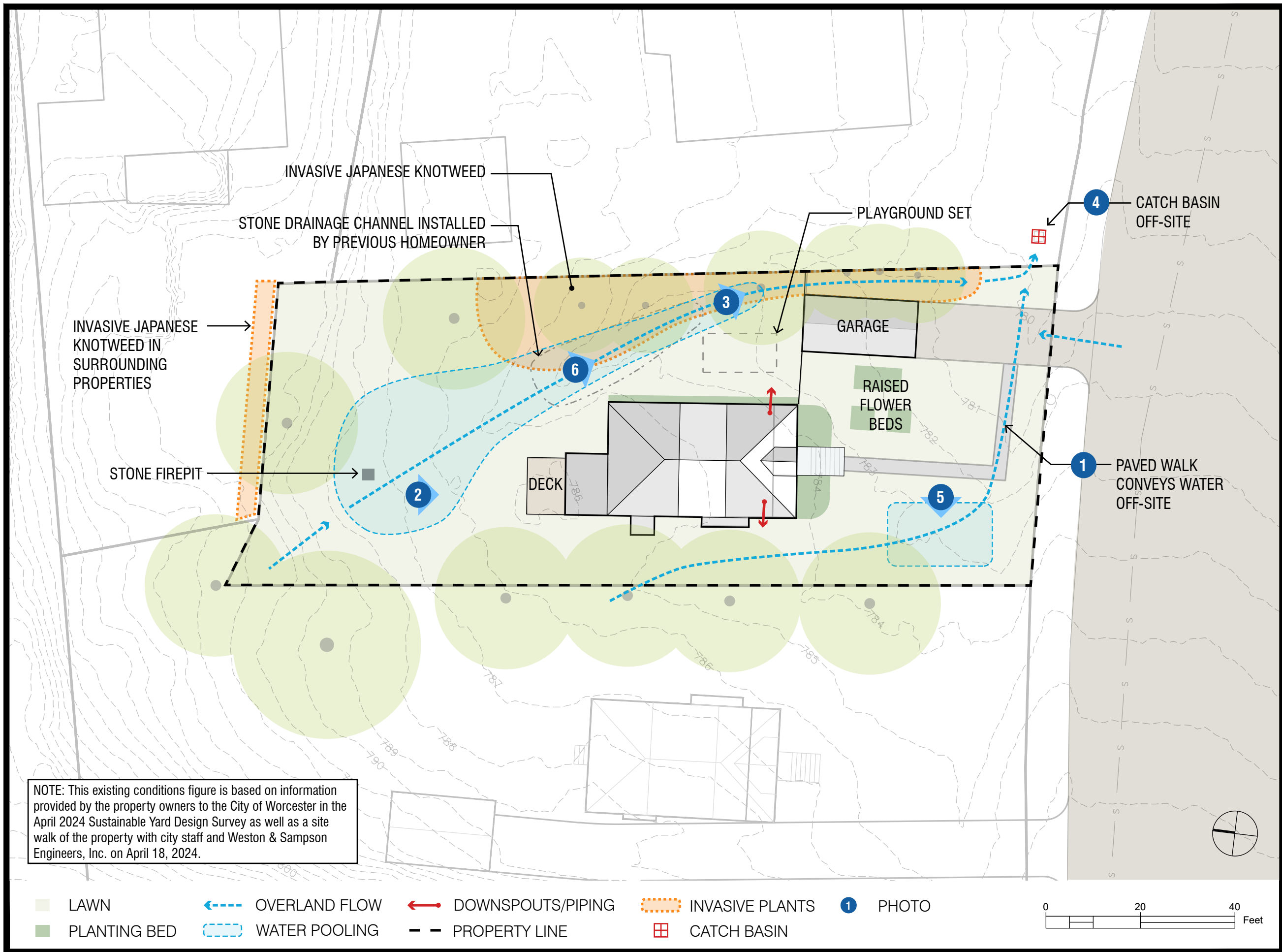


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Project:  
SUSTAINABLE YARD DESIGN  
CASE STUDY 3  
WORCESTER, MA



