	30%	\$5,340	\$24,000	\$17,000	\$36,000	20	\$1,770	10%	\$180	\$1,950
<b>Total</b>							<b>\$341,000</b>	<b>\$238,000</b>	<b>\$513,000</b>						

Pomperaug River Watershed Based Plan  
 Planning-Level Costs for Site-Specific BMP Concepts

Order of Magnitude Cost Range															
Location and Element		Construction				Planning and Design		Cost Range			Life Cycle				
		Unit Cost	Unit	Quantity	Cost (2018\$)	Allowance	Cost	Total Cost	-30%	50%	Lifespan (yrs)	Annual Cost over Lifespan	O&M (% Cost)	O&M (\$/yr)	Total Capitalized Cost/yr over lifespan
<b>Dog Park 1</b>															
1	Infiltration Basin	\$18.72	cf runoff treated	1,100	\$20,592	30%	\$6,180	\$27,000	\$19,000	\$41,000	20	\$1,990	10%	\$200	\$2,190
2	Buffer Restoration	\$12,166.62	acre	0.25	\$3,017	30%	\$900	\$4,000	\$3,000	\$6,000	20	\$290	10%	\$30	\$320
<b>Total</b>								<b>\$31,000</b>	<b>\$22,000</b>	<b>\$47,000</b>					
<b>Town Park 2</b>															
1	Buffer Restoration	\$12,166.62	acre	3.70	\$45,016	30%	\$13,500	\$59,000	\$41,000	\$89,000	20	\$4,340	10%	\$430	\$4,770
<b>Total</b>								<b>\$59,000</b>	<b>\$41,000</b>	<b>\$89,000</b>					
<b>Livestock 1</b>															
1	Buffer Restoration, grazing area	\$12,166.62	acre	0.11	\$1,397	30%	\$420	\$2,000	\$1,000	\$3,000	20	\$150	10%	\$20	\$170
2	Buffer Restoration, pasture	\$12,166.62	acre	0.51	\$6,145	30%	\$1,840	\$8,000	\$6,000	\$12,000	20	\$590	10%	\$60	\$650
3	Shade Structure	\$1.60	sf	300	\$480	30%	\$140	\$1,000	\$1,000	\$2,000	15	\$90	10%	\$10	\$100
<b>Total</b>								<b>\$11,000</b>	<b>\$8,000</b>	<b>\$17,000</b>					
<b>Livestock 3</b>															
1	Buffer Restoration, feeding area	\$12,166.62	acre	0.37	\$4,469	30%	\$1,340	\$6,000	\$4,000	\$9,000	20	\$440	10%	\$40	\$480
2	Buffer Restoration, hay and grazing	\$12,166.62	acre	1.91	\$23,182	30%	\$6,950	\$31,000	\$22,000	\$47,000	20	\$2,280	10%	\$230	\$2,510
Add-on	Filter Berm	\$13.86	ft	375	\$5,198	30%	\$1,560	\$7,000	\$5,000	\$11,000	15	\$630	10%	\$60	\$690
