



Bioengineering GROUP

Building Sustainable Communities
on an Ecological Foundation

Glacken Slope Restoration

Fresh Pond Reservation

Cambridge, MA

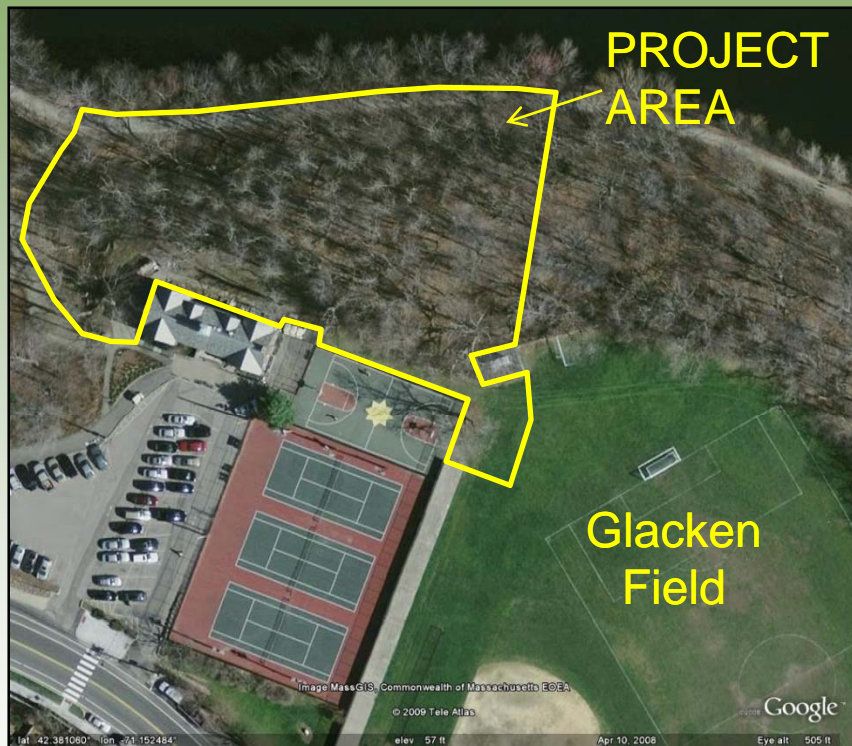
Presentation to the Fresh Pond Advisory Board

15 October 2009

Agenda

- Introductions (Chip Norton, Watershed Manager)
- Project History (timeline)
- Site Inventory and Analysis
- Recommendations
- Early Concepts and Design Development
- Phasing Strategies
- Next Steps

Project History



- Fall 2008 – BioGroup and CWD discuss pilot project for steep slope restoration below Golf Course Clubhouse - problems and conceptual solutions
- Winter 2008 – Inventory & Analysis Phase
- Spring 2009 – Schematic Design
- Summer/Fall 2009 – Construction Documents & Notice of Intent Submittal
- October 2009 – Conservation Commission voted to issue Order of Conditions for project
- 15 October 2009 – Fresh Pond Advisory Board presentation

Site Inventory - Soils

Soil Erosion

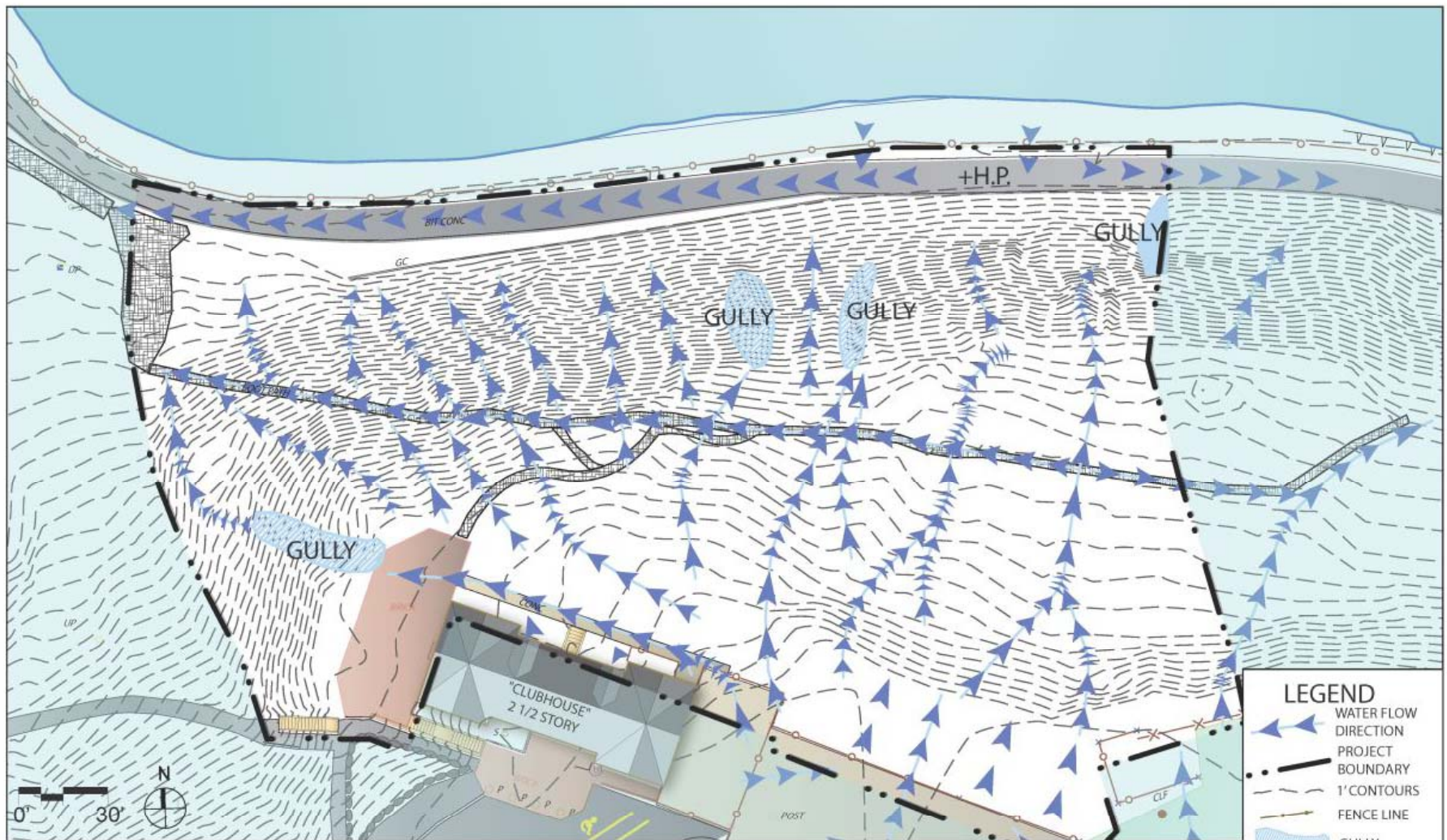
- Ongoing Erosion from steep, unprotected slopes
- Limited litter/duff layer
- Soil accumulates at toe of slope
- Dogs/humans on steep slopes exacerbating erosion
- Severe compaction and poor nutrient composition