Weston & Sampson Engineers, Inc.  
55 Walkers Brook Drive, Suite 100  
Reading, MA 01867  
978.532.1900 800.SAMPSON

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Date: 05/09/24  
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Reviewed By: AS  
Approved By: JM

W&S Project No.: ENG22 - 1048  
W&S File No.:

Drawing Title:  
EXISTING CONDITIONS  
PLAN

Sheet Number:  
C101





1 PAVED WALK CONVEYS WATER OFF-SITE



2 SIGNIFICANT WATER IN BACK YARD



3 WATER RUNS ALONG NORTH EDGE OF PROPERTY TOWARDS CATCH BASIN BEYOND



4 CATCH BASIN OUTSIDE OF PROPERTY



5 WATER POOLING IN FRONT OF HOUSE



6 STONE DRAINAGE CHANNEL INSTALLED BY PREVIOUS HOMEOWNER AND INVASIVE JAPANESE KNOTWEED THROUGHOUT BACK YARD

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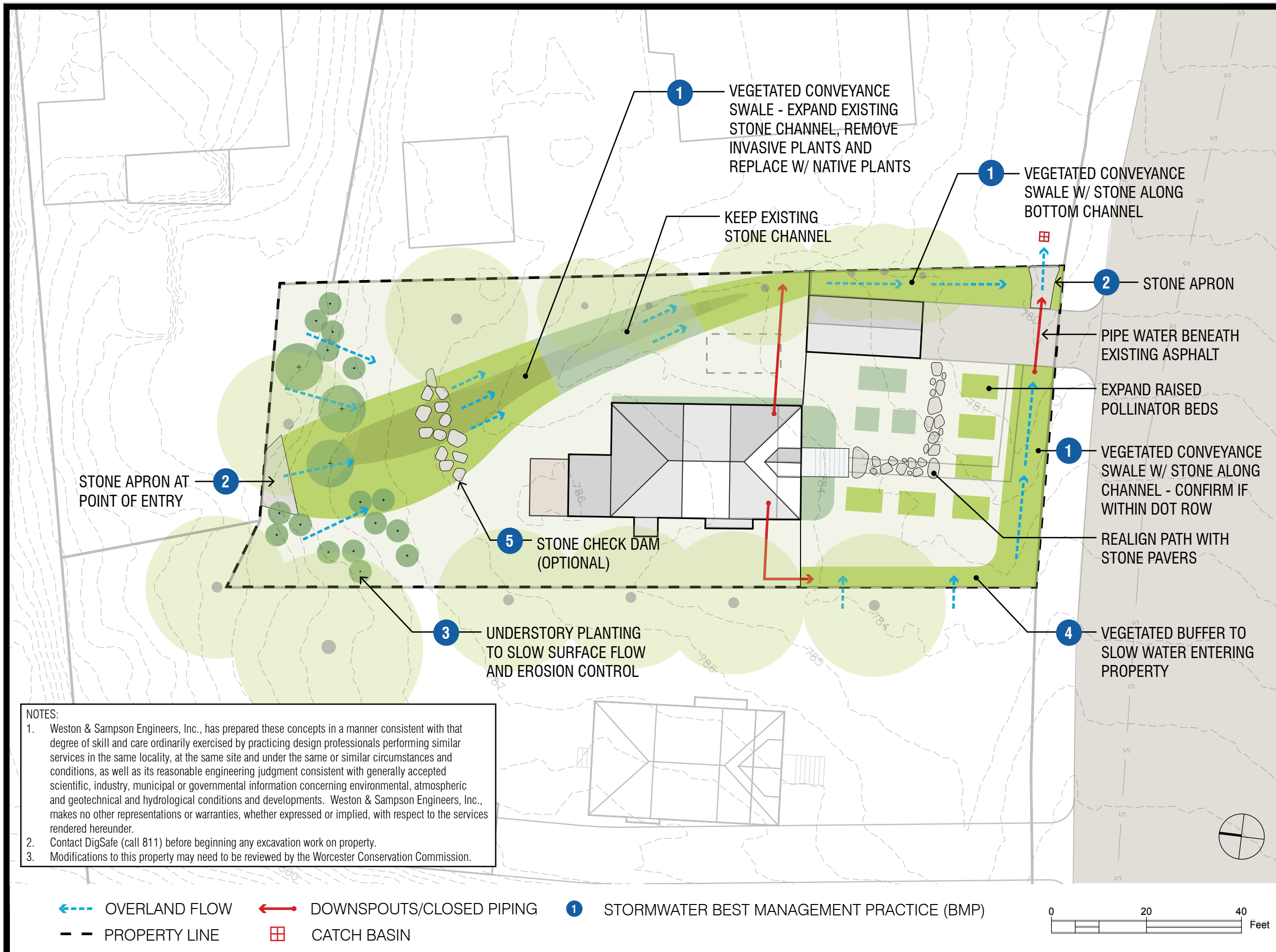
W&S Project No.: ENG22 - 1048  
W&S File No.:

