



*TURNING
BROWNFIELDS INTO
ECONOMIC ASSETS
THROUGH URBAN &
COMMUNITY
FORESTRY*

A PRACTITIONER'S GUIDE TO ESTABLISHING
POPLAR TREE FARMS ON BROWNFIELD SITES

By Todd Parker, Senior Manager, Delta Institute



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Purpose of Guide

With this guide, Delta Institute intends to share its knowledge and experience in an easy-to-use format so that municipal and community leaders may replicate this work in other areas. This guide is divided into six sections, with each describing a major component of a phytoremediation project. Within each section are action steps, which one would carry out to implement a phytoremediation project. While Delta has included many of the actions steps which we have implemented in our phytoremediation projects, it is not an all-inclusive list. Implementing a similar project in your area may require additional or fewer steps, depending on your objectives, community considerations, and budget.

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Delta Institute is a 501(c)3 nonprofit organization that serves as a catalyst for environmental sustainability and economic development throughout the Great Lakes region. Delta works in partnership with business, government and communities in the Great Lakes region to create and implement innovative, market-driven solutions that build environmental resilience, economic vitality and healthy communities. Visit online at www.delta-institute.org.

Background

Phytoremediation is the process of using the natural functions of plants to remediate contaminated soil, sludge, sediment, ground water, surface water, or waste water. These functions include water and chemical uptake, metabolism within the plant, exudate release into the soil that leads to contaminant loss, and the physical and biochemical impacts of plant roots on soil. With phytoremediation, it is necessary to ensure that unwanted transfer of contaminant to other media does not occur. Phytoremediation is potentially applicable to a variety of contaminants, including some of the most significant contaminants, such as petroleum hydrocarbons, chlorinated solvents, metals, radionuclides, and nutrients.

With funding from the Great Lakes Restoration Initiative, through the USDA Forest Service, Northeastern Area State and Private Forestry, Delta Institute (Delta) has established hybrid poplar tree farms on brownfield sites in Muskegon, Michigan for the dual purpose of integrating environmental improvement with community economic development.

Hybrid poplars are excellent for phytoremediation because they grow rapidly and take up contaminants, like heavy metals, chlorinated solvents and volatile organic compounds (VOCs).¹ Heavy metals are toxic to aquatic life at certain concentrations and can bio-accumulate in the fatty tissue of fish, leading to fish consumption advisories. Chlorinated solvents and VOCs, like benzene, toluene, and trichloroethylene (TCE), can persist for years in the soil and ultimately percolate into a community's drinking water.

Poplar trees also absorb significant amounts of water, reducing stormwater run-off, which the U.S. EPA had identified as the most important remaining uncontrolled source of water pollution.² Stormwater carries sediment, oil, grease, toxics, pesticides, pathogens, and heavy metals into nearby storm drains, where it usually enters local streams and waterways.³

Delta's work advances phytoremediation a step further, by incorporating community economic development. Delta wants to create a source of wood fiber for a local wood product manufacturer. Hybrid poplars are among the fastest growing trees in North America, producing between 4 and 10 dry tons of wood per year and achieving a height of up to 60 feet in as little as six years.⁴ Poplar tree farms are well-suited to the production of fiber for bio-energy, as well as, lightweight wood for cabinets, doors and paneling.

Ultimately, creating poplar tree farms on brownfield sites improves soil and water quality and creates economic opportunity, while providing a clear case study and model that can be replicated in other communities. Our work also demonstrates that community forestry provides an opportunity to return vacant industrial land into an economic asset.

1 DONALD DICKMANN ET AL, POPLAR CULTURE IN NORTH AMERICA. NRC-Research Press. (2001). See also U.S. ENV'T'L PROT. AGENCY, PHYTOREMEDIATION – TRANSFORMATION AND CONTROL OF CONTAMINANTS (S.C. McCutcheon & J.L. Schnoor, eds., 2003). See also U.S. ENV'T'L PROT. AGENCY, PUBL'N NO. EPA 542-B-99-003, EVALUATION OF PHYTOREMEDIATION FOR MANAGEMENT OF CHLORINATED SOLVENTS IN SOIL AND GROUNDWATER (2005).