Stormwater/Runoff

- Lack of control and infiltration of runoff at top of slope



Surface Hydrologic Analysis



SURFACE HYDROLOGIC ANALYSIS
FRESH POND SLOPE RESTORATION
 INVENTORY + ANALYSIS | JANUARY 2009



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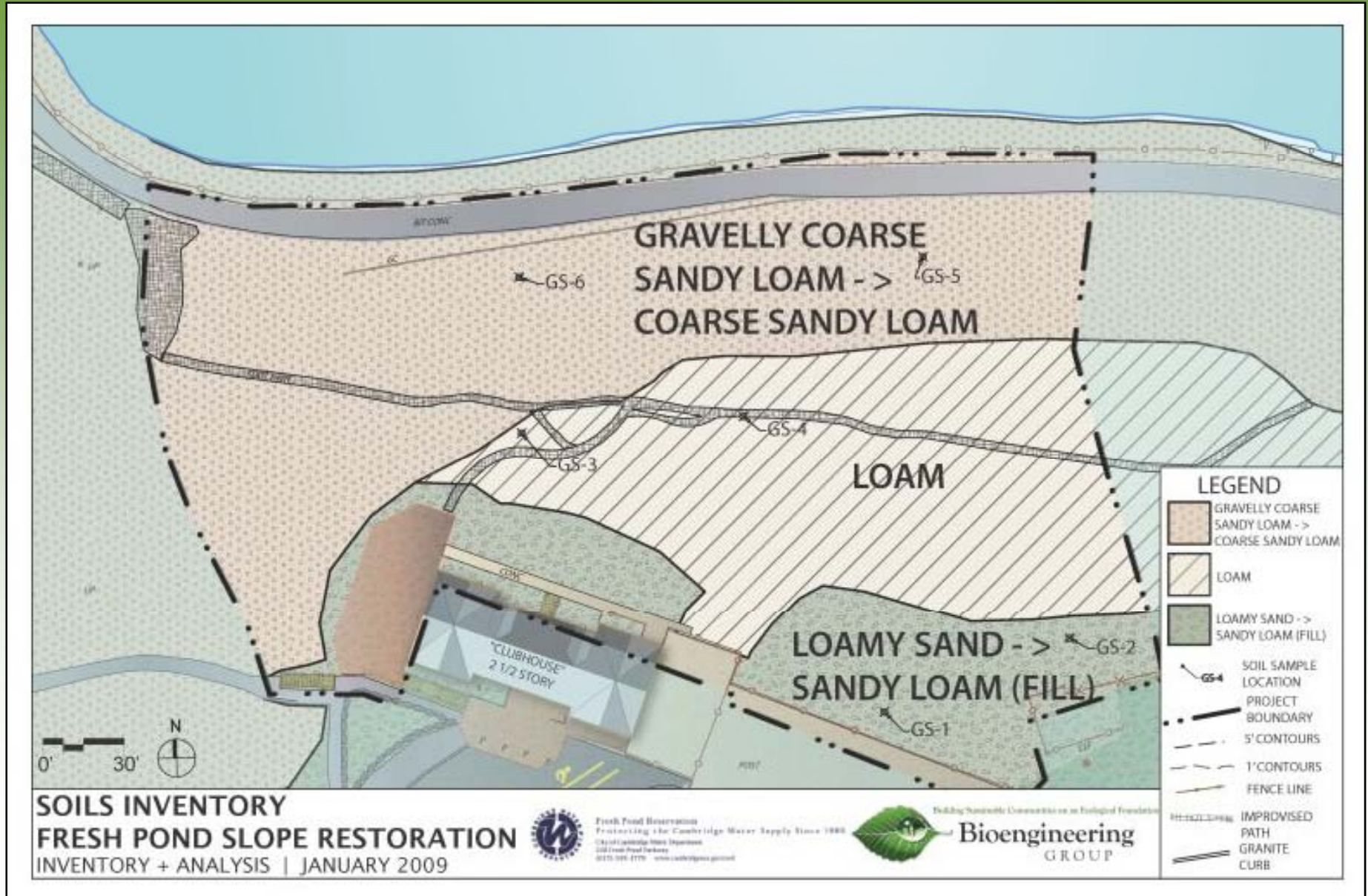


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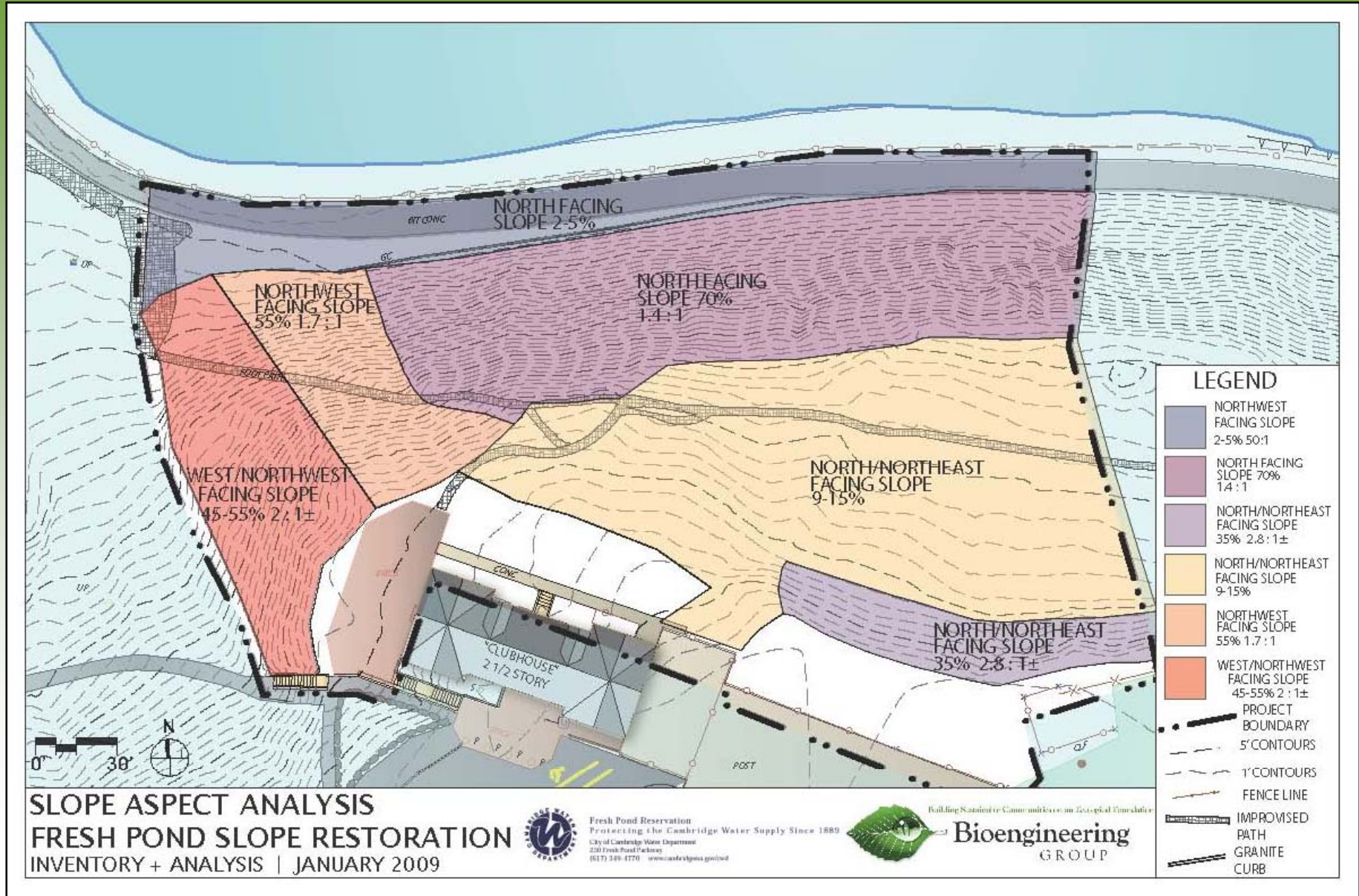
LEGEND