Drawing Title:

## SITE PLAN

Sheet Number:

C201





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STORMWATER BEST MANAGEMENT PRACTICE (BMP)



Photo Credit: Massachusetts Office of Coastal Zone Management (CZM)

1 VEGETATED CONVEYANCE SWALE



Photo Credit: Alliance for the Bay, MD

2 STONE APRON

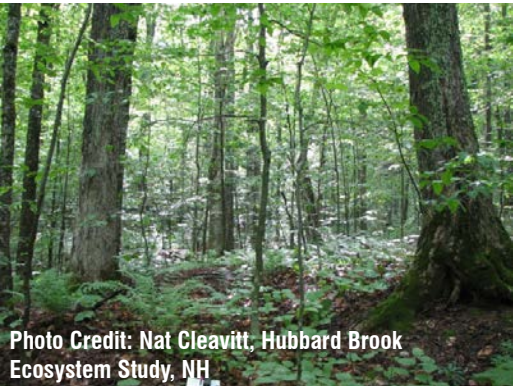


Photo Credit: Nat Cleavitt, Hubbard Brook Ecosystem Study, NH

3 UNDERSTORY PLANTING FOR EROSION CONTROL



Photo Credit: Massachusetts Office of Coastal Zone Management (CZM)

4 VEGETATED BUFFER



Photo Credit: After Wild Fire, NM

5 STONE CHECK DAM

JAPANESE KNOTWEED RESOURCES

- [PennState Extension](https://extension.psu.edu/japanese-knotweed) (https://extension.psu.edu/japanese-knotweed)
- [Ontario Invasive Plant Council](https://www.ontarioinvasiveplants.ca/wp-content/uploads/2016/06/OIPC_BMP_JapaneseKnotweed.pdf) (https://www.ontarioinvasiveplants.ca/wp-content/uploads/2016/06/OIPC\_BMP\_JapaneseKnotweed.pdf)

NATURE-BASED SOLUTIONS RESOURCES

- [Easthampton Homeowner's Guide to Do-It-Yourself Stormwater Management Solutions that Improve Community Resilience](http://easthamptonma.gov/DocumentCenter/View/3891/Residential-Guide-to-Stormwater-Management---English?bidId=) (easthamptonma.gov/DocumentCenter/View/3891/Residential-Guide-to-Stormwater-Management---English?bidId=)
- [National Fish and Wildlife](http://www.stormwaterguide.org/static/HomeownersGuide.pdf) (www.stormwaterguide.org/static/HomeownersGuide.pdf)

CONSIDERATIONS FOR PLANTING

Refer to the UMASS Extension Landscape, Nursery and Urban Forestry Program "[Plant Selection for Managed Landscapes: Right plant, right place](#)" guidelines below when selecting landscape plants.