2 U.S. ENV'T'L PROT. AGENCY, LAKE MICHIGAN LAKEWIDE MANAGEMENT PLAN, 7-9 (2008).

3 U.S. ENV'T'L PROT. AGENCY, PUBL'N NO. EPA 841-B-05-004, NATIONAL MANAGEMENT MEASURES TO CONTROL NONPOINT SOURCE POLLUTION FROM URBAN AREAS (2005), available at <http://water.epa.gov/polwaste/nps/urban/index.cfm#02> (last accessed July 8, 2011).

4 See G. TUSKAN, POPULAR POPLARS: TREES FOR MANY PURPOSES, available at <http://bioenergy.ornl.gov/misc/poplars.html> (last accessed March 3, 2011).



PHYTOREMEDIATION DECISION PROCESS

Step 1:

Identify and Evaluate Potential Brownfield Sites

June – September

Step 2:

Create a Landscape Plan and Order Trees

October – December

Step 3:

Hire a Contractor

March – April

Step 4:

Plant the Trees

Mid May – Mid June

Step 5:

Site Monitoring and Maintenance

July – October

Step 6:

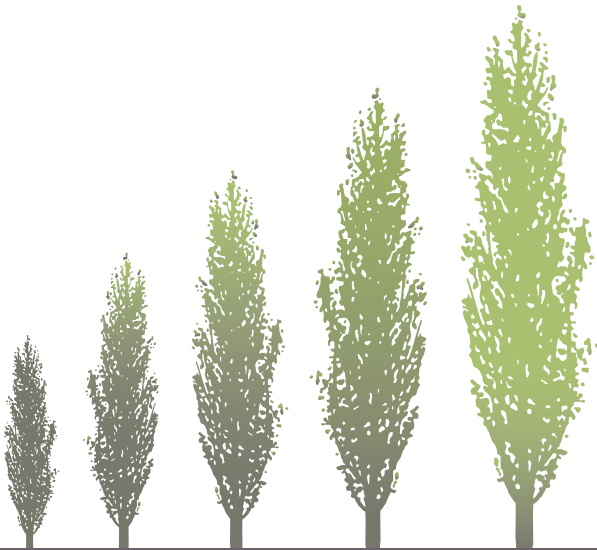
Quantifying the Uptake of Contaminants

October of 2nd Growing Season

Step 7:

Considering the End Use of Poplar Trees

Year Round



Identify and Evaluate Potential Brownfield Sites

The initial step to implementing a phytoremediation project is identifying and evaluating potential brownfields sites. This begins with site characterization, which includes the following elements:

- » Size of parcel
- » Ownership of parcel (public/private)
- » Development potential of parcel
- » Past industrial uses
- » Known or suspected contaminants
- » Community considerations



Phytoremediation can be implemented on any size site. However, it is most cost effective on sites that are an acre or more in size. Larger sites allow for machine planting, which is a more cost effective and efficient alternative to hand or auger planting. Phytoremediation is advisable for sites that are not development ready or will not be development ready for ten years or more. Private ownership can be more desirable than public ownership, since planting decisions can be made without public participation. However, privately owned sites have a higher risk of development, meaning the trees might be harvested too early. The longer the trees can remain on the site, the greater the reduction in soil and groundwater contamination. And, if the trees are allowed to grow for 10 years or more, the landowner will have more utilization options when it comes to removing the trees.

Site ownership will also determine what, if any, site control agreements are necessary. Prior to planting, the landowner and project manager need a clear understanding of site access requirements, data gathering and ownership of the trees. Landowners, particularly private landowners, can be very sensitive about the amount and type of information discovered regarding the site, as the planting activities may create additional liability or 'due care'⁵ responsibilities. It is also critical to determine who owns the plant material and is responsible for its short-term care and long-term removal. For grant funded planting projects, it is common for the project manager to have control over the trees for the duration of the grant. Once the grant period ends, ownership of the trees generally reverts to the landowner, unless other provisions have been agreed to. See Appendix I for a sample property access agreement.