- WATER FLOW DIRECTION
- PROJECT BOUNDARY
- 1' CONTOURS
- FENCE LINE
- GULLY
- IMPROVISED PATH
- GRANITE CURB

Soils Distribution



Site Aspect and Grade

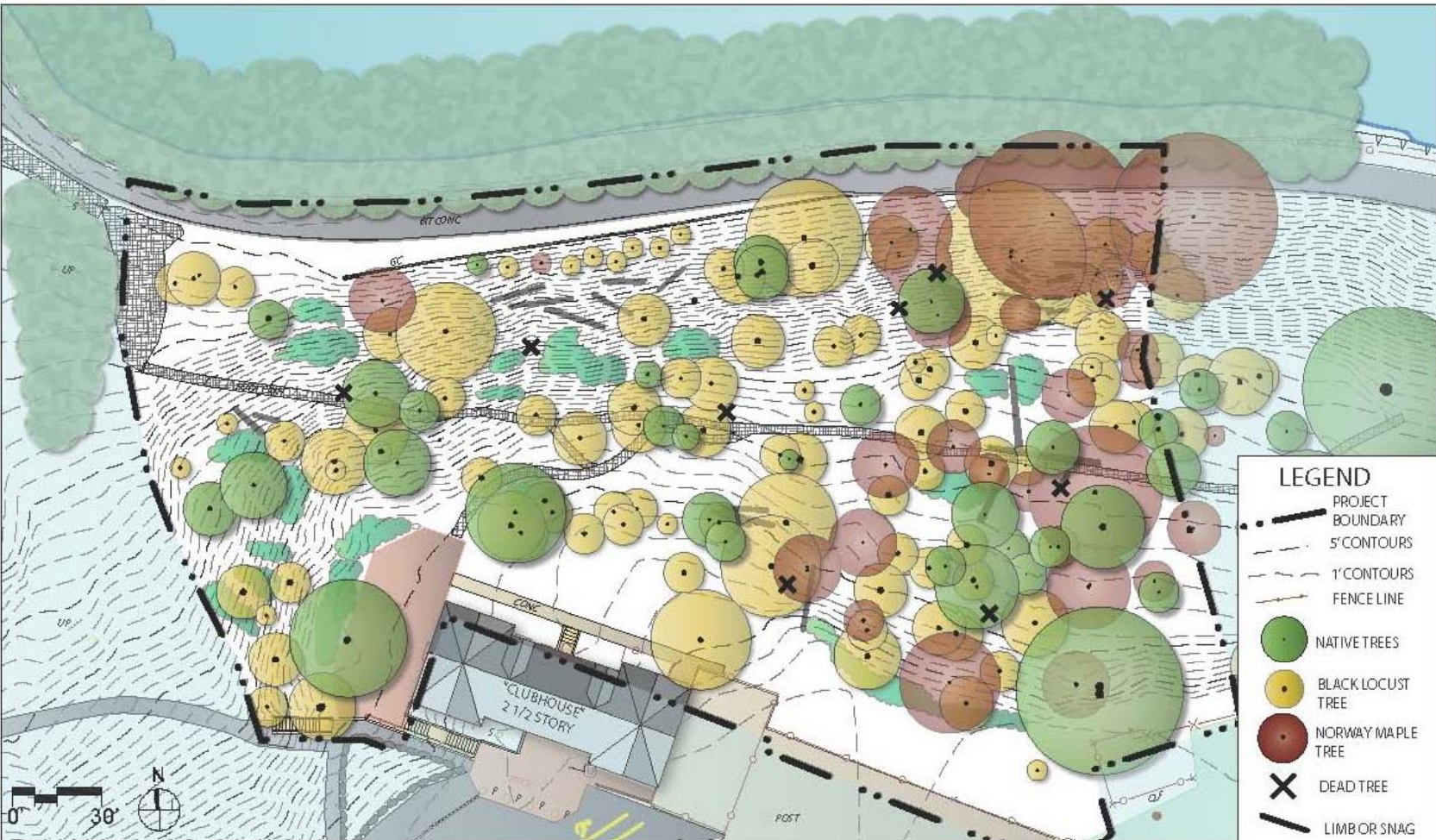


Site Inventory - Vegetation



- Lack of established understory vegetation
- Existing Tree Canopy = 80% non-native species
- Low ecologic diversity
- Invasive monoculture contributes minimal habitat value
- Limited long-term ecological viability

Existing Conditions: Tree Canopy



TREE CANOPY INVENTORY
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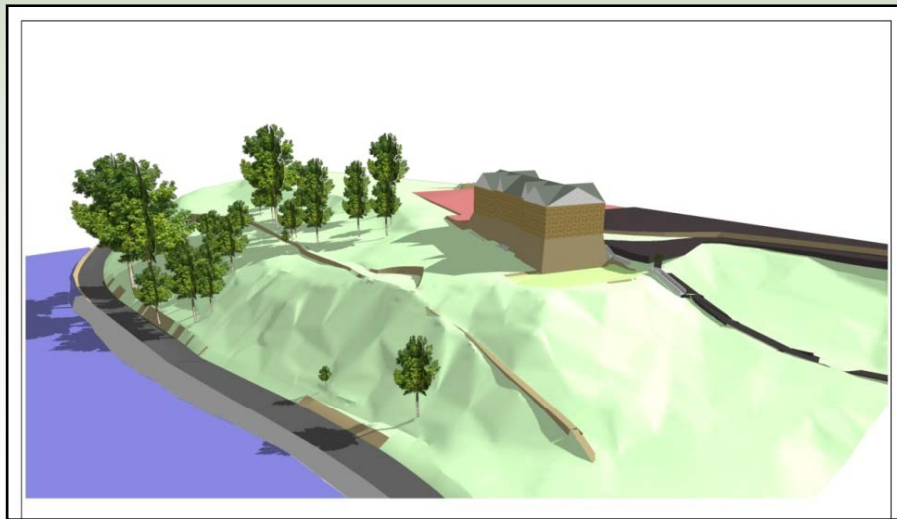
Tree Canopy Inventory



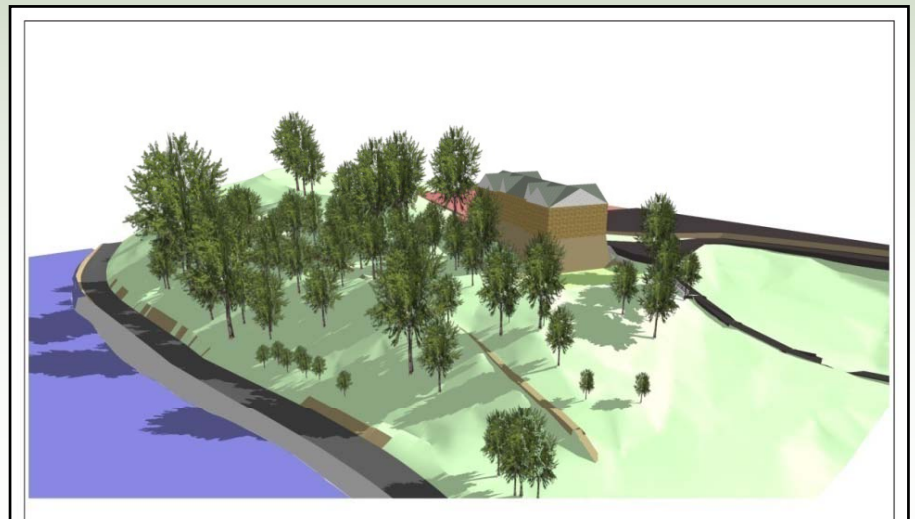
Existing Conditions – Full Canopy



Native Tree Distribution



Norway Maple Distribution



Black Locust Distribution

Site Inventory – User Experience



- Limited overlooks/views during growing season
- Numerous secondary trails - desire lines (especially at western extent)
- Very steep and unstable trail conditions
- Poor drainage on Perimeter Road



Summary of Master Plan Recommendations

- Control invasive species
- Encourage hickory, hackberry, and hop hornbeam
- Plant a native ephemeral groundcover, shrub, vine, and tree understory
- Stabilize slopes by re-grading where necessary, top dressing with compost and/or highly organic loam topsoil, and securing with biodegradable fabric
- Stabilize slopes with cross-slope placement of tree trunks (check logs) and brush bundles to provide instant cover, capture silt and improve habitat value



Summary of Master Plan Recommendations

- Improve slope drainage through simple diversion channels and modest re-grading/terracing
- Improve the existing escarpment trail along the top of the slope to reduce erosion and compaction
- Enhance the overlook(s) at the top of the slope by resurfacing with porous material
- Open views to the Reservoir through selective thinning of trees below overlook(s)



Summary of Stewardship and Master Plan Recommendations

- Improve Reservoir views from Perimeter Road
- Improve Perimeter Road drainage



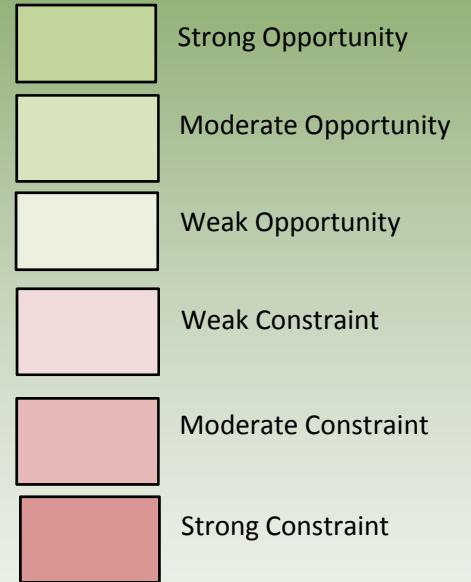
Additional Project – based Recommendations

- Improve stormwater runoff management at the top of slope through interception, infiltration, and removal of impervious surfaces
- Restore healthy and stable woodland soil biota
- Maintain opportunities for a diverse wildlife community through revegetation
- Reduce erosion on steep slopes by removing and/or relocating trails