Some site conditions to keep in mind when selecting landscape plants include:

- light availability, intensity and duration (full sun to deep shade)
- water availability, both quantity and quality
- exposure to wind and temperature extremes
- soil type, drainage, compaction
- hardiness zone
- competition from existing vegetation
- below ground conditions in urban sites
- above ground wires or obstructions

Aesthetic considerations for plant selection include:

- growth habit, i.e. pyramidal, columnar, spreading, etc.
- season and color of bloom
- foliage color, texture, and shape
- winter interest of bark, fruit, or structure
- benefits to wildlife
- fall color
- longevity

PLANT SELECTION BY FUNCTION

- [Pollinator Garden](http://massnrc.org/ppd/) (massnrc.org/ppd/)
- [Rain Garden](http://mass.gov/info-details/stormwater-solutions-for-homeowners) (mass.gov/info-details/stormwater-solutions-for-homeowners)
- [Understory Planting for Erosion Control](http://mass.gov/info-details/stormwater-solutions-for-homeowners) (mass.gov/info-details/stormwater-solutions-for-homeowners)
- [Vegetated Buffer](http://mass.gov/info-details/stormwater-solutions-for-homeowners) (mass.gov/info-details/stormwater-solutions-for-homeowners)
- [Vegetated Swale](http://mass.gov/info-details/stormwater-solutions-for-homeowners) (mass.gov/info-details/stormwater-solutions-for-homeowners)

WHERE TO PURCHASE NATIVE PLANTS

- [Grow Native Massachusetts](http://grownativemass.org/Great-Resources/nurseries-seed) (grownativemass.org/Great-Resources/nurseries-seed)
- [Native Plant Trust](http://nativeplanttrust.org) (nativeplanttrust.org)
- [Native Plant Initiative](http://apcc.org/our-work/education/native-plant-initiative/) (apcc.org/our-work/education/native-plant-initiative/)
- [Blue Stem Natives](http://bluestemnatives.com) (bluestemnatives.com)
- [New England Wetland Plants](http://newp.com) (newp.com)
- [Tree Talk Natives](http://treetalknatives.com) (treetalknatives.com)
- [American Beauties Native Plants](http://abnativeplants.com) (abnativeplants.com)
- Lady Bird Johnson Wildflower Center (wildflower.org)
- [National Nursery and Seed Directory](http://nnp.rngr.net/resources/directory) (nnp.rngr.net/resources/directory)
- [Arbor Day Foundation](http://arborday.org) (arborday.org)

SAMPLE PLANT LIST

VEGETATED CONVEYANCE SWALE

- Grasses & Perennials
- Blue Flag Iris (Iris versicolor)
  - Canada Bluejoint (Calamagrostis canadensis)
  - Cardinal Flower (Lobelia cardinalis)
  - Marsh Marigold (Caltha palustris)
  - Swamp Milkweed (Asclepias incarnata)
  - Sweet Joe-Pye Weed (Eutrochium purpureum)
  - Tussock Sedge (Carex stricta)
  - Little Bluestem (Schizachyrium scoparium)
  - New England Aster (Aster novae-angliae)
  - Pennsylvania Sedge (Carex pensylvanica)
- Shrubs & Trees
- Sweet Gale (Myrica gale)
  - Highbush Blueberry (Vaccinium corymbosum)
  - American Witch Hazel (Hamamelis virginiana)

UNDERSTORY PLANTING

- Grasses & Perennials
- Pennsylvania Sedge (Carex pensylvanica)
  - Red Columbine (Aquilegia Canadensis)
  - Little Bluestem (Schizachyrium scoparium)
  - White Turtlehead (Chelone glabra)
  - Foamflower (Tiarella cordifolia)
- Shrubs & Trees
- American Witch Hazel (Hamamelis virginiana)
  - Mountain Laurel (Kalmia latifolia)
  - Highbush blueberry (Vaccinium corymbosum)
  - Serviceberry (Amelanchier spp.)