<b>Total</b>								<b>\$44,000</b>	<b>\$31,000</b>	<b>\$67,000</b>					
<b>Cropland/Livestock 1</b>															
1	Buffer Restoration	\$12,166.62	acre	0.69	\$8,379	30%	\$2,510	\$11,000	\$8,000	\$17,000	20	\$810	10%	\$80	\$890
2	Exclusion Fencing	\$15.00	linear foot	1,250.00	\$18,750	30%	\$5,630	\$25,000	\$18,000	\$38,000	20	\$1,840	10%	\$180	\$2,020
<b>Total</b>								<b>\$36,000</b>	<b>\$26,000</b>	<b>\$55,000</b>					
<b>Cropland/Livestock 2</b>															
1	Buffer Restoration 1	\$12,166.62	acre	2.66	\$32,400	30%	\$9,720	\$43,000	\$30,000	\$65,000	20	\$3,160	10%	\$320	\$3,480
2	Buffer Restoration 2	\$12,166.62	acre	0.19	\$2,346	30%	\$700	\$4,000	\$3,000	\$6,000	20	\$290	10%	\$30	\$320
3	Filter Berm	\$13.86	ft	325	\$4,505	30%	\$1,350	\$6,000	\$4,000	\$9,000	15	\$540	10%	\$50	\$590
<b>Total</b>								<b>\$53,000</b>	<b>\$37,000</b>	<b>\$80,000</b>					
<b>Equestrian 1</b>															
1	Buffer Restoration	\$12,166.62	acre	0.75	\$9,125	30%	\$2,740	\$12,000	\$8,000	\$18,000	15	\$1,080	10%	\$110	\$1,190
2	Exclusion Fencing	\$20.00	foot	1,300.00	\$26,000	30%	\$7,800	\$34,000	\$24,000	\$51,000	15	\$3,060	10%	\$310	\$3,370
<b>Total</b>								<b>\$46,000</b>	<b>\$32,000</b>	<b>\$69,000</b>					
<b>Equestrian 2</b>															
1	Buffer Restoration, Equestrian	\$12,166.62	sf	0.20	\$2,430	30%	\$730	\$4,000	\$3,000	\$6,000	15	\$360	10%	\$40	\$400
Add-on	Bank Stabilization	\$57.70	linear foot	850.00	\$49,045	30%	\$14,710	\$64,000	\$45,000	\$96,000	20	\$4,710	10%	\$470	\$5,180
<b>Total</b>								<b>\$68,000</b>	<b>\$48,000</b>	<b>\$102,000</b>					
<b>Equestrian 7</b>															
1	Buffer Restoration	\$12,166.62	acre	0.73	\$8,938	30%	\$2,680	\$12,000	\$8,000	\$18,000	15	\$1,080	10%	\$110	\$1,190
2	Exclusion Fencing	\$20.00	foot	900.00	\$18,000	30%	\$5,400	\$24,000	\$17,000	\$36,000	15	\$2,160	10%	\$220	\$2,380
<b>Total</b>								<b>\$36,000</b>	<b>\$25,000</b>	<b>\$54,000</b>					
<b>All Projects:</b>								<b>\$2,331,000</b>							