⁵ US Legal.com, Due Care Law & Legal Definition, <http://definitions.uslegal.com/d/due-care/> (last visited 12/15/14) (defining due care as "the effort made by an ordinarily prudent or reasonable party to avoid harm to another, taking the circumstances into account. It refers to the level of judgment, care, prudence, determination, and activity that a person would reasonably be expected to do under particular circumstances.")



A critical part of the site selection process is obtaining information about the soil contaminants. Ideally, site contaminants have already been identified, either through Phase 1 or Phase 2 Environmental Site Assessments⁶ or anecdotal knowledge of the site's commercial/ industrial history. For a phytoremediation project to be successful, the site should contain contaminants, like organics, solvents, and oils, which can be readily absorbed and broken down by the poplar trees. Poplar trees can also absorb and contain certain heavy metal compounds into the root system, but the trees will not eliminate the contaminants. Furthermore, phytoremediation works best on sites with mild to moderate levels of contamination, which is spread over a large area and occurs within the top six feet of the soil. If the contamination is deeper than six feet, it is beyond the tree's immediate rooting zone, and the trees will need a few years of growth before reaching the contaminated area.

If the landowner would like to characterize soil or groundwater contamination prior to planting, sampling can be performed. Generally, one would sample for priority metals (arsenic, cadmium, chromium, copper, lead, and mercury) suggested by the U.S. Environmental Protection Agency, polycyclic aromatic hydrocarbons (PAH's), selected volatile organic compounds (PCE or TCE), total petroleum hydrocarbons (specifically, diesel range organics (DRO)), and soil pH. Sampling is very expensive and should only be used as budget permits.

⁶ U.S. ENV'T'L PROT' AGENCY, EPA BROWNFIELD GRANTS, CERCLA LIABILITY, AND ALL APPROPRIATE INQUIRIES 3, available at <http://epa.gov/swerosps/bf/ai/aaicerclafs.pdf> ('All Appropriate Inquiries' is the process of conducting due diligence or a Phase I Environmental Site Assessment to determine prior uses and ownership of a property and assess conditions at the property that may be indicative of releases or threatened releases of hazardous substances at, on, in, or to the property.) See also 40 CFR Part 312. (defining the standards and practices comprising 'All Appropriate Inquiries.')

Create a Landscape Plan and Order Trees

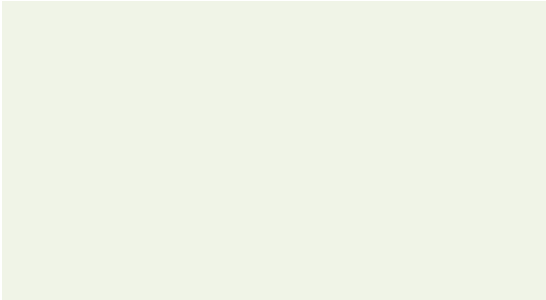
A landscape plan is a planting scheme for each site, which provides the technical information on how the site should be planted and maintained (See Appendix II). Essentially, this plan is the job specification and should be used when seeking bids from tree planting contractors. The landscape plan also helps the project manager estimate project costs, determine the required number of trees, and plan for contingencies.

To create the landscape plan, the project manager must decide what type of tree (or variety of poplar) to plant, the spacing of the trees and the necessary site preparation. Hybrid poplar trees (*Populus deltoids* x *Populus nigra*) are a cross between a native cottonwood tree and European black poplar. There are many varieties of hybrid poplar trees - Delta Institute prefers two varieties of poplar trees for Michigan - I45/51 "Italian" clone and the DN-177 "Dutch" clone. These clones are disease resistant and well-suited for the cold winters. Cottonwood (*Populus deltoids*) and black willow (*Salix nigra*) trees can also be planted for phytoremediation purposes.