POLLINATOR GARDEN

- Perennials
- Star Flower (Amsonia tabernaemontana)
  - Marsh Marigold (Caltha palustris)
  - Red Columbine (Aquilegia canadensis)
  - Blue Iris (Iris versicolor)
  - Joe-Pye Weed (Eupatorium maculatum)
  - Swamp Milkweed (Asclepias incarnata)
  - Coneflower (Echinacea purpurea)
  - Foxglove (Penstemon digitalis)
  - Smooth Aster (Aster laevis)
  - Bolton's Aster (Boltonia asteroides)
  - False Sunflower (Heliopsis helianthoides)

NOTE: Plant suitability is not limited to the sample plant list. A professional horticulturalist, landscape designer, or landscape architect can help in exploring additional species suitable for your site.

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W&S Project No.: ENG22 - 1048  
W&S File No.:

Drawing Title:

SITE PLAN

Sheet Number:

C202



Prepared by Weston & Sampson, May 2024

Item Description	Quantity	Unit	Unit Price	Total Price	Notes	Reference Link
Downspout Extensions						
Aluminum Downspout	5	10 FT	\$16.50	\$82.50	Downspout piping typically sold in 10-ft segments. ~\$16.50 for 2"x3"x10' segment, per Home Depot. Larger size (3"x4"x10') is ~\$18.	<a href="https://www.homedepot.com/p/Amerimax-Home-Products-2-in-x-3-in-x-10-ft-White-Aluminum-Downspout-2601000120/100016183">https://www.homedepot.com/p/Amerimax-Home-Products-2-in-x-3-in-x-10-ft-White-Aluminum-Downspout-2601000120/100016183</a>
Aluminum Downspout B-Elbow	1	EA	\$4.25	\$4.25	B-Elbows allow for horizontal turns on the ground. 2"x3" ~\$4.25, 3"x4" ~\$5.25, per Home Depot.	<a href="https://www.homedepot.com/p/Amerimax-Home-Products-2-in-x-3-in-White-Aluminum-Downspout-B-Elbow-27065/100011647">https://www.homedepot.com/p/Amerimax-Home-Products-2-in-x-3-in-White-Aluminum-Downspout-B-Elbow-27065/100011647</a>
River Stone Apron at Downspout Outlet	2.5	CF	\$10.00	\$25.00	Assume 10 sf x 3" deep per apron. 1 apron needed at west side (downspout extension on east side will discharge into the stone-lined swale). Per home depot, one 0.5-cf bag costs ~\$5.	<a href="https://www.homedepot.com/p/Vigoro-0-5-cu-ft-Bagged-River-Pebble-Landscape-Rock-54250V/100558618">https://www.homedepot.com/p/Vigoro-0-5-cu-ft-Bagged-River-Pebble-Landscape-Rock-54250V/100558618</a>
Contingency	20%	Subtotal		\$111.75		
				\$22.35		
		Total		\$134.10		
Conveyance Swale Segment 1 - North (Backyard)						
Stone Check Dam	2	CY	\$100.00	\$200.00	Assume 22' x 1' x 2' check dam. Larger stones needed for check dam.	<a href="https://www.aawillmaterials.com/store/3%E2%80%9D-8%E2%80%9D-Riverbed-Tan-p362094617">https://www.aawillmaterials.com/store/3%E2%80%9D-8%E2%80%9D-Riverbed-Tan-p362094617</a>
Stone Apron	20	CF	\$10.00	\$200.00	~80 sf apron at point of entry. Assume 3" depth. Assume same river stone as the aprons for downspout outlets (\$5 per 0.5-cf bag)	
Stone Channel	90	CF	\$10.00	\$900.00	Assume 6 ft wide, 3" deep channel along bottom of segment 1 (~60 ft long). Assume same river stone as the stone aprons.	
Mulch - 3"	294	CF	\$2.00	\$588.00	3" depth over ~1175 sf conveyance swale segment.	<a href="https://www.homedepot.com/p/Vigoro-2-cu-ft-Bagged-Premium-Black-Wood-Mulch-52050197/205606445">https://www.homedepot.com/p/Vigoro-2-cu-ft-Bagged-Premium-Black-Wood-Mulch-52050197/205606445</a>
