We crafted the following ecological restoration plan in the Spring of 2016 for a Restoration Ecology class assignment. We were Agroecology graduate students, and we studied ecologically beneficent agriculture. To research Agroecological restoration *and* satisfy the Restoration Ecology project requirements, we initiated a partnership with local food-education non-profit Community GroundWorks. Through their generous provision of time and resources, we document ecological degradation issues on their farm, gardens, and restored native landscapes of Troy Gardens. We review restoration methods available through methods of food production, and through their extensive, integrated network of visitors, and supporters.

Troy Land and Gardens: An Ecological Restoration Master Plan

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1. Introduction: Restoration, Collaboration, and Agriculture

Holistic Restoration Goals:

Ecological restoration projects analyze degraded lands. They set goals for the land's nourishment and use, and offer a plan for realizing those goals. The goals are dependent on what beneficiaries want and need - people like land-owners and land-users.

Plans sometimes divide restoration goals into two categories: ecosystem services and human services. Ecosystem services include aspects like the ecosystem's ability to support stable populations of native wildlife; or maintain soil fertility; or filter and cycle water. Human services refer more to infrastructure – such as a bike path, or a shady spot to sit.

When human services clash with ecosystem services, we see a disturbed landscape. When human activities encourage ecosystem health, we have a workable restoration plan.

Collaborative Restoration Plans:

Restoration practitioners argue over the numerous ways to "restore" a landscape. How do we choose our restoration "finish line?" Do we try to determine how the ecosystem functioned before an industrial revolution? Or, before colonial settlement? Do we look back fifty years? A thousand years?

In order to understand what a landscape might look like in a stable and productive state – building soil, growing a variety of plants, supporting a pristine pond - restoration workers look back in time. They seek to understand the story of the land.

But they also look around. They invite and integrate the voices of the people who live with that land. They collaborate.

And, they look to the future, asking how the land can be shaped and nourished so that human use encourages ecosystem health.

When restoration workers collaborate with impacted communities ("stakeholders," "beneficiaries"), the plan's goals and directions align with people's ecological and social needs, and with the resources available to carry out the work. When restoration workers understand the story of the stakeholders, they can coordinate plans that knowledgably leverage the resources at hand.

Invite impacted individuals and communities to shape the project. They have a stake in the work – if the vision for the landscape speaks to their needs and desires.

Continuous and Multifunctional Restoration Management:

Restoration is a long-term project. Restoration workers follow management plans until the goals are achieved. But these achievements must be maintained. How do we keep up with the infinite and infinitely-changing work of restoration?

Plans that regard stakeholder needs and desires can turn to these folks to care for the land.

But how do we *sustain* continuous and careful stakeholder engagement? How can human use "help" a landscape? If people enjoy and depend upon the work that restores the land, they have an incentive to continue that work. In a sustainable restoration plan, loving the land, using the land, and restoring the land will coincide.

Agriculture is not widely recognized as a means of restoration. Yet food production can support ecosystem services. Soil health, nutrient cycling, and wildlife habitat can improve through food production – if growers prioritize these outcomes.

Agriculture nourishes people by nourishing ecosystems, and by providing access to food.

Community-focused agriculture grows from local voices, needs, and labor. When local communities are prioritized, their voices determine what food to grow, how to grow it, and how to share food production work and wisdom. They have a stake in the work – they will come back week after week, after month, after year. Their care and interaction with the land means that many sets of eyes continuously investigate the land, and monitor its health.

Ecological restoration can use community agriculture to restore degraded lands.

Plans that value the voices of impacted communities will cultivate holistic, realistic goals, and the support needed to monitor and meet those goals.

2. Project Overview: Troy Gardens and Project Purpose

Growing and Learning at Troy Gardens

Troy Gardens offers a uniquely appropriate site for ecological restoration that operates through community agriculture and involvement. Troy Gardens is a beloved Madison institution dedicated to building socio-economically diverse learning communities through experiential education around food production.

This north Madison site was developed in 1995, when the city was selling fifteen acres of property slated for municipal and residential development. Instead, surrounding residents voiced a desire to keep the space open and available for recreation. They organized into a group called "Friends of Troy Gardens."

A year later, the group's call inspired the Madison Area Community Land Trust, the Urban Open Space Foundation, and the Community Action Coalition to purchase the land, as well as an additional sixteen acres. In 1998, a lease agreement was finally reached. In 2001, the 31 acres were purchased solely by Madison Area Community Land Trust, and placed under the management of Friends of Troy Gardens. At this point, the "Friends" incorporated into the non-profit Community Groundworks.

Community Groundworks now maintains this site for a variety of uses: a community supported agriculture (CSA) farm, a children's educational garden, a co-housing development, a community garden, a restored forest, and an edible food forest.

Ecological Degradation and Project Purpose

Community GroundWorks and folks who use the land have noticed ecological degradation. We inquired into these issues through conversations with their land management team. We analyzed the most disruptive aspects of Troy Gardens' ecological degradation, and the organization's primary use goals. From these considerations, we developed a hypothetical ecological restoration plan.

This master plan provides tractable options and alternatives for restoration of Troy Land and Gardens based on identified needs of Community Groundworks and Madison residents. When implemented, this plan should nourish the land, thus contributing to the health of local stakeholders, as well as the health of surrounding natural areas like Lake Mendota. It will support the present and future vibrancy, diversity, and resilience of plant, animal, and soil communities.

The following plan offers a brief review of ecological and human-use goals. Then, we expand on the intended use of Troy Gardens, to demonstrate the activity and needs that these goals support. We offer descriptions of our reference communities**,** that we studied alongside Troy Gardens to clarify opportunities and expectations for restoration. That section precedes a site inventory and analysis where we detail key aspects of Troy Gardens' ecosystem, and the shape and impact of ecological degradation. Finally, we share three restoration options for ameliorating this degradation. We evaluate the strengths and weaknesses of each plan, and suggest which plan provides the most functional path forward.

3. Restoration Goals

The authors and Community GroundWorks developed these restoration goals through reviewing the intended use and ecosystem degradation at Troy Gardens.

I. Ecosystem Services: Provisioning and Regulating

1. Water
    a. Improve Infiltration into Soil
    b. Improve Quality
    c. Capture and store for use on farm
2. Soil
    a. Retain Topsoil
    b. Build Soil Nutrients
    c. Decontaminate Soil
    d. Create New Soil with Improved Composting System
    e. Build Soil Structure and Reduce Compaction
3. Plant and Animal Life
    a. Build Pollinator Habitat
    b. Increase Biodiversity
    c. Increase Native Plants
    d. Increase Perennials

II. Human Services: Social Equity and Food Access

1. Community Building
    a. Support Gathering Spaces
    b. Increased communication and coherence between factions of Troy Gardens
    c. Engage the community surrounding the farm
    d. Increase Visibility and Accessibility of Growing and Recreation Opportunities
2. Education
    a. Increase interpretive signage explaining functional elements of the landscape design
3. Provision of Healthful, Culturally Relevant Food
    a. Expand Garden Plot and Increase Size of Family Plots
    b. Enable Season Extension
    c. Make Forest Food Crops Available

4. Troy Gardens Use Policy: Options for Varied Engagement

At present, the site maintains several different uses. Below, we will briefly outline the current and projected use policy of each aspect of the land.

Co-Housing Area

Approaching the property from the south on Troy Drive, one first sees the Co-housing Area. These apartments are inhabited by individuals and groups whose income falls under a certain amount. It is an "income restricted" housing complex, intended to provide safe and beautiful housing to those who may not have a competitive advantage in finding housing at market rates. Our restoration plans do not alter the use of this area, but they do promote interaction between co-housing residents and the rest of the site.

Community Gardens

The organic garden is divided up into over 300 20' by 20' plots. Gardeners pay between $10-$65 a year for their plots, and have access to materials such as mulch. Gardeners who adhere to garden rules may tend their plot at any time during the year. Gardeners also organize events for the education and recreation of the surrounding community. Our restoration plans maintain or augment the number of garden plots, which fluctuate in amount and location from year to year.

Maple Woods Restoration

Next to the community gardens lies a strip of a restored maple woods stand. This area has a path through it, and provides respite and vegetation to people walking through. Our restoration plans maintain this use.

Prairie Restoration

The restored prairie upholds the parameters of the Troy Gardens deed, which stipulates that a certain portion of the land must be kept as "open space." Visitors walk through the prairie on a designated path, for exercise and to experience flora and fauna hosted by the prairie. The prairie is also a point for community involvement, as community members are invited to collect seeds and weed out invasive plants. Our restoration plans maintain the recreational and maintenance uses of the prairie, while advising for some of the prairie to be converted to other uses like gardening.

CSA Farm

This organic farm is managed by Community GroundWorks staff and interns. Community GroundWorks also hosts farm tours for children and adults, to provide education on organic and community-based farming. Our restoration plans maintain this use.

Edible Woodland

The prairie is bordered by a series of plantings that provide free tree crops for visitors and nearby residents. Visitors also walk through the area for exercise.

Wildlife Corridor

This area separates the gardens and cohousing from the prairie and farm. It was built on a buried railroad line. The area is used for quiet recreation like hiking, meditation, and bird-watching.