Notes:

Rate of Inflation used = 2%  
 Interest (discount) rate used = 6%

\*Projects are proposed for these locations already. Costs estimated in this table are for adding ecological and water quality elements to the assumed original purpose of the proposed projects. Costs should be used for planning purposes only based on screening-level evaluations of site characteristics. Construction costs could vary significantly.

**Unit Costs**

Element	2018 Adjusted Cost	Unit	Cost	\$YEAR	Source
<b>Low Impact Development/Green Infrastructure Practices</b>					
Curbside Bioswale	\$ 15,000.00	ea			Recent bids for New Haven West River Bioswales, Fuss & O'Neill.
Large Bioretention Retrofit	\$ 13.10	cf runoff treated	\$ 10.50	2006	Center for Watershed Protection Urban Subwatershed Retrofit Manual 3 (2007), cost adjusted, Page E-3
Small Bioretention Retrofit (<0.5 acre)	\$ 35.62	sf	\$ 32.50	2012	District of Columbia Water and Sewer Authority, George S. Hawkins, General Manager, Green Infrastructure Summit 2012, February 29, 2012.
Rain Garden	\$ 7.98	sf	\$ 7.28	2012	Woodard & Curran - Route 1 Falmouth Commercial District Stormwater Management, 2012
Water Quality Swale	\$ 10.96	sf	\$ 10.00	2012	District of Columbia Water and Sewer Authority, George S. Hawkins, General Manager, Green Infrastructure Summit 2012, February 29, 2012.
Porous Asphalt	\$ 3.07	sf	\$ 2.80	2012	UNH Stormwater Center 2012 Biennial Report. Page 12
Permeable Pavers	\$ 10.96	sf	\$ 10.00	2012	Center for Watershed Protection Urban Subwatershed Retrofit Manual 3 (2007), cost adjusted, Page E-5
Reinforced Gravel Parking	\$ 5.07	sf	\$ 5.07	2013	<a href="http://www.boddingtonsonline.com/products/grass-ground-reinforcement/grass-reinforcement-protection/bodpave-85-permeable-gravel-pavers.php">http://www.boddingtonsonline.com/products/grass-ground-reinforcement/grass-reinforcement-protection/bodpave-85-permeable-gravel-pavers.php</a> ; Added \$2/sf for installation
Subsurface Infiltration	\$ 20.00	cf runoff treated	\$ 20.00	2018	Fuss & O'Neill, City of Pawtucket Grant Application, 2018.
Green Roof	\$ 25.21	sf	\$ 23.00	2012	District of Columbia Water and Sewer Authority, George S. Hawkins, General Manager, Green Infrastructure Summit 2012, February 29, 2012.
Blue Roof	\$ 5.48	sf	\$ 5.00	2012	NYC Department of Environmental Protection (2012), Rooftop Detention: A Low-Cost Alternative for Complying with New York City's Stormwater Detention Requirements and Reducing Urban Runoff.
Subsurface Gravel Wetland	\$ 23.93	cf runoff treated	\$ 21.83	2012	Woodard & Curran - Route 1 Falmouth Commercial District Stormwater Management, 2012
Pond Retrofit	\$ 13,852.80	impervious acre of runoff treated	\$ 11,100.00	2006	Center for Watershed Protection Urban Subwatershed Retrofit Manual 3 (2007), cost adjusted, page E-2
French Drain/Infiltration Trench	\$ 19.97	lf	\$ 16.00	2006	Center for Watershed Protection Urban Subwatershed Retrofit Manual 3 (2007), cost adjusted, page E-11
Tree Box	\$ 6,576.00	ea	\$ 6,000.00	2012	UNH Stormwater Center 2012 Biennial Report, adjusted based on professional judgement, inflation, and materials cost.
Infiltration Basin	\$ 18.72	cf runoff treated	\$ 15.00	2006	Center for Watershed Protection Urban Subwatershed Retrofit Manual 3 (2007), cost adjusted
Constructed Wetland	\$ 5.08	sf	\$ 4.07	2006	Center for Watershed Protection Urban Subwatershed Retrofit Manual 3 (2007), cost adjusted, page E-11
<b>Restoration Practices</b>					
Vegetated Buffer Restoration	\$ 12,166.62	ac	\$ 10,543	2010	Oregon Department of Environmental Quality, 2010, Cost Estimate to Restore Riparian Forest Buffers and Improve Stream Habitat in the Willamette Basin, Oregon. Page 20
Stream Channel Restoration	\$ 14,232.28	ac	\$ 12,333	2010	Oregon Department of Environmental Quality, 2010, Cost Estimate to Restore Riparian Forest Buffers and Improve Stream Habitat in the Willamette Basin, Oregon. Page 20
Remove Invasive Species	\$ 3,692.80	acre	\$ 3,200	2010	Professional Engineering Experience
Tree Planting	\$ 500.00	ea			Street tree cost
Bank stabilization	\$ 57.70	river mile	\$ 50.00	2010	Professional Engineering Experience
Educational Signage	\$ 1,200	ea	\$ 1,200	2013	Professional Engineering Experience
<b>Agricultural Practices</b>					
Filter Berm	\$ 13.86	linear foot	\$ 12.65	2013	Warner et al. (2013) Designing Contour Weep Berms to Reduce Agricultural Nonpoint Source Pollution. Applied Engineering in Agriculture 29: 521-528. \$41.50 per linear meter. Converted to linear feet.

**Inflation Rates**

Inflation from	Inflation to	Percent
2004	2018	33.40%
2006	2018	24.80%
2010	2018	15.40%
2011	2018	11.80%
2012	2018	9.6%
2013	2018	8.0%

<http://www.usinflationcalculator.com/>