Bioretention Soil Mix - 18"	66	CY	\$30.00	\$1,980.00	18" depth over ~1175 sf conveyance swale segment.	Other projects
Coarse Sand - 1"	4	CY	\$55.00	\$220.00	1" depth over ~1175 sf conveyance swale segment.	Other projects
Pea Gravel - 3"	11	CY	\$86.00	\$946.00	3" depth over ~1175 sf conveyance swale segment.	Other projects
3/4" Crushed Stone - 8"	29	CY	\$50.00	\$1,450.00	8" depth over ~1175 sf conveyance swale segment.	<a href="https://www.aawillmaterials.com/store/3-4-Crushed-Stone-p281934456">https://www.aawillmaterials.com/store/3-4-Crushed-Stone-p281934456</a>
Geotextile Fabric	1475	SF	\$0.10	\$147.50	~1175 sf total area of conveyance swales, plus assume an additional 5 ft along the 60-ft length of swale segment to line the sides. Assume \$0.10 per sf based on multiple Home Depot options.	
Erosion Control/Restoration Mix for Moist Sites	3	LBS	\$39.00	\$117.00	1250 sf per lb, minimum order 3 lbs. ~1175 sf total.	<a href="https://newp.com/product/new-england-erosion-control-restoration-mix-for-detention-basins-and-moist-sites/">https://newp.com/product/new-england-erosion-control-restoration-mix-for-detention-basins-and-moist-sites/</a>
Contingency	20%	Subtotal		\$6,748.50		
				\$1,349.70		
		Total		\$8,098.20		
Conveyance Swale Segment 2 - East (Side Yard)						
Stone Channel	80	CF	\$10.00	\$800.00	Assume 4 ft wide, 3" deep channel on average along bottom of segment 2 (~80 ft long). Assume same river stone as the stone aprons.	
Mulch - 3"	142	CF	\$2.00	\$284.00	3" depth over ~565 sf conveyance swale segment.	<a href="https://www.homedepot.com/p/Vigoro-2-cu-ft-Bagged-Premium-Black-Wood-Mulch-52050197/205606445">https://www.homedepot.com/p/Vigoro-2-cu-ft-Bagged-Premium-Black-Wood-Mulch-52050197/205606445</a>
Bioretention Soil Mix - 18"	32	CY	\$30.00	\$960.00	18" depth over ~565 sf conveyance swale segment.	Other projects
Coarse Sand - 1"	2	CY	\$55.00	\$110.00	1" depth over ~565 sf conveyance swale segment.	Other projects
Pea Gravel - 3"	6	CY	\$86.00	\$516.00	3" depth over ~565 sf conveyance swale segment.	Other projects
3/4" Crushed Stone - 8"	14	CY	\$50.00	\$700.00	8" depth over ~565 sf conveyance swale segment.	<a href="https://www.aawillmaterials.com/store/3-4-Crushed-Stone-p281934456">https://www.aawillmaterials.com/store/3-4-Crushed-Stone-p281934456</a>
Geotextile Fabric	965	SF	\$0.10	\$96.50	~565 sf total area of conveyance swales, plus assume an additional 5 ft along the 80-ft length of swale segment to line the sides. Assume \$0.10 per sf based on multiple Home Depot options.	
Erosion Control/Restoration Mix for Moist Sites	3	LBS	\$39.00	\$117.00	1250 sf per lb, minimum order 3 lbs. ~565 sf total.	<a href="https://newp.com/product/new-england-erosion-control-restoration-mix-for-detention-basins-and-moist-sites/">https://newp.com/product/new-england-erosion-control-restoration-mix-for-detention-basins-and-moist-sites/</a>
Contingency	20%	Subtotal		\$3,583.50		
				\$716.70		
		Total		\$4,300.20		