Old Field and ATC Corridor

The northernmost part of the site is called the Old Field. It has some scattered oaks, interspersed by lawn and shrubs. Nearby residents stroll and walk dogs on its concrete path. The Old Field connects to a corridor of American Transmission Company (ATC) high-voltage power lines. This area is not attended to by visitors. Our restoration plans provide alternative functions for the Old Field, maintaining its accessibility while making room for more food-related recreation. The ATC corridor remains undeveloped and unused, to maintain safety in this steep area.

5. Reference Communities

We have introduced the site's history, intended use, and goals to improve and support the site's health and function. Before detailing how the site falls short of its intended use, we will provide a summary of examples that aid our vision of a functional and healthful version of this site. These reference models include constructed systems for people and agriculture, as well as Southern Wisconsin natural landscapes.

Urban Area

- Urban ecosystem degradation commonly includes highly disturbed systems along with frequent changes in soil and plant cover. Water availability and temperature change quickly.
- Land cover can be impervious to water, and subsequently degrade soil life. Vegetation includes monocultures of non-native plantings, like lawns (Mann 2014).

Agricultural Field

- Contemporary agriculture often follows the model of converting natural ecosystems to agroecosystems, leading to a loss of species diversity, and degradation of soil health and water purity. Much agricultural production depends on non-renewable resources like oil, gas, and agrochemicals ("Field to Market" 2012).
- Agriculture can include practices that support soil health and biodiversity. For instance, farmers build hedgerows and windbreaks – rows of trees and woody perennials – around fields to inhibit wind erosion. These tree stands also shape micro-climates and habitats that support natural enemies of crop pests. (Mann 2014).

Urban Forests and Urban Agriculture

- Urban forests are built to provide goods and services. Services include air and water quality improvement, while goods include food and medicine. A study in Seattle finds that 42% of city trees are vulnerable to pest, disease, and wind damage. When cared for, trees and woody perennials promote soil conservation and add to biodiversity (McClain 2012). Allowing gathering of tree crops in urban forests provides food access to low income and food insecure communities. When gathering is allowed, herbicides are less likely to be used.
- Urban agriculture provides local food access to urban residents. Municipal legislation is tending towards a more permissive regulation of urban agriculture. For instance, municipalities are recognizing urban agriculture zones. Urban agriculture can be incorporated aesthetically into city landscapes, with plants like sweet potatoes sometimes used as ground cover.
- Some urban growers ally with the *Permaculture* movement. Permaculture refers to an ever-evolving model for agricultural ecosystems, focused on polycultures using perennial plants, integrated with animals. These systems are designed to mimic natural ecosystems, requiring minimal human intervention to produce food and maintain fertility (Ferguson and Lovell 2014).

Southern Mesic Prairie

- We look to Southern Mesic Prairies because Community GroundWorks intends for their natural landscapes to mimic natural, self-maintaining plant communities. Established or restored prairies they require minimal intervention, and are self-maintaining (Community GroundWorks 2009).
- A prairie has over 80% of vegetative area inhabited by warm, tall season grasses. Native grasses and flowers then send down roots up to fifteen feet into the soil, with most plants maintaining nearly two thirds of their biomass in the soil. This biomass prevents erosion and allows storm water penetration into the soil.
- Prairies that maintain variety in bloom times and seed sizes will support avian and rodent populations.Prairie burns occur periodically, though this may be a constructed feature of prairies, dating back only a few tens of thousands of years.

6. Site Inventory and Issue Analysis: Needs and Resources

This section reviews the following characteristics of the site, to facilitate building workable restoration management options:

Data sources include interviewing Troy Gardens' land manager Shelly Strom, a site visit, and past restoration management plans coordinated by Community GroundWorks.

Land manager Shelly Strom (on left) with authors during site visit, March 2016

Overview

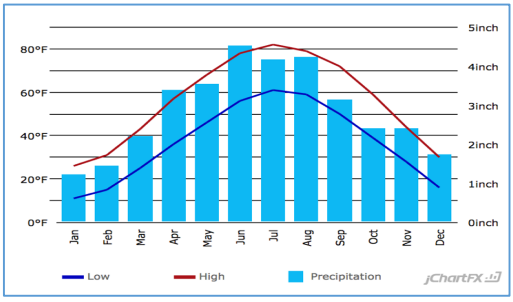
We initiated our inventory and analysis through a site tour, where our host outlined the goals of the organization, and how the current state of the land was supporting or inhibiting those goals.

This site has the resources to maintain a restoration plan because they have staff and volunteers who find personal and professional fulfillment in caring for the land and producing programming. The site is compatible with human use and wildlife use.

Due to site divisions, some staff are not aware of the resources available in other parts of the site. Indeed, they sometimes act in a way that undermines the function of other aspects of the site.

A. Climate

Annual high temperature:	55.8°F
Annual low temperature:	36.8°F
Average temperature:	46.3°F
Average annual precipitation - rainfall:	34.44 inch
Days per year with precipitation - rainfall:	-
Annual hours of sunshine:	-
Av. annual snowfall:	53 inch



Climate Characteristics: The above statistics from usclimatedata.com denote annual averages for high temperatures, low temperatures, and precipitation in Madison, located in South Central Wisconsin. This climatic context supports thousands of acres of farmland in the region, as well as prairie, woodland, and wetland.

Climate Issues: The Wisconsin Initiative for Climate Change Impacts (wicci.wisc.edu) reports that Madison will see changes in climate in coming years, according to their climate change studies. By the end of the

century, the Madison climate will more closely resemble an area of Illinois just north of Springfield. This area also hosts agriculture and natural landscaping.

B. Soil and Topography

Soil Characteristics: The USGS Web Soil Survey categorizes the soils at Troy Gardens into the following types (map on right):

- Pecatonica silt loam.
  2% acreage.
  1-3% slopes.
  2% Soil organic matter (SOM).
  Over 200cm to water table

- Troxel silt loam.
  9% acreage.
  2-6% slopes.
  4% SOM.
  137cm to water table

- Westville silt loam.
  90% acreage.
  2-6% slopes.
  0.5% acreage.
  6-12% slope.
  2% SOM.
  Over 200cm

USGS map of soil types at Troy Gardens.

The USGS survey finds this site and these soil types to be suitable for agriculture.

Soil Issues: Erosion has proven to be an issue in the prairie.

The community garden relies on cycling of nutrients. The organization of soil cycling has been in flux over the past few years, changing from in-plot composting, to a larger collective composting system.

Because the farm has no on-site storage, a truck drives continuously over the area of land between the Wildlife Corridor and the farm, compacting the soil and leading to ponding.

C. Hydrology

Water Characteristics: Troy Land and Gardens is half a mile from Lake Mendota, the northernmost lake in the Yahara River Watershed. The lake is 9,842 acres and has 21.9 miles of shoreline. It is 82 feet deep at its deepest spot. It contains 17,834 cubic feet of water. The lake has a maximum depth of 83 feet deep and a mean depth of 42 feet. About 17 square miles of land drain directly to the lake. The lake has been studied for decades, and is impacted negatively by eutrophication, due to agricultural chemicals entering the watershed (YaharaPortal.org)

On site, water is seasonably available to staff, volunteers, and gardeners on this land, through city supplies. they cited their use of water as unsustainable. Season extension is difficult because the city turns off their pumps in the winter. They buy their water from the city. They do have some rainwater storage.

Water Issues: Runoff originates in the prairie, and travels to the southern edge of the farm and the Wildlife Corridor. The farm tractor continually rolls over the area just above the Wildlife Corridor, compacting the soil and limiting infiltration. The cause of limited infiltration in the prairie, causing runoff and subsequent ponding of water, is not as clear. One contribution to runoff may be a high water table, as this land was not originally prairie, but likely some sort of wetland. According to the USGS Web Soil Survey, the chances of water ponding on these soils is "none," indicating that a change in management of plants may leverage the ease of infiltration inherent in these soils.

D. Vegetation

Native plants provide habitat for native animals, which can contribute to pest management that supports farm and gardening sites. The prairie is apparently more of a seed source for weeds than anything else (2013 Prairie Management plan).

Prairie:

According to Community Groundworks, Troy Gardens prairie is Wisconsin's only organically managed community prairie restoration (2013). Originally planted with 63 species of grasses, sedges, rushes, forbs, and shrubs, the prairie looks quite different today.