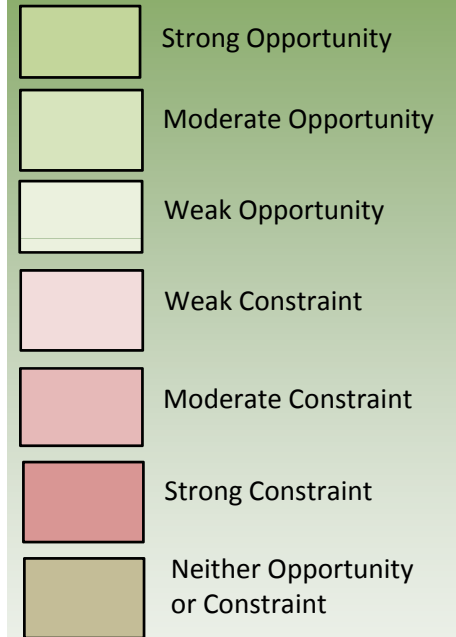
Ecosystem Viability Matrix

EXISTING ECOSYSTEM VIABILITY		Existing Resource Condition		
		<i>Retain Water</i>	<i>Cycle Nutrients</i>	<i>Minimize Erosion</i>
Slope & North Aspect	0 -15 +/-	Weak Opportunity	Weak Opportunity	Moderate Opportunity
	16 - 55 +/-	Weak Constraint	Moderate Constraint	Weak Opportunity
	36 - 55 +/-	Moderate Constraint	Strong Constraint	Moderate Constraint
	>55 +/-	Strong Constraint	Strong Constraint	Strong Constraint
	Gullies	Strong Constraint	Strong Constraint	Strong Constraint
Soil	Morphology	Strong Constraint	Strong Constraint	Strong Constraint
	Nutrients	Not Applicable	Strong Constraint	Strong Constraint
	Mod to High Erodibility	Moderate Constraint	Moderate Constraint	Moderate Constraint
Vegetation	Species and Diversity	Strong Constraint	Strong Constraint	Strong Constraint
	Structure	Strong Constraint	Strong Constraint	Strong Constraint