Prepared by Weston & Sampson, May 2024

Item Description	Quantity	Unit	Unit Price	Total Price	Notes	Reference Link
Conveyance Swale Segment 3 - South (Front Yard) & Vegetated Buffer						
PVC Pipe	2	10-FT STICK	\$8.50	\$17.00	~15 ft of piping needed to route water underneath driveway. Assume 1" PVC, sold in 10-ft segments.	<a href="https://www.homedepot.com/p/Charlotte-Pipe-1-in-x-10-ft-PVC-Schedule-40-Tubing-DWV-Pipe-PVC040100600RS/100348473">https://www.homedepot.com/p/Charlotte-Pipe-1-in-x-10-ft-PVC-Schedule-40-Tubing-DWV-Pipe-PVC040100600RS/100348473</a>
Pavement Replacement - QUIKRETE Permanent Blacktop Repair	4	EA	\$18.50	\$74.00	Assume 12' long x 1' wide patch, 2" thick. QUIKRETE sold in 50 lb bags. Quantity determined from product guidelines for area and thickness.	<a href="https://www.homedepot.com/p/Quikrete-50-lb-Commercial-Grade-Blacktop-Repair-Patch-170152/100545936">https://www.homedepot.com/p/Quikrete-50-lb-Commercial-Grade-Blacktop-Repair-Patch-170152/100545936</a>
Stone Apron	12	CF	\$10.00	\$120.00	~45 sf apron at outlet of piping underneath driveway. Assume 3" depth. Assume same river stone as the aprons for downspout outlets (\$5 per 0.5-cf bag)	
Stone Channel	40	CF	\$10.00	\$400.00	Assume 4 ft wide, 3" deep channel along bottom of segment 3 (~40 ft long). Assume same river stone as the stone aprons.	
Mulch - 3"	145	CF	\$2.00	\$290.00	3" depth over ~580 sf area (400 sf conveyance swale segment, 180 sf vegetated buffer).	<a href="https://www.homedepot.com/p/Vigoro-2-cu-ft-Bagged-Premium-Black-Wood-Mulch-52050197/205606445">https://www.homedepot.com/p/Vigoro-2-cu-ft-Bagged-Premium-Black-Wood-Mulch-52050197/205606445</a>
Bioretention Soil Mix - 18"	33	CY	\$30.00	\$990.00	18" depth over ~580 sf area (400 sf conveyance swale segment, 180 sf vegetated buffer).	Other projects
Coarse Sand - 1"	2	CY	\$55.00	\$110.00	1" depth over ~580 sf area (400 sf conveyance swale segment, 180 sf vegetated buffer).	Other projects
Pea Gravel - 3"	4	CY	\$86.00	\$344.00	3" depth over ~400 sf conveyance swale segment.	Other projects
3/4" Crushed Stone - 8"	10	CY	\$50.00	\$500.00	8" depth over ~400 sf conveyance swale segment.	<a href="https://www.aawillmaterials.com/store/3-4-Crushed-Stone-p281934456">https://www.aawillmaterials.com/store/3-4-Crushed-Stone-p281934456</a>
Geotextile Fabric	600	SF	\$0.10	\$60.00	~400 sf total area of conveyance swale segment, plus assume an additional 5 ft along the 40-ft length of swale segment to line the sides. Assume \$0.10 per sf based on multiple Home Depot options.	
Erosion Control/Restoration Mix for Moist Sites	3	LBS	\$39.00	\$117.00	1250 sf per lb, minimum order 3 lbs. ~580 sf total.	<a href="https://newp.com/product/new-england-erosion-control-restoration-mix-for-detention-basins-and-moist-sites/">https://newp.com/product/new-england-erosion-control-restoration-mix-for-detention-basins-and-moist-sites/</a>
Contingency	20%	Subtotal		\$3,022.00		
				\$604.40		
		Total		\$3,626.40		
Understory Plantings						
Tree Plantings	3	EA	\$350.00	\$1,050.00	Assume 2-2.5" caliper.	