Once the tree species has been selected, the project manager must determine the spacing of the trees and the planting method. This decision is largely based on the project objectives, the site characteristics and the project budget. For large, open sites, machine planting at a 6 x 10 spacing (6 feet between trees within each row; 10 feet between the rows) is common. This spacing yields 725 trees per acre; although realistically, 650-750 trees per acres is common, as site conditions (rocks, roots, etc.) and the skill of the individuals planting the trees often lead to greater or lesser spacing. For smaller sites, hand planting with a mechanical auger is often practiced. This planting method allows for a random, more natural appearance.

Site preparation is critical for the success of a phytoremediation project. The purpose of site preparation is to eliminate competition from other plants, particularly grasses, so the trees will have full access to water and nutrients. Without adequate site preparation, particularly on sites with heavy grass cover, many trees will not survive. Site preparation should occur one to two weeks prior to planting. Generally, site preparation involves the application of pre-emergent herbicide, such as glysophate. The pre-emergent should be applied by a licensed pesticide applicator in a one to two foot band, which would become the planting row. For sites near water or wetland areas, the project manager should obtain wetland-rated forms of glysophate or similar herbicides.

The landscape plan should also indicate the desired time of planting and any site maintenance required after planting. Hybrid poplar trees should always be planted in spring, ideally after the last frost. In Michigan, the planting window is four to six weeks, running from May 1 to June 15. After planting, mowing between the rows (and sometimes between trees) is often necessary to control the grass and improve site aesthetics. If the budget permits, the project manager can require the application of hardwood mulch around each tree to improve moisture retention, weed control and site aesthetics. The mulch will typically last two years.





Finally, the landscape plan should note all hazards, obstructions or special site conditions. The project manager should request utility location prior to planting, even if the site is remote and not near any visible infrastructure. Brownfields sites often have unknown underground utilities that could be breached during planting.

The greatest limiting factor for any phytoremediation project is the availability of plant material. Because of unpredictable demand, nurseries do not often stock large quantities of hybrid poplar trees. And nurseries might not stock the specific variety necessary for the project. So it is critical to work with local nurseries very early in this process. The project manager should order trees as early as possible, particularly if the nursery does not regularly stock the plant material and needs a year to grow it. If the nursery has the plant material, then the project manager should order by December 1 for a spring planting.

For best results, the project manager should order rooted cuttings of hybrid poplar trees. Poplar cuttings are taken from young, dormant trees and grown in a nursery bed for one year, before being lifted and trimmed. The end result is a 10-12 inch cutting with an established root system. Rooted cuttings provide the best opportunity for a successful establishment on a contaminated site. Again, trees should be ordered early, as rooted cuttings are not often available in enough quantity to plant more than a few acres each year. The cost of rooted hybrid poplar cutting is typically between \$1.50 and \$3.00 per tree. All plant material ordered for the project should meet American Standard for Nursery Stock (ANSI Z60.1) specifications for trees and plant material.

Hire a Contractor

Three months prior to planting, the project manager should release a bid request for tree planting services. The bid package should be sent to landscape contractors, Christmas tree farmers, nurseries and forestry companies. In the bid package, the project manager should include project goals and objectives, a description and location of the planting sites, planting specifications and equipment requirements (e.g. the landscape plan), the contract length, billing process, and other bidder requirements.

With regards to the billing process, the method of charging for services should be on a time and material basis, based on a rate schedule set forth in the winning bid. The project manager should expect an hourly rate for each crew member and a list of direct costs associated with herbicide application, mulch, equipment use, and travel. Lump sum bids are not desirable for these services.