Prairie Plantings in 2005:

Forbs (wild flowers)	Color	Bloom Time A M J J A S O	Ht	Comments
Liatris pycnostachya Prairie Blazingstar	Purp	J A S	3-4'	Very showy; butterfly plant
Monarda fistulosa Bergamot	Lav	J A S	2-4'	Butterfly and humming bird plant; mint aroma
Monarda punctata Dotted Mint	Crm & purp	J A	6-30"	Biennial; flower small but very showy; butterfly plant
Oenothera biennis Common Evening Primrose	Yel	J J A S	2-6'	Biennial; interesting wintertime texture
Penstemon digitalis Smooth Penstemon	Wht-pur	J J	2-4'	Leaf finely toothed; readily self sows
Polygonatum biflorum Solomon's Seal	Yel	J J	2-5'	Arching form with hanging flowers; blue-black berries
Potentilla arguta Tall Cinquefoil	Yel	J A S	12-40"	Lower leaves feather-divided
Ratibida pinnata Yellow Coneflower	Yel	J A S	3-5'	Short-lived colonizer; butterfly plant; aromatic seed head
Rudbeckia hirta Black-eyed Susan	Yel	J J A S O	2-3'	Biennial; pioneer; butterfly plant
Rudbeckia subtomentosa Swt. Black Eyed Susan	Yel	A S O	3-6'	Large, downy flower heads; butterfly plant
Rudbeckia triloba Branched Coneflower	Yel	J A S O	2-4'	Biennial; butterfly plant; very showy
Silphium integrifolium Rosin Weed	Yel	J A S	4-8'	Tall; unbranched; birds eat seeds
Silphium laciniatum Compass Plant	Yel	J J A S	4-8'	Prairie giant; awesome; butterfly and bird plant
Silphium perfoliatum Cup Plant	Yel	J A S	4-8'	Birds drink from leaf "cups"; butterfly plant
Silphium terebinthinaceum Prairie Dock	Yel	J A S	4-8'	Taproots reach 9-12' deep; butterfly & bird plant
Solidago graminifolia Grass-leaved Goldenrod	Yel	J A S	2-4'	Grass-like foliage; small but abundant flowers
Solidago rigida Stiff Goldenrod	Yel	A S O	1-5'	Butterfly plant; roots penetrate to 15'
Solidago speciosa Showy Goldenrod	Yel	A S O	1-4'	Butterfly plant; one of the showies
Tradescantia ohiensis Spiderwort	Blue	M J	2-4'	Butterfly plant; forms arching clumps
Verbena stricta Hoary Vervain	Blue	J A S	3-6'	Butterfly plant; foliage is finely hairy
Vernonia fasciculata Ironweed	Purp	J A S	4-6'	Butterfly plant; very showy; rich color
Veronicastrum virginicum Culver's Root	Wht	J J A	3-6'	Long flower spike; butterfly plant
Zizia aptera Heartleaf Golden Alexanders	Yel	A M J	1-3'	Heart-shaped leaves; butterfly plant
Zizia aurea Golden Alexanders	Yel	A M J	1-3'	Butterfly plant

Shrubs	Color	Bloom Time A M J J A S O	Ht	Comments
Amorpha canescens Lead Plant	Purp & gold	J J A	30-40"	Shrub; butterfly plant; gray-green foliage
Ceanothus americanus New Jersey Tea	Wht	J J A	18-36"	Shrub; butterfly plant; large clusters of flowers
Rosa blanda Early Prairie Rose	Pink	J J	3-5'	Shrub; butterfly plant; red rose hips in fall

- Big bluestem and Switchgrass are doing so well that they are shading out desirable wildflowers.
- The staff finds that without herbicides, is it difficult to eradicate invasives. Getting rid of invasives will provide opportunity for local prairie species to volunteer and establish. Eutrophication from farm may contribute to invasives.
- The prairie is adjacent to the Community GroundWorks farm. UC Sonoma County Master Gardeners show that planting an insectary of grassland forbs supports pollination and pest control of organically managed garden.
- The prairie involves community members and allows for active engagement in nature (Community Groundworks 2013). Volunteers have spent hundreds of hours engaging in prairie restoration tasks, taking pride in this work when they learn of its potential impacts. For example, in the summer of 2013 volunteers collected prairie seeds during native planting workshops.

Edible Woodland:
Troy Gardens' Edible Landscape contains a variety of edibles including: walnuts, mulberries, black cherries, hackberries, Russian olives, black raspberries, sumacs, and asparagus. Staff observe that many visitors do not know that this resource is available.

Edible Woodlands Plant List as Existing October 2010

Deciduous Trees

Sym.	Common Name	Botanical Name
Ag	Amur Maple	*Acer ginnala*
Bp	White Birch/Paper Birch	*Betula papyrifera*
Ca	Pagoda Dogwood	*Cornus alternifolia*
Ci	Northern Pecan	*Carya illinoensis*
Ck	American Yellowwood	*Cladris kentukea*
Cp	Washington Hawthorn	*Cratagus phaenopyrum*
Gy	Kentucky Coffeetree	*Gymnocladus dioicus*
Ju	Butternut	*Juglans cinerea*
Mb	Bearing Apples	*Malus species*
Ms	Low-Gro Wild Crabapple	*Malus species*
Pa	Bearing Apricot	*Prunus species*
Pb	Bearing Plum	*Prunus species*
Pc	Bearing Sour Cherry	*Prunus species*
Pr	American Plum	*Prunus americana*
Pt	Quaking Aspen	*Populus tremuloides*
Py	Bearing Pear	*Pyrus species*
Qw	White Oak	*Quercus alba*
Ta	Basswood	*Tilia americana*

Evergreen Trees

Sym.	Common Name	Botanical Name
Jc	Upright Juniper	*Juniperus chinensis sp.*
Ps	White Pine	*Pinus strobus*

Deciduous Shrubs

Sym.	Common Name	Botanical Name
As	Running Serviceberry	*Amelanchier stolonifera*
Co	Hazelnut	*Corylus americana*
Cr	Grey Dogwood	*Cornus racemosa*
Dl	Dwarf Bush Honeysuckle	*Diervilla lonicera*
Ea	Burning Bush	*Euonymous alatus*
Fs	'Meadowlark' Forsythia	*Forsythia sp.*
Hv	Witch Hazel	*Hammamelis virginiana*
Ph	'Minnesota Snowflake' Mockorange	*Philadelphus sp.*
Po	Ninebark	*Physocarpus opulifolius*
Ra	Fragrant Sumac	*Rhus aromatica*
Ri	'Red Lake' Currant	*Ribes sp.*
Ro	'Virginia' Rose	*Rosa virginiana*
Rs	'Illini' Blackberry	*Rubus sp.*
Sc	Elderberry	*Sambucus canadensis*
Sp	'Miss Kim' Lilac	*Syringa patula sp.*
Ss	Indiancurrant Coralberry	*Symphoricarpos orbiculatus*
Sv	Purple & White Common Lilac	*Syringa vulgaris*
Vp	Blackhaw Viburnum	*Viburnum prunifolium*
Ws	Red Prince Weigela	*Weigela florida*

Evergreen Shrubs

Sym.	Common Name	Botanical Name
Js	Sea Green Juniper	*Juniperus chinensis sp.*

Community Gardens:
Our research revealed use issues – not ecological issues – with the gardens. Some gardeners requested a reformed compost system. They wanted a more inclusive and efficient composting system for nutrient building.

Maple Woods Restoration:
The maple stand is managed to make canopy room for maples. Ash, boxelder, and elm compete with the sugar maple for dominance. The area is infested with invasive species like reed canary grass, garlic mustard, burdock, foxtail, and leafy spurge.

Maple Woods Restoration Plant List as Planted Spring 2004

Trees

Sym.	Common Name	Botanical Name
Al	Serviceberry	*Amelanchier laevis*
Ps	White Pine	*Pinus strobus*

Shrubs

Sym.	Common Name	Botanical Name
Ca	American Filbert	*Corylus americana*
Cr	Grey Dogwood	*Cornus racemosa*
Eu	Wahoo	*Euonymous atropurpurea*
Ha	Witchhazel	*Hammamelis virginiana*
St	Bladdernut	*Staphylea trifolia*
Vl	Nannyberry	*Viburnum lentago*
Vp	Blackhaw Viburnum	*Viburnum prunifolium*
Vt	Cranberrybush	*Viburnum trilobum*

Ferns

Sym.	Common Name	Botanical Name
ap	Maidenhair Fern	*Adiantum pedatum*
oc	Interrupted Fern	*Osmunda claytoniana*

Ephemerals and Wildflowers

Sym.	Common Name	Botanical Name
aa	Baneberry	*Actaea alba*
as	Ginger	*Asarum canadensis*
at	Jack-in-the-Pulpit	*Arisaema triphyllum*
ct	Blue Cohosh	*Caulophyllum thalictoides*
ea	Dog Tooth Violet	*Erythronium albidum*
gm	Geranium	*Geranium maculatum*
he	Hepatica	*Hepatica acutiloba*
pb	Solomon's Seal	*Polygonatum biflorum*
pd	Woods Phlox	*Phlox divaricata*
pp	Mayapple	*Podophyllum palatatum*
sm	False Solomon's Seal	*Smilacina racimosa*
sr	Bloodroot	*Sanyvinaria ranadensis*
tg	Trillium	*Trillium grandiflorum*
ug	Bellwort	*Uvularia grandifolia*

CSA Farm:
The CSA farm is organically managed. No synthetic agrochemicals are applied for nutrient building or for pest control.

Old Field and ATC Corridor:
The corridor slopes steeply down to railroad and housing area (2010). Community GroundWorks wanted to preserve the bordering vegetation, but ATC cut it down in the mid 2000s. There is now no physical barrier to the power line area.

The Old Field was set up to function as an Oak Savannah, but is now threatened by invasive Yellow Sweet Clover.

Wildlife Corridor:

Community Groundworks found this land to be "heavily invaded" with weeds and invasive species. It is identified in 2010 as a problem area. However, the corridor also supports migrating birds and insects.