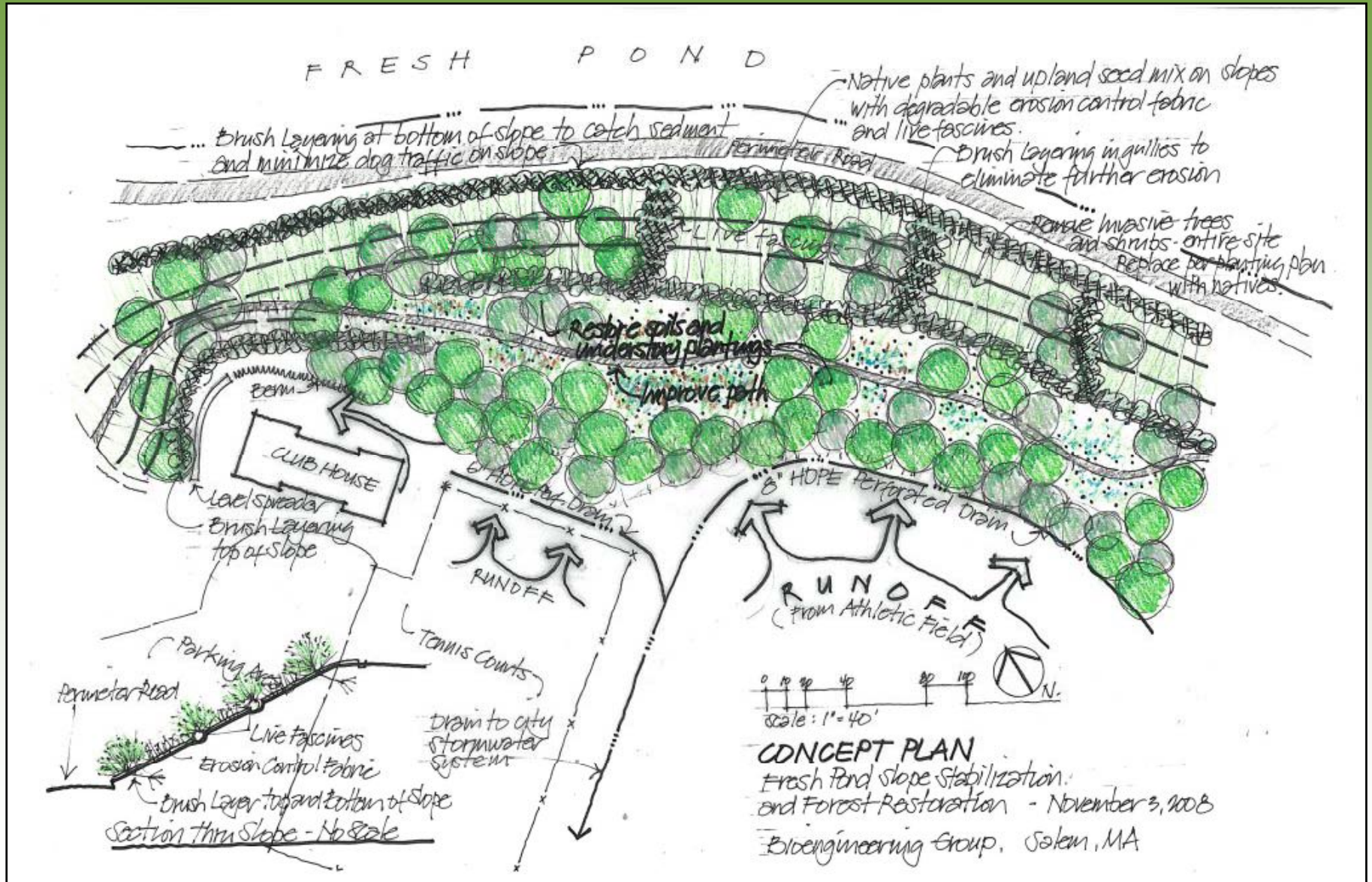


Restoration Matrix

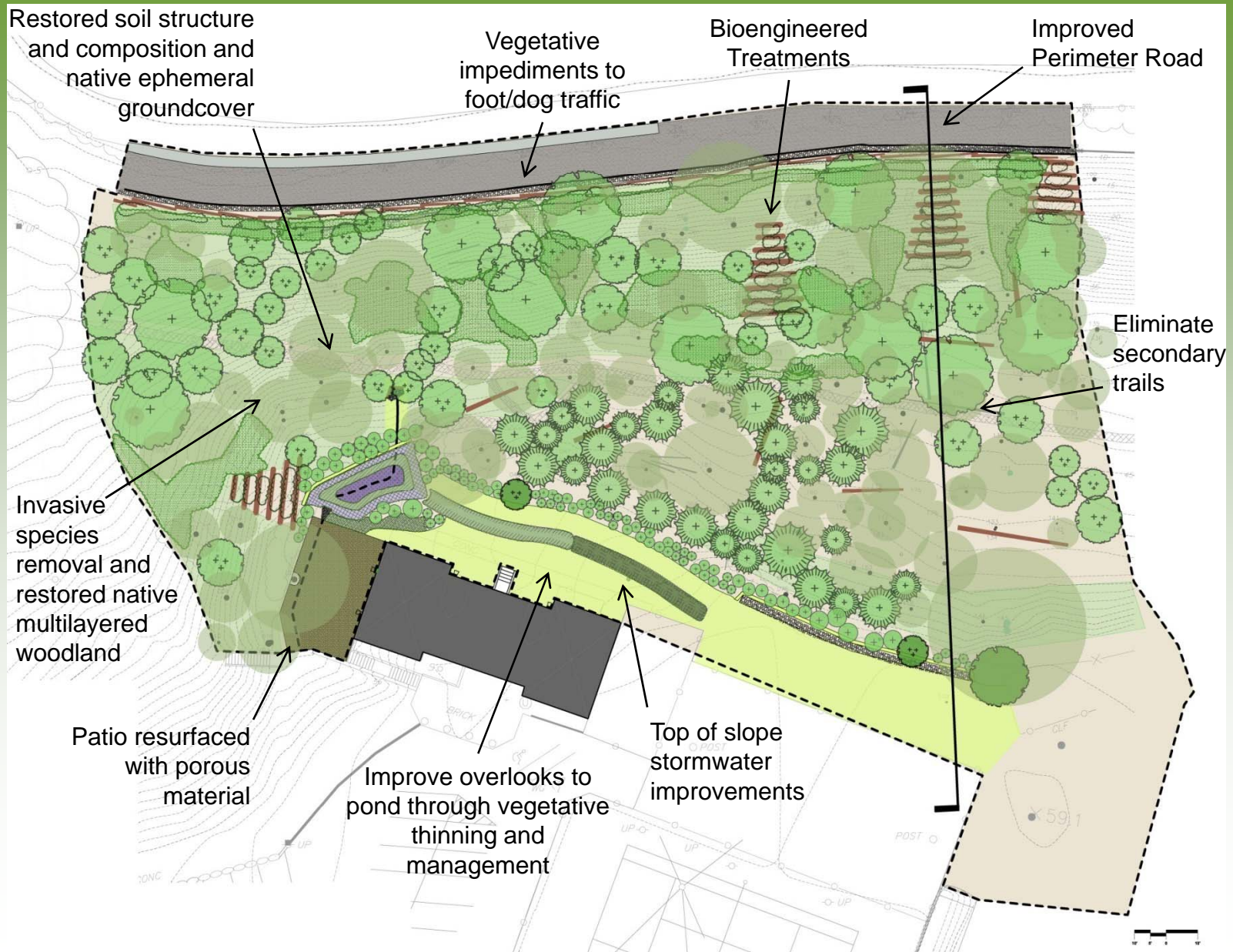
TECHNIQUES TO RESTORE ECOSYSTEM VIABILITY		Existing Resource Condition							
		Rolled Erosion Control Fabric (REC) & Seed with Natural Soil	Brush Layering	Cribbing (Gullied Areas)	Coir Mat Slope Transects with Natural Soil	Straw/Leaf Mulch over Natural Soil	Wattles/Fascines (Slope Transects)	Tree/Shrub/GC Planting	Scarify and Restore A Horizon
Slope (%) & North Aspect	0 - 15 +/-	Neither opportunity or constraint	Neither opportunity or constraint	Neither opportunity or constraint	Weak Opportunity	Strong Opportunity	Neither opportunity or constraint	Strong Opportunity	Strong Opportunity
	16 - 35 +/-	Moderate Opportunity	Weak Opportunity	Neither opportunity or constraint	Strong Opportunity	Weak Opportunity	Moderate Opportunity	Strong Opportunity	Strong Opportunity
	36 - 55 +/-	Strong Opportunity	Strong Opportunity	Weak Opportunity	Moderate Opportunity	Neither opportunity or constraint	Strong Opportunity	Strong Opportunity	Strong Opportunity
	>55 +/-	Strong Opportunity	Neither opportunity or constraint	Weak Opportunity	Weak Opportunity	Neither opportunity or constraint	Strong Opportunity	Strong Opportunity	Strong Opportunity
	Gullies	Strong Constraint	Moderate Opportunity	Strong Opportunity	Moderate Constraint	Strong Constraint	Strong Constraint	Weak Opportunity	Moderate Opportunity
Soil	Morphology	Strong Constraint	Neither opportunity or constraint	Neither opportunity or constraint	Strong Constraint	Strong Constraint	Neither opportunity or constraint	Strong Constraint	Strong Opportunity
	Nutrients	Strong Constraint	Strong Constraint	Neither opportunity or constraint	Strong Constraint	Weak Opportunity	Neither opportunity or constraint	Strong Constraint	Strong Opportunity
	Moderate to High Erodibility	Moderate Constraint	Strong Opportunity	Strong Opportunity	Strong Opportunity	Moderate Opportunity	Strong Opportunity	Moderate Constraint	Strong Constraint
Vegetation	Species and Diversity	Strong Constraint	Weak Constraint	Not Applicable	Not Applicable	Not Applicable	Weak Opportunity	Strong Opportunity	Neither opportunity or constraint
	Structure	Strong Constraint	Strong Constraint	Neither opportunity or constraint	Strong Constraint	Strong Constraint	Neither opportunity or constraint	Strong Opportunity	Neither opportunity or constraint