Shrub Plantings	16	EA	\$12.00	\$192.00	1 gal buckets ~\$12 per NEWP, other plant size options available, see links to right	NEWP: <a href="https://newp.com/catalog/shrubs/">https://newp.com/catalog/shrubs/</a> NPT: <a href="https://newfs-society.s3.amazonaws.com/documents/2024-05-02_NPT_2024_Plants_Price_Availability_List.pdf">https://newfs-society.s3.amazonaws.com/documents/2024-05-02_NPT_2024_Plants_Price_Availability_List.pdf</a>
Contingency	20%	Subtotal		\$1,242.00		
				\$248.40		
		Total		\$1,490.40		
Front Walkway & Raised Pollinator Beds						
Stone Pavers	1	LS	\$1,400.00	\$1,400.00	Assume one 120 sf pallet of stone pavers needed for walkway.	<a href="https://www.homedepot.com/p/Southwest-Boulder-Stone-16-in-x-12-in-x-2-in-120-sq-ft-Storm-Mountain-Natural-Flagstone-for-Landscape-Gardens-and-Pathways-02-0222/312664854">https://www.homedepot.com/p/Southwest-Boulder-Stone-16-in-x-12-in-x-2-in-120-sq-ft-Storm-Mountain-Natural-Flagstone-for-Landscape-Gardens-and-Pathways-02-0222/312664854</a>
Planting Soil	690	CF	\$5.00	\$3,450.00	Assume planting soil used in pollinator beds. Assume 36" depth of new soil. Pollinator beds ~230 sf.	<a href="https://www.homedepot.com/s/planting%20soil?NCNI-5">https://www.homedepot.com/s/planting%20soil?NCNI-5</a>
Mulch - 3"	58	CF	\$2.00	\$116.00	Assume 3" of mulch is applied in all pollinator beds.	<a href="https://www.homedepot.com/p/Vigoro-2-cu-ft-Bagged-Premium-Black-Wood-Mulch-52050197/205606445">https://www.homedepot.com/p/Vigoro-2-cu-ft-Bagged-Premium-Black-Wood-Mulch-52050197/205606445</a>
Erosion Control/Restoration Mix for Moist Sites	3	LBS	\$39.00	\$117.00	1250 sf per lb, minimum order 3 lbs. Pollinator beds ~230 sf total.	<a href="https://newp.com/product/new-england-erosion-control-restoration-mix-for-detention-basins-and-moist-sites/">https://newp.com/product/new-england-erosion-control-restoration-mix-for-detention-basins-and-moist-sites/</a>
Contingency	20%	Subtotal		\$5,083.00		
				\$1,016.60		
		Total		\$6,099.60		
TOTAL COST				\$23,748.90		

Notes:

1. Costs are for materials only and exclude labor costs (contractor).

2. Costs are presented in 2024 US dollars and include a 20% contingency.

3. Costs are based on pricing from Home Depot, New England Wetland Plants, Inc., Native Plant Trust, and reference pricing from other projects

4. Weston & Sampson Engineers, Inc. makes cost estimates using its best judgement as an experienced and qualified professional engineer generally familiar with the construction industry. Weston & Sampson Engineers, Inc. has no control over the cost of labor, materials, equipment or services furnished by others, or any methods of determining prices, or competitive bidding or market conditions when the project will be constructed. Weston & Sampson Engineers, Inc. cannot and does not guarantee that a contractor's bids or actual construction costs will not vary from cost estimates prepared. If property owner desires greater assurance as to probable construction cost, property owner should obtain a quote from a contractor.