Old Field Plantings, 2005

Deciduous Trees		
Sym.	*Common Name*	*Botanical Name*
Co	Shagbark Hickory	*Carya ovata*
Jn	Black Walnut	*Juglans nigra*
Jg	Carpathian Walnut	*Juglans nigra 'Carpathian'*
Ma	Wild Crabapple	*Malus sp.*
Md	'Dolgo' Bearing Crabapple	*Malus sp.*
Qa	White Oak	*Quercus alba*
Qb	Swamp White Oak	*Quercus bicolor*
Qm	Bur Oak	*Quercus macrocarpa*
Qr	Red Oak	*Quercus rubra*
Sc	Elderberry	*Sambucus canadensis*
Ta	Basswood	*Tilia americana*

Evergreen Trees		
Sym.	*Common Name*	*Botanical Name*
Ji	'Iowa' Juniper	*Juniperus chinensis species*

E. Fauna:

Areas across the site are found to provide habitat for local and migratory birds, rodents, and pollinators.

F. Culture:

- The project nourishes a culturally and economically diverse population, by supporting residents in growing and preparing food. There are many volunteer opportunities. There is a cohousing site, which hosts after-school programs that come from neighborhood schools and community centers.
- Community GroundWorks cites social justice as key piece of their motivation. Their social justice work includes supporting food-insecure individuals and communities by providing access to land, to grow food on their own terms. They also ensure access to food. They note that some gardeners have need of wheelchair accessible plots, and find that their scooters can traverse the lawns.
- Community GroundWorks wants Troy to be more visible to people in the neighborhood, in order to encourage visitors. Some parts of Troy are barely visible from other parts of Troy. Community GroundWorks wants community members to engage with aspects of the land beyond their usual routines.
- Troy has an overabundance of meeting spaces, some of which are not used very often, including significant patches of lawn.
- Community Groundworks and Troy Gardens provide ample opportunity and incentive for community involvement, in the form of inexpensive land and educational/recreational events.
- They have interpretive signs and trails that are outdated, and do not reflect current upkeep and functions of different areas on site.
- Our contact, Shelly, asserted that she does not like to see land go idle. Yet the farm has only limited season extension opportunities. The farm is limited by a lack of water access after October, when the city shuts off the pumps that the farm uses during the growing season.
- The many branches of the organization and land provide opportunities for a variety of interactions. However, staff informed us that different parts of the site are isolated from each other, even for staff. Our contact mentioned that many people think that the property stops at the Wildlife Corridor. Meanwhile, there are dozens of trees around the perimeter of the site that provide edible products.

The following section provides three alternate restoration plans guided by goals, balancing the issues and resources detailed in the site inventory, and guided by our natural and constructed reference communities.

7. 'Connectivity and Flow…'
1st Restoration Design Alternative

In this plan alternative, we focus on increasing connectivity between different aspects of the land and different staff throughout the organization. We also try to make the land more visible and accessible to visitors. We do so through connecting the different patches of land to each other – land that supports habitat for wildlife and pollinators, as well as for people.

Pollinator Corridor – Edible Woodlands – Replace Lawn – Replace Infested Prairie – Rain Garden – Wildlife Corridor – Replace Buffer Zone

A. Pollinator Corridor

- We will create a pollinator corridor by connecting the Old Field to the edge bordering the prairie restoration. The corridor will follow the north end of the Wildlife Corridor, bridging the Maple woodland and food forest, edging along the Old Field and following the boundary between the prairie and farm. It will edge around the farm back towards the Wildlife Corridor. We strongly emphasize the inclusion of native species, as seen on the planting list, in order to increase the presence of a variety of pollinators.

Planting List for Pollinator Corridor:
Swamp Milkweed
American Columbine
Butterfly Flower
Sky Blue Aster
Pale Purple Coneflower
Rattlesnake Master
Spotted Joe-Pye Weed
Wild Geraniu
Prairie Blazing Star
Cardinal Flower
Great Blue Lobella
Wild Bergamot Golden Groundsel
Grey-Headed Coneflower
Black-Eyed Susan
Sweet Coneflower
Stiff Goldenrod

- This aspect of the plan fulfills several outlined goals: increasing habitat space, increasing biodiversity, and increasing the use of native plants. By forming a pollinator corridor rather than a segmented garden, we increase the surface area of the land dedicated to pollinator habitat, and also increase the fluidity of such a space. Increased fluidly will spur pollinators to inhabit a larger area of Troy Gardens.
- When deciding where to place the corridor, we made sure to include a portion within the edible forest. We hope that the pollinator corridor in combination with the fruit trees will lead to a more effective and desirable habitat for the bees. By selecting primarily native plants, we are increasing the likelihood that native pollinators will frequent the area. We are also enhancing the biodiversity by expanding on the species already in existence at Troy Gardens.
- By creating a corridor that caters to pollinator needs, the overall connectivity of the land is increased.

B. Edible Woodlands

- The edible forest provides food and invites recreation. Our restoration alternative focuses on its expansion. This expansion will increase community interest, as visitors will gain awareness of this interactive section. The edible forest will be expanded into the Old Field.
- Edible forest gardens are made up of various perennial edibles. When managed correctly, this polyculture system produces significant economic and environmental benefits. It does not require the time and energy investments of growing non-perennial crops and monocultured vegetables.
- The edible forest accomplished both ecological and human services. As mentioned previously, the edible forest promotes biodiversity and pollinator habitat through the inclusion of the pollinator corridor. In addition, the edible forest is a food source for people,
- By increasing the edible forest, we also hope to promote community involvement. Presently, many people do not travel beyond the community gardens, but hopefully the incentive of fresh food will lead to greater utilization of the land by community members.
- This list is meant as an addition to the current plantings. Some plants on this list already grow in the edible forest – we hope to increase their presence. Below, we review the planting guides for the following Layers: Canopy, Low-Tree, Shrub, Herbaceous, Groundcover, and Rhizosphere.

Canopy Layer

- Spacing: The canopy trees will be placed 10-15 feet apart, with rows that are about 20 feet apart. Apple trees will be given greater room, as they typically need a space of 35' by 35' feet, while cherry trees typically need 20' by 20'. This layer is characterized by trees that are 9 meters high or more.

Plant List	Plant Characteristics
Mulberry	Thrive in even harsh climates, could be used as forage for chickens
Black Willow	Promotes pollinators, native to WI
Black Cherry	Native to WI, Edible fruit but poisonous leaves)
Crab Apple	-
Box Elder	-

Low-tree layer

- This layer typically contains shade tolerant trees, and should be pruned in order to optimize light.
- Spacing: each of the smaller trees will require an area of approximately 10' by 10'. This layer is characterized by trees that are 4 meters high.

Plant List	Plant Characteristics
White Walnut	To increase population, does best on well drained soils
Contorted Willow	-

Shrub layer

- This layer is characterized by woody perennial plants. These plants will contain flowers and fruit as well in order to increase wildlife presence. Plants were also selected on their ability to fix nitrogen
- Spacing: the nitrogen fixing shrubs will be interspersed in the rows containing canopy trees. Shrubs typically require 2 feet of separation between other plants and structures.

Plant List	Plant Characteristics
Sea Buckthorn	-
Siberian Peashrub	-
Eastern Redbud	-
Elderberry	Avoids frost damage due to date of bloom in early summer
Roughleaf Dogwood	Promotes birds
Wolfberry	Attracts wildlife, flowers present in May and June

Herbaceous layer

- This layer is characterized by perennial vegetables and self-seeding annuals. It can include a large portion of plants from the pollinator corridor plant list.
- Spacing: The Herbaceous layer must negotiate the shade from the canopy when determining layout.
- We must also consider available water, as the tree roots will limit available water to the herbaceous layer.

Plant List
Asparagus
Dill
Asparagus
Rhubarb
Lemongrass

Groundcover layer

- This layer is characterized by plants that reach a height less than 30cm. The goal of this layer is to incorporate species that can form a living mulch, keeping in moisture and soil.

Plant List
Boston Ivy
Purpleleaf Wintercreeper Euonymus
Japanese Pachysandra

Rhizosphere layer

- This layer is characterized by species with edible roots and tubers.
- Spacing: within rows, they should be planted about 1 inch apart, with rows spaced up to 4 inches apart. Winter varieties will need greater room, with about 15 inches between rows.

Plant List
Radishes
Turnips
Beets

C. Replace Lawn with More Garden Plots

- The current lawn space at Troy Gardens in underutilized. Our plan focuses on increasing effective use of the land.
- We advise placing more community gardens in the current lawn space, leaving room for added infrastructure by the hoop houses. This may also promote further exploration of the land by community gardeners.
- By reducing mowing, and increasing garden plots, we are able to accomplish established objectives. For instance, by reducing the amount of lawn space that needs to be mowed, we are able to promote soil health through increased nutrient retention.
- By expanding community garden plots, community members will have greater access to fresh and local food. This reorganization of the land additionally provides Troy Gardens with room to grow, making space available for added infrastructure. The organization wants to build an additional hoop house, and now would have a realistic location for such.