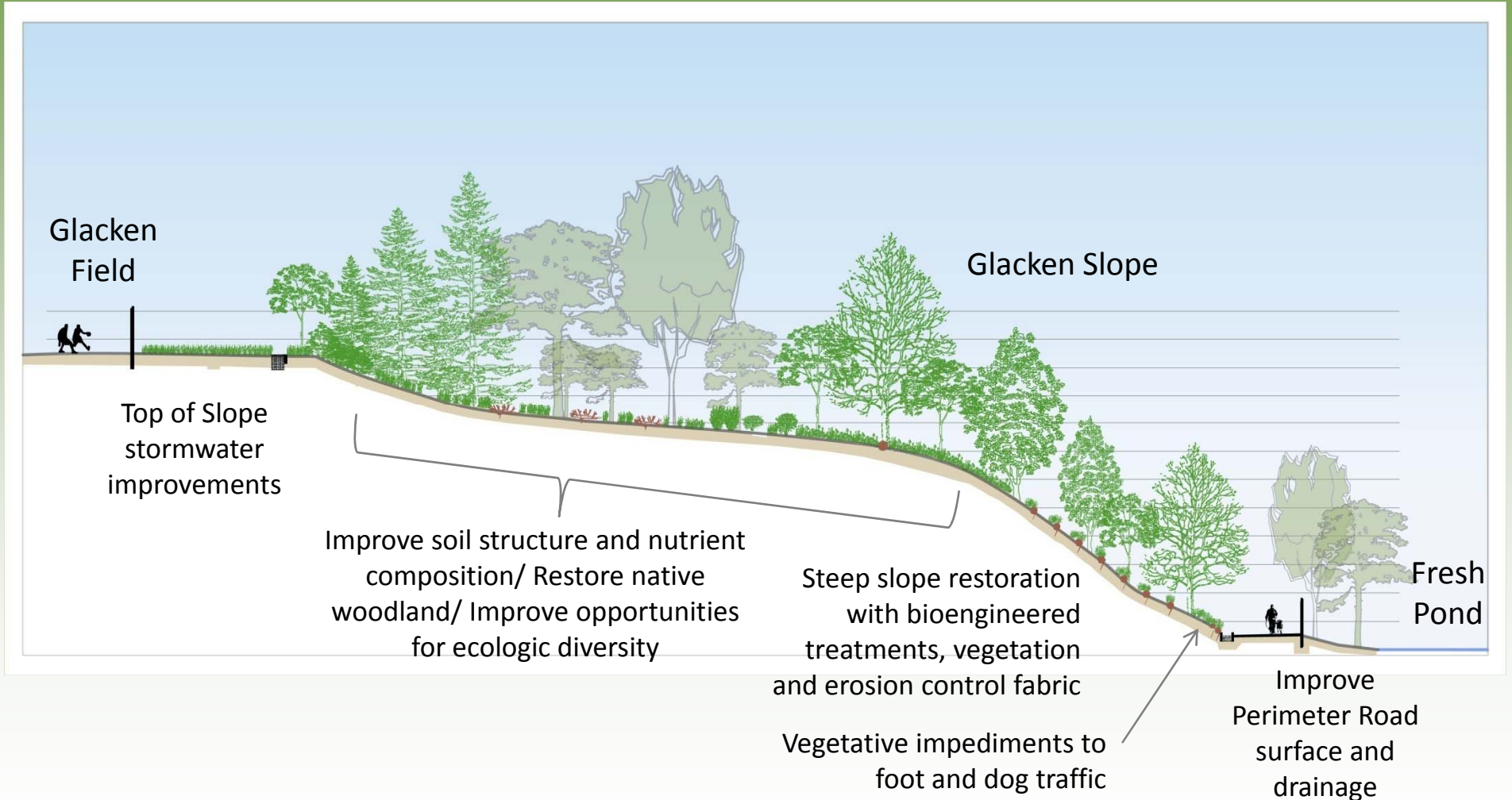
Initial Concept Plan



Design Development - Plan



Design Development - Section



Phased Plan

Phase 1: Top of Slope Drainage improvements

Phase 2: Restoration and Reforestation

Phase 3: Restoration and Reforestation

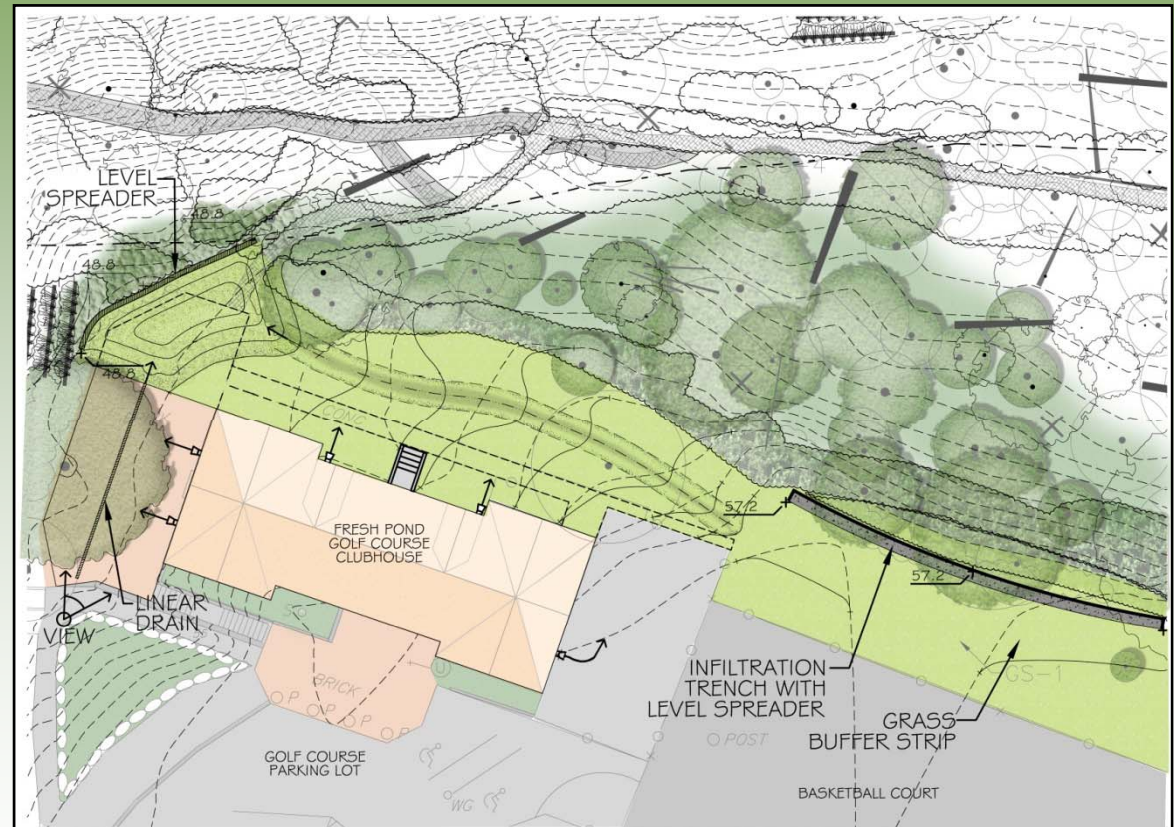
Phase 4: Perimeter Road Improvements



Phase 1: Top of Slope Stormwater Improvements

Design Elements

- Remove Degraded Concrete Walkway
- Redirect downspouts towards infiltration BMPs
- Water Quality Swale
- Rain Garden with Underdrain and Level Spreader
- Resurface patio with Porous Paving
- Infiltration Trench with Level Spreader



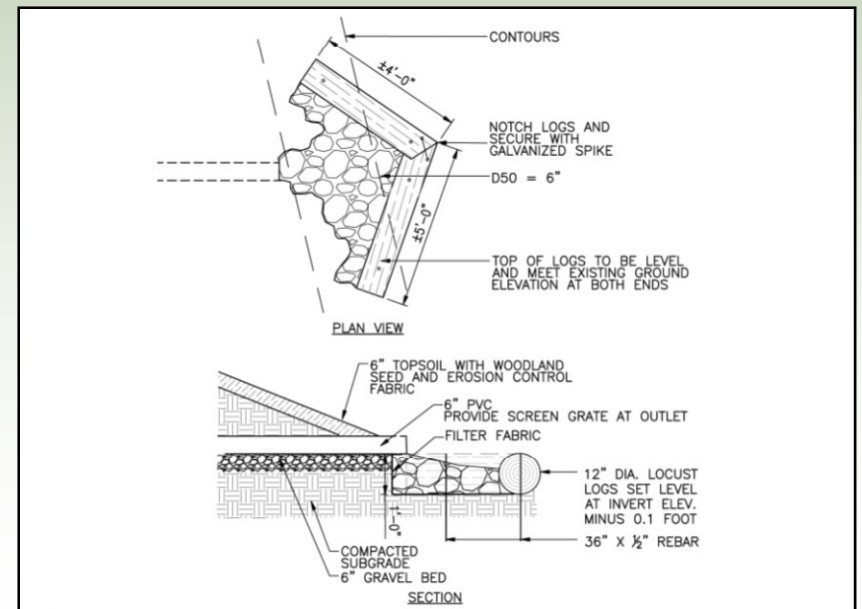
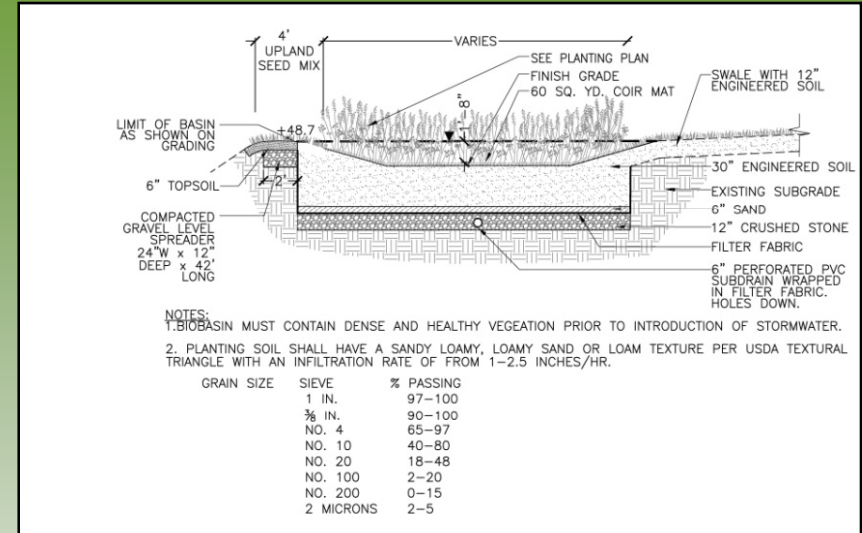
Phase 1: Rain Garden

Rain Garden Plantings, typ.



Phase 1: Rain Garden

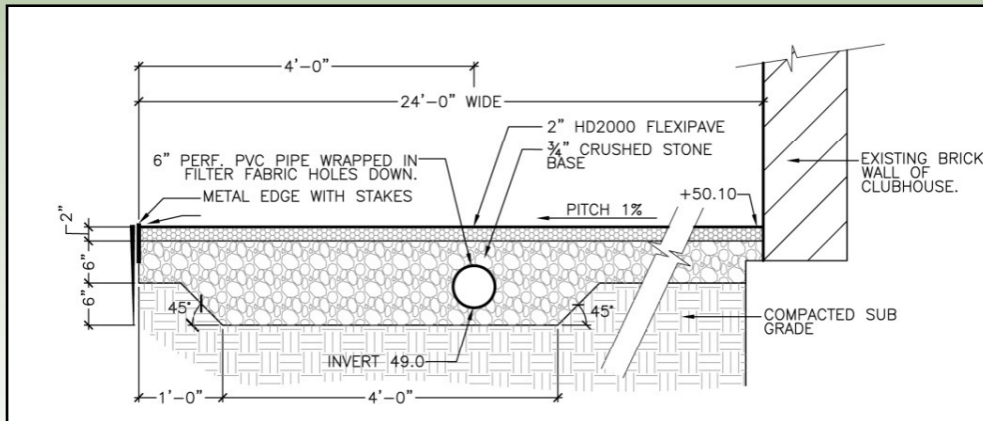
- Rain Garden – 36” Engineered Soil with Underdrain and Level Spreader
- Underdrain Outlet Energy Dissipater – Recycled Black Locust Log Level Spreader and Gravel
- Capacity = 47% of 10-YR Storm Event