There is plenty of boilerplate language that could be included in a bid specification, depending on the entity releasing the bid. Delta recommends the following bidder requirements be included as boilerplate in any bid specification:

1. Experience on comparable projects
2. Staff qualifications, include documentation of state Pesticide Applicators License
3. Names, addresses, and telephone numbers of two customer references who have received similar tree planting services
4. Availability during the 6 week planting window (May 1 – June 15)
5. Budget
 - a. Hourly rate for labor. Please included number of staff who will participate in project.
 - b. Daily/weekly cost for equipment rentals (if necessary). Please note that organization WILL NOT pay for the purchase of new equipment.
 - c. Cost of consumable supplies, such as mulch, herbicide, fuel, etc.



Plant the Trees

In late March or early April, prior to leaf-out, the nursery will “lift” the rooted cuttings from the planting bed and trim to size, usually 10-12 inches in length. A good nursery will then pack the rooted cuttings in moist peat moss, wrap bundles of 100 cuttings in plastic or burlap and store the bundles in a cooler until the planting date. The cuttings should be delivered to an interim storage location near the planting sites, a day before planting. If possible, the cuttings should be stored in a cool, dark location. The cuttings should arrive at the planting site in a dormant state.



On the day of planting, the project manager should only take as many cuttings as needed for the day’s planting. Prior to planting, the cuttings should be dipped in a root solution or gel, which provides moisture and nutrients and promotes root growth. The cuttings should be planted according to the landscape plan.

When planting mechanically, the two-person crew should plant within the rows that were treated with the pre-emergent herbicide. After seven to ten days, the herbicide should have killed all the vegetation within the planting row. The mechanical planter should be set at a depth of one foot, if possible. The cuttings should be placed into the ground, no deeper than the bottommost bud. If mechanically planting the cuttings, a crew member should walk behind the planter to pack the soil around the cuttings, i.e. “heeling in the cuttings,” and straighten them. If hand planting, the cuttings should be held in the planting hole, while soil is pushed into the hole and around the cutting. Again, the depth should be no more than the bottommost bud. After planting, a slow release fertilizer should be applied to each cutting. This will help the cutting establish its root system in the poor, nutrient deficient soils of a brownfield site. Adding one or two inches of hardwood mulch around each tree will help with moisture retention, weed control and aesthetics.



If the cuttings cannot be planted immediately or if the planting schedule is interrupted, the cuttings can be stored in a dark, cool place for up to three weeks. If the cuttings are not stored in a refrigerated environment, they will likely break bud and begin to grow leaves – even in the dark! The leaves will be a waxy yellow color and the stems white, due to the lack of photosynthesis. The cuttings can still be planted in this condition, although the entire planting will likely have a greater amount of mortality than cuttings planted during dormancy.



The yellow cuttings should “green up” after a few days in the sun. If the cuttings are not planted within three weeks, the yellow leaves will fall off, leaving white stems with black ends. These cuttings can still be planted, although mortality is likely to be greater than 60%. Delta’s planting contractor has suggested that if cuttings cannot be planted immediately, they could be temporarily stored outside and allowed to sprout leaves in the sun. These cuttings would be more ready to grow once planted, than cuttings that have been “growing” in a dark storeroom.

Upon completion, the project manager should walk the entire site and count the cuttings. Having an accurate count at the time of planting is critical to determining the level of mortality at the end of the growing season. It is also helpful to place flags or stakes at the end of each row, so crews mowing the site can avoid the ends of each row.

Monitor and Maintain

Within two weeks of planting, the cuttings should have sprouted leaves. Throughout the summer, the cuttings will push new roots into the soil and add height. The project manager should monitor the planting sites for potential issues, like animal browsing, black leaves or mower damage. The site should be maintained according to the property access agreement established with the landowner. Site maintenance usually involves bi-weekly or monthly mowing between the rows. In some instances, it may be necessary to mow between trees within a row. Care must be taken not to damage the trees. Spreading mulch around the trees can prevent mower damage because it alerts the mower operator to the presence of a tree. Without the mulch, an operator may mistake the cutting for a stick or branch and destroy it.