D. Replace Infested Prairie with Rain Garden

- The Southwestern-most corner of the prairie is overrun with the invasive plant Crown Vetch. Removing this patch of invasive species will minimize the risk of infesting the rest of the prairie. Prior analysis has suggested that the prairie can be mowed and the crown vetch eliminated through repetitive mowing, at least weekly (2013).
- Flooding occurs at the bottom of the prairie. In order to encourage water to infiltrate, we will recontour the land to a berm/swale model (a berm is a hill, and a swale is a depression) so that a Rain Garden can be built in the swale.
- A Rain Garden will sustain native wetland plants along the edges of the prairie. Plant roots will support re-development of soil structure after re-contouring. The Rain Garden and surrounding plants will capture that water for underground recharge, evaporation, or uptake by plants, to prevent run-off and erosion. Erosion will also be inhibited by perennials planted throughout the prairie's bare patches.

Rain Garden

- The plants for the Rain Garden are prevalent in wet prairies (Curtis 1959).
- Plugs will be planted, in order to immediately provide structure to this disturbed soil.
- Spacing: Path Rush will be planted along the berm, and will interweave - as it trails down into the swale - with drifts of Blue Flag. Farther back into the depression will be Sloughgrass, then farther back the Water Hemlock. Sloping back up towards the prairie will be the Prairie Blazingstar, then New England Aster and Prairie Dock.

Plant List
New England Aster
Prairie Dock
Prairie Blazingstar
Blueflag
Water Hemlock
Sloughgrass
Path Rush

Prairie Perennials

The following plants will be seeded in bare spots through the rest of the prairie, to establish perennials that will further inhibit erosion. These plants are prevalent in Southern Mesic Prairie (Curtis 1959). Additionally, they are already present in the prairie, and so can provide the seeds for their proliferation.

Plant List
Smooth Aster
Stiff Coreopsis
Canada Wild Rye
Indian Grass
Prairie Dropseed
Tall Cinquefoil

E. Build Rain Garden in Wildlife Corridor

- Many visitors fail to realize that Troy Gardens extends beyond the Community Gardens. A water feature and gathering space would show-off and utilize this area, drawing visitors further back into the property. This change also water to infiltrate the ground, instead of running off and eroding the soil.
- We will countour a depression to the top border of the Wildlife Corridor to establish another Rain Garden, planting plugs of Blueflag, Water Hemlock, and Path Rush in the depression. Behind them we will plant interweaving drifts of the Canada Wild Rye, Prairie Blazingstar, and Stiff Goldenrod.

Plant List
Blueflag
Water Hemlock
Sloughgrass
Path Rush
Canada Wild Rye
Prairie Blazingstar
Stiff Goldenrod

F. Replace Buffer Zone with Low Edible Shrubs and Natives

- In this area, plants are sparse, and large swaths dominated by a grass monoculture.
- Native plants will replace grass monoculture.
- We will dig out some of the larger invasive shrubs. Then, co-housing inhabitants and visitors will have a clearer view of the farm, encouraging connectivity between different parts of the Troy property. Beautiful plants and a self-renewing food source for people will increase awareness of the co-housing site.
- We will plant one of each of the following, from cuttings derived from the plants that already proliferate in the prairie (2010).

Plant List	**Plant Characteristics**
Roundhead Bushclover	Interesting texture in winter, fixes nitrogen
Prairie Dock	Large and showy, attracts butterflies
Compass Plant	Large and showy, attracts butterflies
American Hazelnut	Edible, will encourage interaction from co-housing residents

Advantages of "Connectivity and Flow" Plan

- Community gardens must be inclusive. Our restoration alternative creates broader access to the site with more holistic and multifunctional engagement with the land. This plan strives to augment the link between the land and its community members by enhancing visibility, promoting connectivity, and working to improve communication (Holland 2004).
- A central component of our restoration alternative is the promotion of pollinator habitat. In 2016, bees were added to the endangered species list for the first time, highlighting the necessity to alter certain land management strategies. By selecting native plant species based on their desirability to pollinators, we will hopefully provide space throughout Troy Gardens to facilitate the growth of a variety of pollinators.

Disadvantages of Connectivity and Flow Plan

- Our plan would be stronger if it contained more precise instructions for responding to invasive species. While we are hoping to expand the edible forest in order to increase food production, and reduce the time commitment associated with production of annual species, the area may be susceptible to more invasive species.
- Feasibility: while there are many aspects incorporated into our restoration plan, some are costly and time-intensive. Rerouting the road and adding infrastructure through added hoop-houses would be difficult to implement.
- Elements of sustainability were not entirely enhanced in this restoration alternative. For instance, we did not integrate any animals as a source of grazing or a food source. An addition of chickens or goats could lead to greater food production and more effective use of the land. While this would require a change in zoning, such a step may lead to many more opportunities for the land.

8. 'Capture, Cleanse, and Store!'
2nd Restoration Design Alternative

Part I. Area Profiles and Plant Selections

"A Areas": Edible Shrubbery and Beautiful, Perennial understory

These segments will be characterized by a diverse selection of edible shrubbery and understory perennial plants. Most of these selected spaces exist on the border between distinct areas (i.e. those that have been designated for disparate land uses) throughout the Troy Gardens property. For this reason, there is great potential for these spaces to act as welcoming entry-ways and navigable bramble patches, which effectively encourage individuals to walk further and explore all there is to explore within the Troy Gardens property. The following plants will be incorporated into the restoration of this area:

Plant List	Botanical Name	Plant Characteristics
Swamp Milkweed	*Asclepias incarnata*	
Butterfly Flower	*Asclepias tuberosa*	
Sky Blue Aster	*Aster azureus*	
Wild Geranium	*Geranium maculatum*	
Cardinal Flower	*Lobelia cardinalis*	
Great Blue Lobelia	*Lobelia siphilitica*	
Black-Eyed Susan	*Rudbeckia hirta*	
Large Flowered Trillium	*Trillium grandiflorum*	
Creeping Jacob's-Ladder	*Polemonium reptans*	
Scarlet runner bean	*Phaseolus coccineus*	Edible; annual
Nasturtium	*Tropaeolum majus*	Edible, annual

"B" Areas: In situ Landscape Reinvigoration

Currently existing on various levels of degraded segments within the Troy Gardens landscape (those that more or less border the CSA Farm space), these areas will be dedicated to plant selections dedicated to water capture and filtration, in-situ soil remediation and rejuvenation, and encouragement of wildlife habitat. This means there will be a healthy and strategic diversity of pollinator, cover crops, and rain garden (i.e. wetland) plant communities.

The following plants will be incorporated into the restoration of this area:

Wisconsin Natives and Pollinators:

Plant List	Botanical Name	Plant Characteristics
Swamp Milkweed	*Asclepias incarnata*	
Butterfly Flower	*Asclepias tuberosa*	
Sky Blue Aster	*Aster azureus*	
Wild Geranium	*Geranium maculatum*	
Cardinal Flower	*Lobelia cardinalis*	
Great Blue Lobelia	*Lobelia siphilitica*	
Black-Eyed Susan	*Rudbeckia hirta*	
Large Flowered Trillium	*Trillium grandiflorum*	
Creeping Jacob's-Ladder	*Polemonium reptans*	

Bio-remediators/Wetland Filtration Plant Species:

*****The below varieties are listed in order of highest concentration to lowest concentration, with those at the top of the list being particularly more adept at purifying and filtering water.

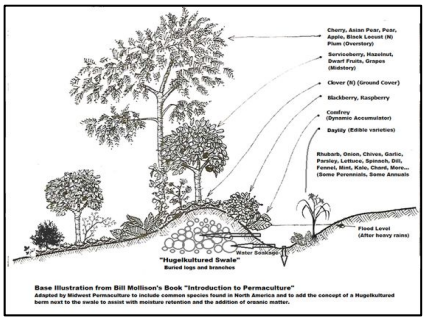
Plant List	Botanical Name	Plant Characteristics
Bulrush	*Scirpus validus*	
Cattail	*Typha spp.*	Wildlife value
Soft rush	*Juncus effusus*	Fiber plant
Chokeberry	*Aronia spp.*	Wildlife value
Cranberry	*Vaccinum macrocarpon*	Wildlife value; foliage
Day lily	*Hemerocallis fulva*	Alkaline tolerant

Cover Crop Plant Species:

Common Name	Botanical Name	N-fixer	Soil preference	Tolerates poor soil	Height	Insectary	Comments
Alfalfa	*Medicago sativa*	•	Loam		2-3 ft	•	well-limed soil
Birdsfoot trefoil	*Lotus corniculatus*	•	Many	•	3-5 ft	•	drought resistant
Chicory	*Cichorium intybus*		Heavy	•	2-3-ft	•	opens heavy soil
Clover, strawberry	*Trifolium fragiferum*	•	Many		1 ft	•	needs moisture
Clover, white Dutch	*Trifolium repens*	•	Many		6-10 in	•	needs moisture
Clover, white Ladino	*Trifolium repens*	•	Many		1 ft	•	needs moisture
Clover, white New Zealand	*Trifolium repens*	•	Many		1 ft	•	needs moisture
Fescue, creeping red	*Festuca rubra*		Many		2-3 ft		
Orchardgrass	*Dactylis glomerata*		Many		1-2 ft		
Ryegrass, perennial	*Lolium perenne*		Heavy		2-3 ft		
Timothygrass	*Phleum pratense*		Heavy		2-3 ft		needs moisture