Phase 1: Resurface Patio

Design Elements

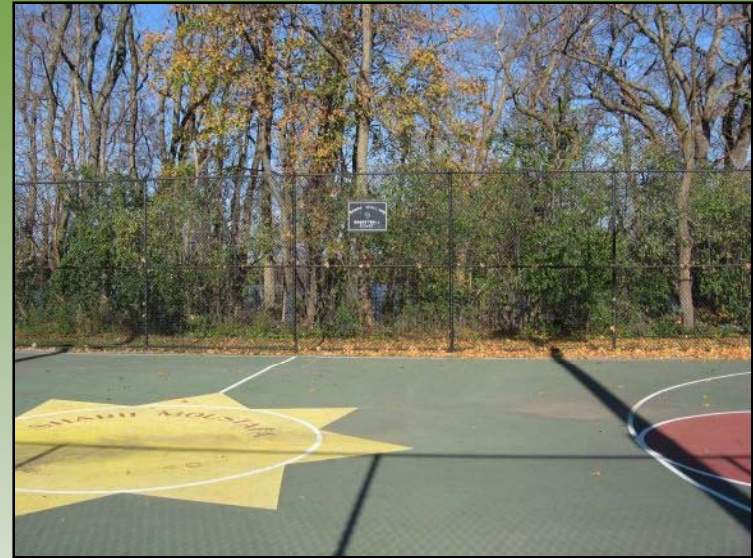
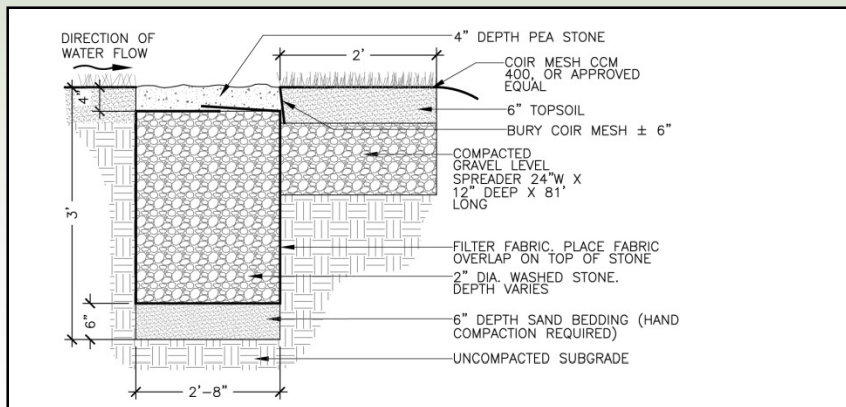
- Permeable Flexipave surface
- Underdrain outfalls to rain garden



Phase 1: Infiltration Trench

Design Elements

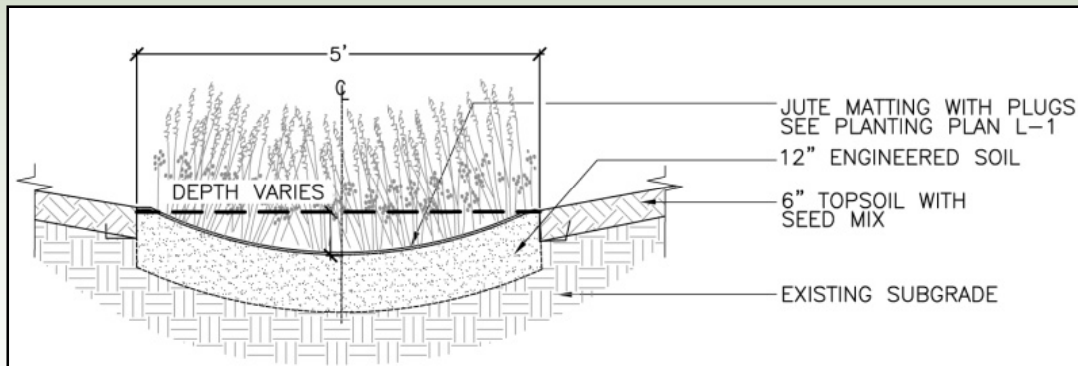
- Twenty (20) foot-wide low turf buffer pre-treatment
- Will overflow after the first 5.5 hours of a 10-year storm
- Level spreader evenly distributes flow



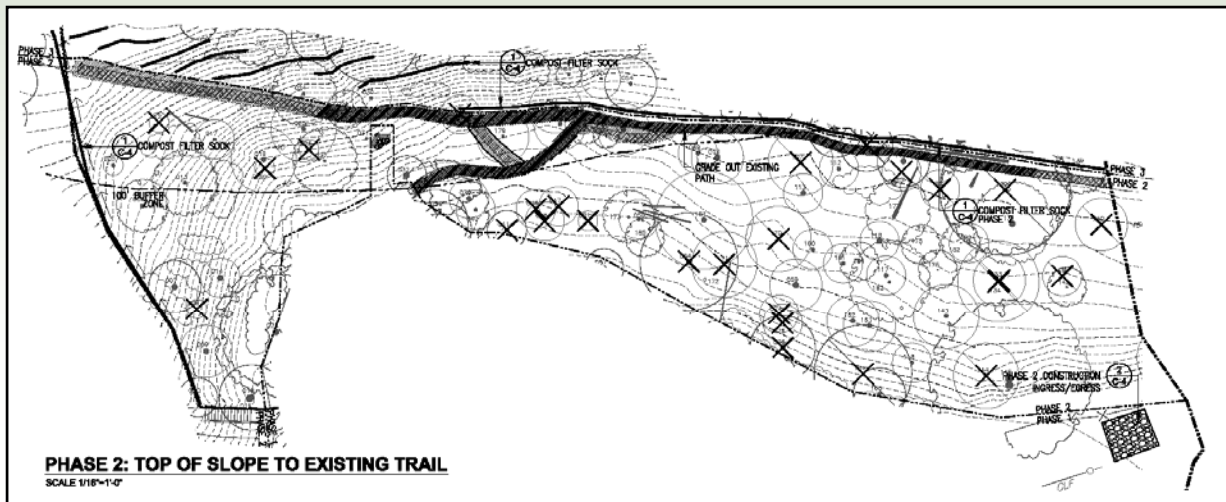
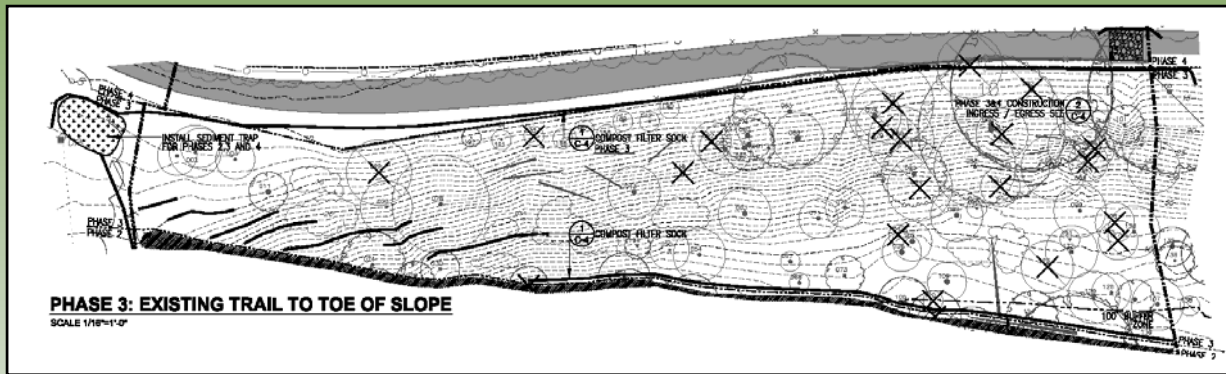
Phase 1: Water Quality Swale/Concrete Walk Removal

Design Elements

- Remove concrete walk to reduce uncontrolled conveyance
- Shallow swale directs runoff from golf cart parking area and downspouts into rain garden



Phases 2/3: Slope Stabilization and Woodland Restoration



Design Elements

- Invasive Plant Removal
 - Black Locust
 - Norway Maple
- Smooth our Rills
- Eliminate dirt trail
- Gully Repair
- Soil Scarification and Enhancements
- Native Plant Installation
- Install brush layering supported by recycled Black Locus logs at toe of slope to impeded foot/dog traffic up slope

Phase 2/3: Woodland Restoration Strategies

Process:

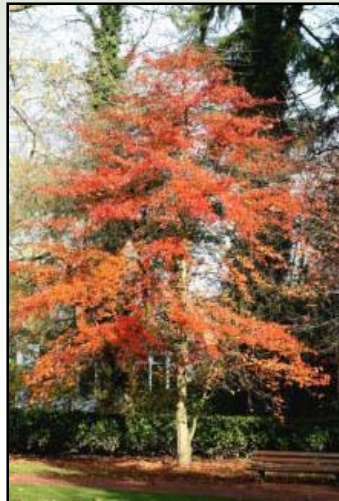
1. Target and remove invasive species
 - All Norway Maple
 - Black Locust: remove those that are dead, dying, or pose a threat to public safety
2. Develop strategy to control and monitor invasives during construction phase
3. Identify soil characteristics and develop plan to stabilize soils during construction
4. Develop planting plan
5. Monitor plant succession over time