"C" areas: Food Forest Expansion

Figure A: Diagram of a Sustainable Food Forest Design (Mollison)



These areas will be an extension of the edible woodlands, essentially looping around the prairie restoration site on the north side of the property. These segments of the landscape remediation project will feature a variety of self-maintaining plant guilds centering around strategically-selected fruit and nut trees. Species selected for these guilds will fulfill crucial roles that exist naturally in a forest landscape whilst likewise being edible; see appendix for further elaboration upon our selected forest garden guilds.
The following plants will be incorporated into the restoration of this area:

Plant List	Botanical Name	Layer	Plant Characteristics
Apple	*Malus pumila*	Tall-Tree Layer	Insectary/edible
Asian Pear	*Pyrus pyrifolia*	Tall-Tree Layer	Edible
Cherry	*Prunus cerasus, P. avum*	Tall-Tree Layer	Wildlife value, insectary, edible
Honey Locust	*Gleditsa triacanthos*	Tall-Tree Layer	Wildlife value/insectary
Apricot	*Prunus armenica*	Low-Tree Layer	Insectary/edible
Apple, dwarf/semi dwarf	*Malus pumila*	Low-Tree Layer	Insectary, edible, wildlife value
Cornelian Cherry	*Cornus mas*	Low-Tree Layer	Wildlife, edible
Golden Chain Tree	*Laburnum spp*	Low-Tree Layer	Nitrogen fixer
Medlar	*Mespilus germanica*	Low-Tree Layer	edible
Mulberry	*Morus spp.*	Low-Tree Layer	Wildlife value/edible
Paw paw	*Asimina trilobata*	Low-Tree Layer	Edible
Peach (both dwarf and non)	*Prunus persica*	Low-Tree Layer	Insectary, edible
American Persimmon	*Diospyrus virginiana*	Low-Tree Layer	edible
Quince	*Cydonia oblongata*	Low-Tree Layer	edible
Japanese barberry	*Berberis thunbergi*	Shrub layer	Wildlife value
Goumi	*Elaegnus multiflora*	Shrub layer	Nitrogen fixer, wildlife value, edible
Nanking cherry	*Prunus tomentosa*	Shrub layer	wildlife value, insectary, edible
Blackberry	*Rubus spp.*	Shrub layer	Wildlife value, edible
Elderberry	*Sambucus spp.*	Shrub layer	Wildlife value, edible
Raspberry	*Rubus idaeus*	Shrub layer	Wildlife value, edible
Kiwifruit, hardy	*Actinidia arguta*	Vine Layer	Insectary
Clematis	*Clematis spp.*	Vine Layer	insectary
Hops	*Humulus lupulus*	Vine Layer	Wildlife value, insectary, edible
Scarlet runner bean	*Phaseolus coccineus*	Vine Layer	Edible; annual
Nasturtium	*Tropaeolum majus*	Vine layer	Edible, annual
Lignonberry	*Vaccinum vitis-idaea*	Ground Cover Layer	Edible
Prostrate Verbena	*Verbena peruviana, V. tenera*	Ground Cover Layer	Insectary
Strawberry	*Fragaria spp.*	Ground Cover Layer	Insectary, edible
Camas	*Camas quamash*	Root Layer	Insectary, edible
Biscuit root	*Lomatium spp.*	Root Layer	Wildlife, insectary, edible
Earth chestnut	*Bunium bulbocastanum*	Root Layer	Wildlife, insectary, edible
Mountain Yam	*Dioscorea batatas*	Root Layer	edible
Ramps	*Alium tricoccum*	Root Layer	edible

"D" areas: Ex-situ Soil Building and Compost Creation

These areas are dedicated to varied strategies for building nutrient-rich, quality compost and soil amendments. These strategies include segments that are specifically dedicated to the following elements:

- Intensive composting infrastructure (i.e. a four-bin turning system, half of which would be insulated to remain functional during the wintertime)
- Behind the compost infrastructure is a chicken coop, which is built to comfortably house ~15 chickens. The chicken coop is designed to accommodate a mobile run and is connected to an electric fencing system, which is large enough to surround the compost infrastructure. The coop will also feature a rain barrel system to capture its own water supply along with an optional heating system via piping hook-ups to the insulated portion of the composting system (for the winter months). The yard surrounding this entire chicken-coop area (aside from the pathway leading up to and immediately in front of the compost) is planted intensively with poultry forage plants and dynamic accumulator crops of all sorts (i.e. those that may be harvested and added to the compost regularly in order to establish a healthy balance of nutrients throughout the finished product)
- One might also consider constructing a chicken tractor (see diagram below) as part of this section, which would enable the chickens to be moved around the entire Troy Gardens property (if desirable).

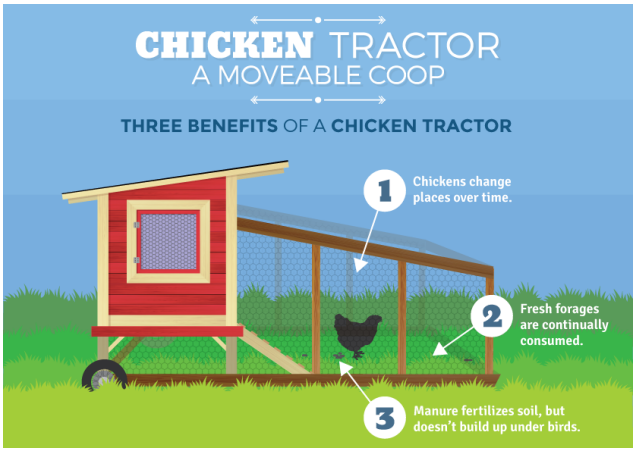


Figure B: Diagram Chicken Tractor; sourced from website

- The area surrounding and leading up to the compost is made up of a thickly-laid wood chip path, which is inoculated with Garden Giant mushrooms during the growing season (these help to break down woodchips into rich and clean soil); the idea here is that the material making up this pathway, once sufficiently broken down, can be replaced with new wood chips after being collected as a carbon source for the composting system.
- Additionally the woodsy portion of area D will be planted to produce mainly compost activator crops and carbon sources, with strategic woodchip pathways and seating areas scattered throughout. All of this would be accompanied by signage to communicate the purpose and role of this design as a means for actively building and remediating the soil throughout Troy Gardens.
- The following plants will be included in the restoration of this area:

Poultry Forage Plants

Plant List	Botanical Name
Mulberry	*Morus spp*
Currant	*Ribes spp.*
Serviceberry	*Amelianchier spp.*
Buckwheat	*Fagopyrum esculentem*
Alfalfa	*Medicago sativa*
Clover	*Trifolium spp.*

Dynamic Accumulators

Plant List	Botanical Name	Plant Characteristics
Alfalfa	Medicago sativa	Nitrogen and Iron
Borage	Borago officinalis	Potassium and Silicon
Bracken Fern	Pteridium aquilinum	Phosphorus K (Potassium) Fe (Iron) Mn (Manganese) Zn (Zinc) Cu (Copper) Co (Cobalt)
Comfrey	Symphytum officinale	Nitrogen, potassium, calcium, magnesium, iron, silicon
Geranium	Pelargonium spp.	Manganese, iron, copper, cobalt, zinc
Lamb's quarters	Chenopodium album	Nitrogen, phosphorus, potassium, calcium, manganese
Mustards spp.	Brassica spp.	Phosphorus, calcium, sulfur, manganese, copper, zinc
Sunflower	Helianthus annuus	Calcium, manganese, copper, zinc
Purslane	Portulaca oleracea	Potassium, magnesium, manganese
Yarrow	Achillea millefolium	Nitrogen, potassium, phosphorus, copper

Fodder Plants (carbon sources)

Plant List	Botanical Name	Plant Characteristics
Silk Tree, Mimosa	Albizia julibrisin	Nitrogen fixing shrub
Black Locust	Robinia pseudoacaia	Nitrogen fixing tree
Willow	Salix spp.	Good for moist areas

"E" areas: Space for Research and Processing Infrastructure

- This will consist of further season extension infrastructure, while improving the infrastructure currently in place. Improvements will include: adding water collection systems to the existing hoop house; building a temporary (collapsible) washing station next to the hoop house, which also includes water capture devices.
- These areas are infrastructure based and do not include plant selections

"F" areas: Community gathering and event space

- These spaces are intended to bring people into areas of Troy Gardens that are currently not commonly frequented, and to bring together various different groups that currently exist largely in isolation from one another. They also may serve as outdoor classroom spaces for groups visiting the space and provide the potential for hosting other small-scale events at Troy.

Plant List	Botanical Name	Plant Characteristics
Swamp Milkweed	*Asclepias incarnata*	-
Butterfly Flower	*Asclepias tuberosa*	-
Sky Blue Aster	*Aster azureus*	-
Wild Geranium	*Geranium maculatum*	-
Cardinal Flower	*Lobelia cardinalis*	-
Great Blue Lobelia	*Lobelia siphilitica*	-
Black-Eyed Susan	*Rudbeckia hirta*	-
Large Flowered Trillium	*Trillium grandiflorum*	-
Creeping Jacob's-Ladder	*Polemonium reptans*	-
Nasturtium	*Tropaoleum majus*	Antibiotic; expectorant
Chives	Allium schoenoprasuum	-

"G" areas: Improvements to Existing Landscapes and Infrastructure

- These are areas that will not be changed in essence but rather improved; these will include the north end of the prairie restoration and the existing gathering space in front of this area, the Organic CSA Farm, the existing orchard, the community gardens/kids garden, the existing portion of the edible woodlands, and the Maple Woodland.

Part II. Design Plans and Restoration Goals

1. Human Services

Gathering spaces

A. Increased communication and coherence between factions of Troy Gardens

B. Engages the community surrounding the farm

Education

A. Interpretive signage explaining functional elements of the landscape design

B. Increase production of fresh, healthy, culturally-relevant food

Garden plot expansion

1. Family plots—larger
2. Season extension
3. Shared food forest crops

Figure A: Five Water-Conserving Methods and Their Benefits

2. Ecosystem Services: Provisioning, Regulating, Cultural

Water: Infiltration and Quality – Capture and Storage for Farm Use
Soil Quality: Topsoil retention **-** Soil Nutrient building - Soil Decontamination - Creation of new soil via improvements to Composting system
Soil Structure: Reducing Compaction

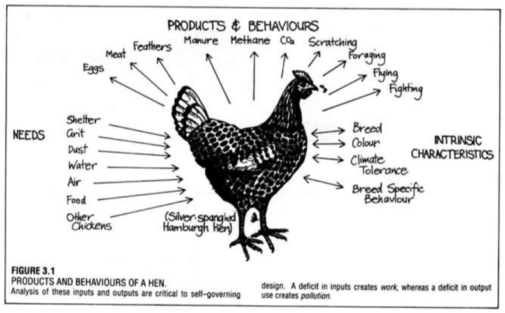


FIGURE 3.1
PRODUCTS AND BEHAVIOURS OF A HEN.
Analysis of these inputs and outputs are critical to self-governing design. A deficit in inputs creates work, whereas a deficit in output use creates pollution.

Water

Infiltration & Quality

- As a rule of thumb, the goals of encouraging increased water infiltration and improving the quality of the water retained on site (in addition to any water that may happen to run off of the site and into the nearby watershed), will be managed by this plan from a number of different angles. Most broadly, this process will be guided by strict attention paid to the five water-conserving methods, which are listed and further explained in figure A, below (Gaia's Garden).
- More specifically, this plan encourages increased water infiltration via strategically-placed contoured swales, straw filled swales, and fish-scale swales. These will be implemented primarily throughout the CSA Farm area, edible forest garden expansion sites, and in-situ landscape reinvigoration areas and will be- more or less- made as amendments to the existing landscape. (see Figures b-d, below)
- Additionally, the installation of carefully-managed cover cropping throughout the "in-situ landscape reinvigoration" areas will likewise improve both water retention and the landscape's capacity for water quality improvement (Please see plant profiles for further elaboration upon root systems, etc.)
- A bio-remediation gray water wetland (see figure below) will function to capture and filter any run-off that would move down the landscape toward the CSA Farm area from the railroad tracks.

Method	Benefits
High organic matter content	Holds moisture
	Adds fertility
	Stores nutrients
	Boosts soil life
	Fluffs soil
	Sequesters carbon
Deep mulching	Slows evaporation
	Cools soil
	Adds fertility
	Boosts soil life
	Smothers weeds
	Arthropod and microbe habitat
Locate plants according to water needs	Conserves water
	Less labor for watering
	Survive drought
	Encourages native plants
Dense plantings	Shades soil
	Smothers weeds
	Increases biodiversity
	Increases yields
Soil contouring	Catches water
	Directs water where needed
	Helps plants and soil life survive both wet and dry periods
	Builds humus
	Adds visual interest

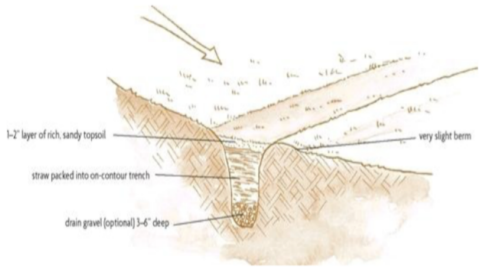


Figure B: Straw-Filled Swale (Gaias Garden)

Figure C: Fish-scale swales (Gaia's Garden)

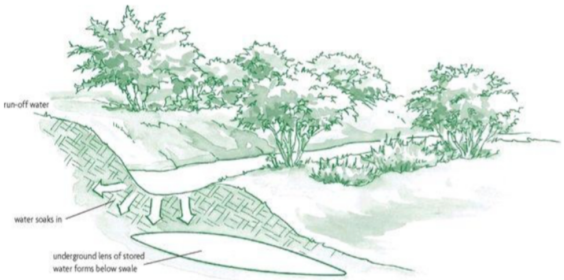


Figure D: Contour Swales (Gaia's Garden)

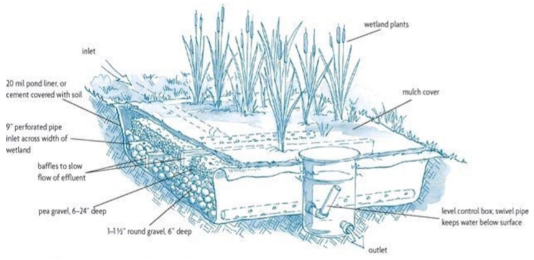


Figure E: Diagram of Back-yard Wetland Design (Gaia's Garden)

Capture and Storage of Water for Use on Farm

Quite a few more water capture installations will be implemented as part of this plan, such as:

- Rain barrels raised on shipping-pallet platforms, which will be scattered all throughout the community gardens areas as a supplement to the existing water source for these plants;
- Additional water capture infrastructure will be implemented within the research and community gathering space, which is shaded purple on the map around the Wildlife Corridor area of Troy.

Figure H: Rain Barrels for Community Gardens (web)

Soil Quality

Topsoil retention
Soil Nutrient building
Soil Decontamination
Creation of new soil via improvements to Composting system

Soil Structure:

Reducing Compaction

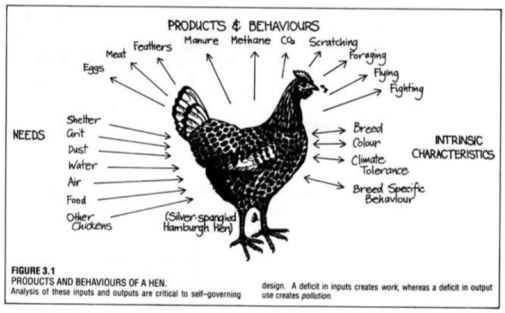
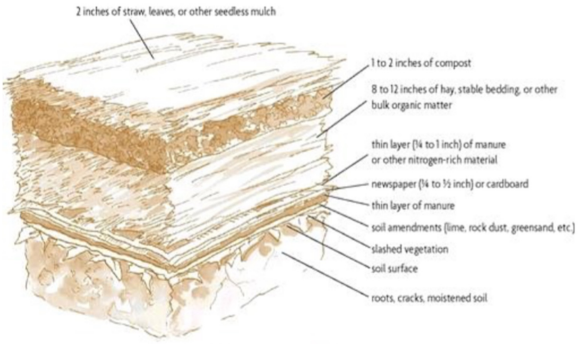


Figure I: the inputs and outputs of a chicken (Permaculture: A Designer's Manual, Mollison)

- The improvement of the soil onsite is a major focus of this particular landscape restoration alternative. Indeed, much of the bigger picture of this particular design is dedicated to varied strategies for generating a steady supply of nutrient-rich, quality compost and soil amendments.
- These strategies include the following design objectives:

- Chicken-keeping facilities will be installed on site to provide living quarters for ~15 chickens. These chickens will both provide a steady source of nitrogen fertilizer and will enable Troy Gardens to expand upon and process their compost more efficiently.
- An assortment of dynamic accumulators will be planted around the composting processing infrastructure, providing a steady supply of whatever mineral may or may not be lacking at any certain point. Please see the planting specifications in part three for further elaboration. Sheet mulching will be employed throughout the compost generation station (see figure below for model that will be employed.)



- Compaction will be reduced through cover cropping and sheet mulching techniques (see below).

(Figure J: Sheet Mulching Diagram; Gaia's Garden)

9. 'Fruit Basket'
3rd Restoration Design Alternative

"A" Areas: Permaculture Orchard

The orchard will be characterized by a diverse selection of edible fruit trees, shrubbery and understory perennial plants. It will stretch from the southwest corner of the prairie to the northeast corner of the prairie. Included in this space, the orchard will occupy the corner of the prairie with the lowest elevation that remains wet longest and collects invasive species.