Phases 2/3 Restoration Plantings

Enhance tree canopy

- Red Maple
- Sugar Maple
- Sweet/Black Birch
- Paper Birch
- Shagbark Hickory
- American Beech
- White Ash
- American Hophornbeam
- White Oak
- Northern Red Oak



Phases 2/3: Woodland Restoration

Enhance Understory Plantings

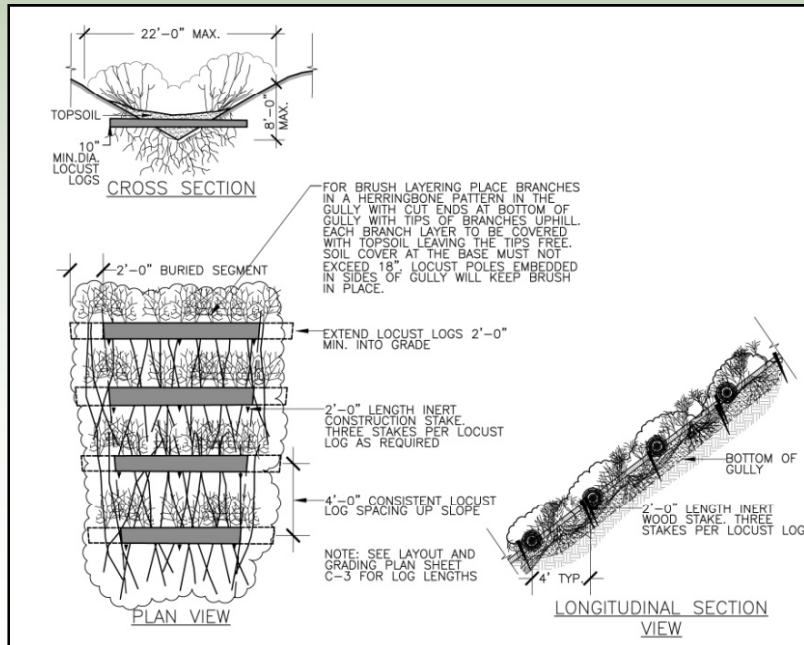
- Gray Birch
- Pagoda Dogwood
- Serviceberry
- Common Witchhazel
- American Mountain Ash



Phases 2/3: Gully Repair

Log Terracing with Branch Packing

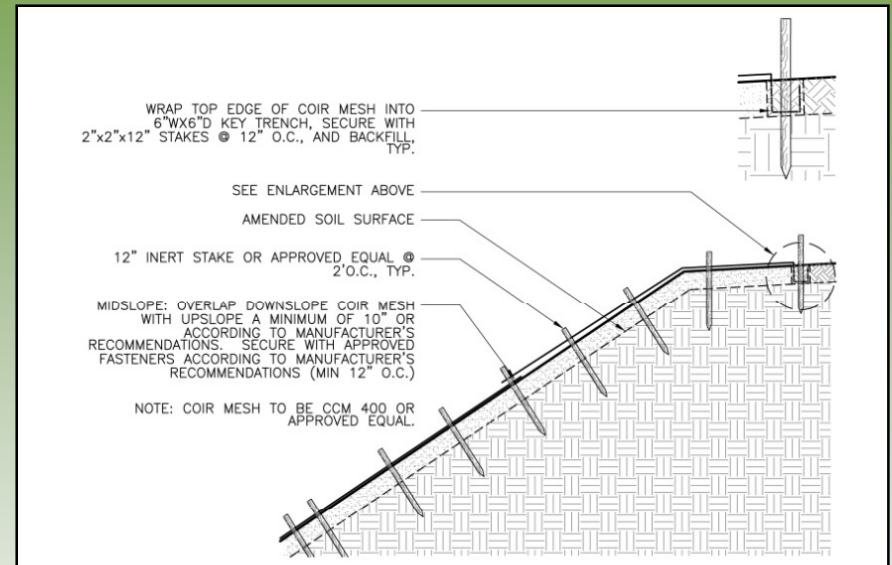
- Recycled Black Locust logs
- Plant selection:
 - Gray Birch
 - Silky Dogwood
 - Quaking Aspen



Phases 2/3: Temporary Slope Stabilization

Coir Mesh with Inert Stakes

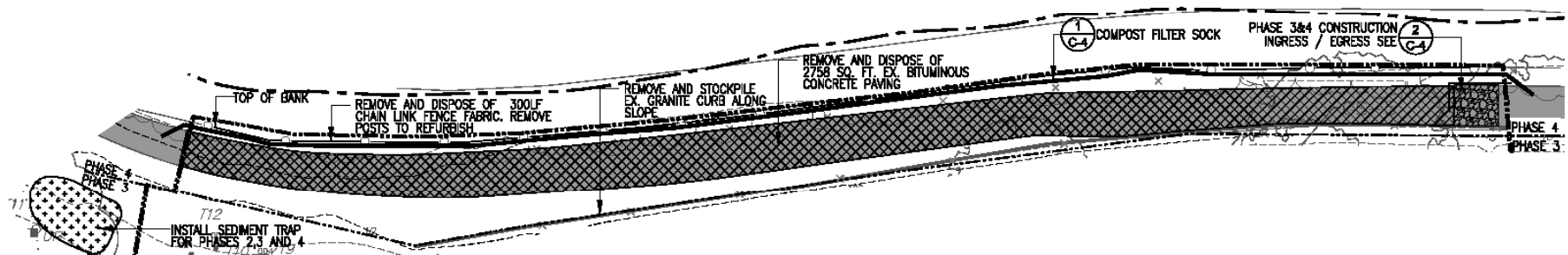
- Maintains good contact on uneven slopes
- Absorbs moisture and helps keep juvenile plantings well-hydrated
- Promotes duff accumulation and A-Horizon formation
- 100% biodegradable



Phase 4: Perimeter Road Improvements

Design Elements

- Remove existing pavement and re-grade to drain away from Fresh Pond
- Adjust Perimeter Road to uniform 12 foot width
- Resurface with bituminous concrete and stabilized aggregate paving
- Refurbish existing chain link fence



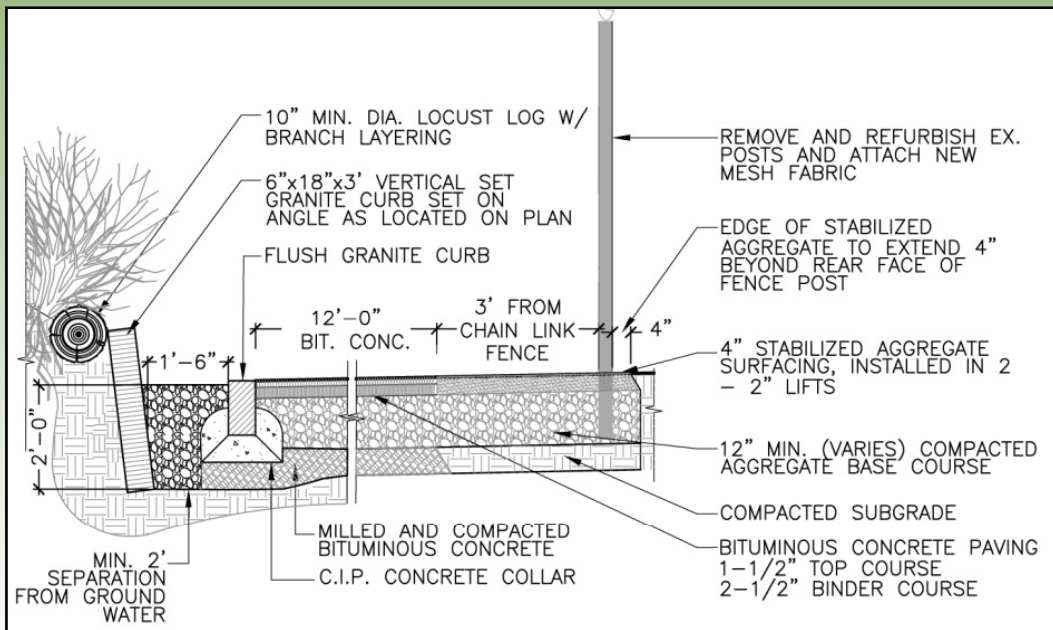
PHASE 4: PERIMETER ROAD

SCALE 1/16"=1'-0"

Phase 4: Perimeter Road Improvements

Design Elements

- Infiltration swale drains Perimeter Road runoff



Next Steps

- Phases 1 and 2, Invasive tree, shrub and vine removal, November 2009
- Phase 1 Construction, March thru May 2010
- Phases 2, 3 and 4, complete by Fall 2012