Species would include: Malus pumila, Asimina trilobata, Prunus cerasus, P. avum, Cydonia oblongata, Sambucus spp., Rubus idaeus, Alium tricoccum, Elaeagnus x ebbingei, Fragaria x ananassa, Hippophae salicifolia, Malus domestica, Mespilus germanica, Pyrus communis sativa, Ribes nigrum, Ribes uva crispa, Rosa rugosa, Rubus idaeus, Sorbus domestica

"B" Areas: Pollinator Habitat

Pollinator strips will serve as borders between distinct areas (i.e. those that have been designated for disparate land uses) throughout the Troy Gardens property. For this reason, there is great potential for these spaces to act as welcoming, beautiful entry-ways and accessible flower patches, which will encourage individuals to walk further and explore all there is to explore within the Troy Gardens property. The strips would replace some land that is currently filled with potentially invasive shrubs, such as mulberry and sumac. This plan proposes clearing the woody shrubs and planting native grasses and flowers that would better support the permaculture orchard as well as the prairie.

Species would include: Asclepias incarnate, Asclepias tuberosa, Aster azureus, Geranium maculatum, Rudbeckia hirta, Lobelia cardinalis, Trillium grandiflorum

"C" areas: Food Forest

The food forest or edible woodlands borders the prairie and orchard on the west side of the property. The food forest will naturally flow into the orchard. While the food forest would be more self-maintained, the orchard will require management. But both segments will feature a variety of self-maintaining plant guilds with a preference for native, food-producing plants. Species selected for these guilds will fulfill crucial roles in a forest landscape whilst also being edible; see appendix for further elaboration upon our selected food forest guilds.

Species would include: Amelanchier grandiflora, Prunus Americana, Prunus serotina, Prunus virginiana, Amelanchier arobrea, Amorpha fruticosa, Ceanothus americanus, Corylus Americana, Hamamelis virginiana, Sambucus Canadensis, Asarum canadense, Asclepias incarnate, Asclepias tuberosa, Aster ericoides, Aster laevis, Aster novae-angliae, Aster sagittifolius, Caltha palustris, Campanula rotundifolia, Chelone glabra

"D" areas: Current and future infrastructure

This area includes the CSA farm, current and planned greenhouse and hoophouse, the new farm road, co-housing units, and the planned composting toilet.

"E" areas: Water capture

We propose to construct a pond and surrounding wetland area in the space currently used as a degraded farm road in between the southwest corner of the prairie and the community gardens. The pond area will be dedicated to plant selections dedicated to water capture and filtration, soil remediation and rejuvenation, and encouragement of wildlife habitat. This means there will be a healthy and strategic diversity of plants tolerant of wet conditions.

"F" areas: Community gardens

This area includes a planned expansion of the current gardens to include larger, family plots in the area used now as the grand lawn

10. Choice of Desired Solution

We decided to recommend the **Capture, Cleanse, and Store! restoration plan** as the desired solution. The Capture, Cleanse, and Store! plan provides the most impactful ecological and human services. The proposed composting system brings together soil building, water capture and infil
tration, native plant restoration, wildlife habitat and food production into one closed loop. Troy Gardens would be able to cut down on waste and benefit from all aspects of the system. The Capture, Cleanse, and Store! plan also provides the most opportunities for education and cohesion between the disparate parts of Troy Gardens. The composting system would be the central piece of the property and would be used by all stakeholders, whether farmers, community gardeners or prairie visitors.

11. **Project Documentation and Information Storage**

Project documentation for the Troy Gardens Restoration Plan consists of the digital version of this plan, hard-copies of maps of each alternative design, meeting notes, photographs from a site visit, and historical site data. The digital version of this plan will be sent to our contact at Troy Gardens. who will use the Troy Gardens shared digital storage to keep the plan available for future users. Keeping the restoration plan in shared digital storage will allow staff at the farm and garden access to the plan so that they can see and imagine what might be done differently. Ease of retrieval and longevity of the project document are both satisfied by keeping the plan in a shared digital storage space at Troy Gardens. It would be important to inform Troy Gardens Staff of the existence and location of the plan. Even if the plan is easy to find, it will only be found be those who know to look.

In order to keep the plan as secure and available as possible into the future, it is also recommended that Troy Gardens staff print a hard copy of the plan and keep it in an organized filing system with other plans that have been created for that space over the years. This would provide a back-up copy of the restoration plan in case of tech problems or internet failure.

12. Future Research at Troy Gardens: Natural Sciences

Troy Land and Gardens is already the host of many restoration efforts, research projects, and educational programs. There is the infrastructure and culture in place to have research projects stem from our restoration plan in the following areas.

Soil Properties:

It will be beneficial in the future to perform a soil test on the grounds of Troy Gardens. There are 8 characteristics that can be determined from such a test, and which in turn provide vital information about the site. These eight characteristics are : pH, texture, nutrient levels, organic matter, plant litter, and compaction. While some of these qualities are obvious simply based on the physical features of the soil, a soil test can provide details on the less clear properties. Specifically, knowing the amount of soil organic carbon could help us to address the water retention problems near the road and prairie edge. A research project could include conducting a soil test, and then formulating recommendations based on the results.

Pollinator tracking:

While a pollinator garden currently exists, we are recommending that the garden becomes more integrated with the rest of the farm. In order to ensure that investment in time, money, and other resources are being managed effectively-I would suggest developing a research program that tracks the occurrence of pollinators. This would be a two-part research project, focusing on a "before and after" tracking system in which prior to the alternation of the original garden, pollinators are tracked, and after alternation pollinators are tracked. This will give garden staff an idea of how effective the restoration project is, and perhaps provide room for improvements if necessary. A potential partner for such a project may be an undergraduate student, who ideally would be able to provide the materials needed for tracking, who would also gain valuable research skills from the project while providing Troy gardens with beneficial information, creating a symbiotic partnership.

Permaculture:

While permaculture was officially introduced into the United States in the 1980s, there is still a significant gap in research and literature between environmental science fields and the actual grassroots movement (Scott 2007). Based on analysis of the First International Permaculture Research Survey, most respondents noted a need for knowledge exchange, or research peer group (Schmidt). Community GroundWorks may work on creating a network within Madison by teaming up with Madison Area Permaculture Guild, in order to better determine what information is available, and what types of research can be conducted on site. In terms of the current literature, there appears to be a significant gap in research pertaining to the natural science side-such as the agro-biodiversity of permaculture in community garden settings. Few papers or research explicitly address the importance of biodiversity within permaculture, in the future, a systematic approach discussing how said plants are grown, what the motivation was, what factors contributed to selection, is needed (Guitart and Bryne 2012).

Compost:

As our chosen restoration plan places a large emphasis on composting, there are plenty of research projects associated with measuring and developing composting techniques. A smaller scale research project could focus on measuring the pH of compost mixes, and comparing the pH of the final compost product. pH values and microorganisms presence may also be measured in order to determine relationships between the two. In addition, field demonstrations using a control and multiple types of compost could demonstrate stability, maturity, and growth based on compost. This could be completed on a small area of land, such as the Children's garden. By incorporating one or multiple research projects centered on compost, we hope to alleviate some of the work of staff and promote community wide interest in composting.

13. Future Research at Troy Gardens: Socio-economic Research:

It has been noted that there is an identifiable gap in the literature relating to the socioeconomic benefits associated with restoration ecology. Future research needs to quantify ecosystem services and socioeconomic considerations. By providing a quantitative assessment, cost and benefit analysis of restoration projects will increase in accuracy (Wortley et al. 2013). While evaluating socioeconomic changes in relation to restoration ecology is a complex task, with a multitude of variables that must be considered, it is vital a component in furthering restoration success. Specifically, socioeconomic monitoring and evaluation is needed post-implementation, in order to provide factual costs and savings, rather than those predicted prior to a restoration project.

While evaluating socioeconomic impacts of restoration ecology is a lofty task, a smaller-scale assessment could be incorporated into Troy gardens. This could be done by quantifying food production on site, and the economic value associated (including the food forest, community garden, and organic farm), as well as through surveys of community members, and analysis of accessible data.

14. Acknowledgements for Each Team Member:

Tracy Campbell:

- Communicating and solidifying our partnership with Community GroundWorks
- Visiting Troy Gardens as a group (and documenting the visit with pictures)
- Creating an alternate restoration plan (ultimately collaborating with Amanda to produce a unified plan)
- Completing the "Research Projects" portion of the final report
- Attended our group meetings throughout the semester.

Amanda Hoffman:

- Researched and wrote Inventory and Analysis, Use Policy, and Summary of Community/Ecosystem Models
- Co-wrote Connectivity and Flow restoration alternative
- Final Edit of document
- Conducted a site visit at Troy Gardens along with group mates.

Carrie Lierl:

- Creation of Maps communicating the various Restoration Alternatives that our group designed
- Creation of map details for each alternative, in order to explain specific aspects of each specific plan
- Collaboration with other group members over the course of the semester in order to build a strong relationship with our community partner, Troy Gardens
- Participation in group research and trouble-shooting
- Designer of the "Capture, Cleanse, and Store" restoration plan
- Attended our group meetings throughout the semester.
- Conducted a site visit at Troy Gardens along with group mates.

Alex Steussy-Williams:

- Created the Fruit Basket Design Alternative
- Participated in group planning and research
- Conducted a site visit at Troy Gardens along with group mates
- Completed the Project Documentation and Information Storage section
- Presented our plan to classmates along with group mates.

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