In mid-October, the project manager should walk the sites and count the trees that have survived the growing season. The fall tree count is much easier if done prior to leaf drop, which in Michigan, occurs in late October. A tree is considered dead if there are no leaves or sprouts from the stem or roots. If necessary, one can scrape the stem of the tree with a fingernail; if the scrape mark shows green, the tree is alive.

Determine whether a planting was successful depends somewhat on the projects objective. Delta considers a planting a complete success if the survival rate exceeds 80%. Sites with survival rates between 51% and 79% are moderately successful by Delta's standards. We consider plantings with a survival rate 50% or less to be a failure.

After determining survival rates the project manager must determine whether time and budget allow for the sites to be replanted. For successful plantings this means the use of auger to hand plant areas of mortality. For failed plantings the project manager must decide whether to save any of the surviving trees or mow everything down and start anew.



Quantifying the Uptake of Contaminants

One of the most important, yet often overlooked, components of a phytoremediation project is the quantification of contaminant uptake and removal. This critical element is often ignored because of the cost, which is easily in the tens of thousands of dollars. Most entities do not have the budget for field sampling and laboratory analysis. However, if one does have the budget, then Delta strongly recommends spending the money for this work. It is the only way to truly quantify a projects impact.

The first step is to develop a sampling and analysis plan. If the project manager cannot do this, we recommend collaboration with university researchers or a laboratory experience in environmental sampling. The purpose of the sampling and analysis plan is to design a sampling scheme and analysis schedule in order to:

- » Characterize the levels and distributions of the selected contaminants of concern in the soil for each site;
- » Characterize the levels and allocations of the selected contaminants of concern within defined components of the poplar trees; and,
- » Understand/develop relationships between soil and plant tissue concentrations for the selected contaminants of concerns.

The sampling and analysis plan should be used to guide any preliminary soil sampling performed during initial site selection. The plan should also provide guidance for plant tissue sampling and analysis. A sampling and analysis plan should have the following components:

- » Project Objectives
- » Identification of Contaminants for Sampling and Analysis
- » Sampling Design for Soil and Plant Tissue
- » Standard Operating Procedures for Soil and Plant Tissue Collection and Handling
- » Description of Analytical Methods of Analyzing Soil and Plant Tissue Samples

As mentioned earlier, one would generally sample for some or all of the following items, depending on the characterization of site:

- » Priority metals (arsenic, cadmium, chromium, copper, lead, and mercury);
- » Polycyclic aromatic hydrocarbons (PAH's);
- » Selected volatile organic compounds (PCB, PCE or TCE);
- » Total petroleum hydrocarbons (TPH, specifically, diesel range organics (DRO)); and
- » Soil pH.





The number of samples collected and analyzed depends solely on the budget. For laboratory analysis, one would expect to pay \$50 to \$100 per contaminant per sample. So, for a single soil sample, being analyzed for priority metals, PAH's, TPH, and soil pH, the cost might be \$150 to \$250. If one were to include plant tissue sampling with soil sampling, the cost of analysis could rise to \$500 to \$750 per sample. The cost climbs even higher if one includes the cost of the labor to collect the samples. It is not unreasonable for sample collection and laboratory analysis to cost \$1,000 per sample location.

If funds are available for sampling and analysis, then Delta recommends soil and whole tree sampling. If soil sampling is allowed by the landowner, then samples should be distributed across the site in a systematic way to properly characterize soil conditions. The laboratory should test for soil pH at every sample location. Analysis of other contaminants depends on the initial site characterization. One does not want to test for contaminants that are not likely to be found on the site. Soil sampling provides a baseline of site conditions to which the results from plant tissue sampling can be compared.

Whole tree sampling involves removal of the entire tree, including the root system, in order to quantify movement of contaminants within the tree. Metals are generally restricted to the root system, whereas PAH's and TPH's will be found through the tree. At a minimum, whole tree sampling and analysis should include the roots, the stem and the leaves, although it could also include the original cutting and the branches. If laboratory analysis finds PAH or TPH contamination in the leaves, and that same contamination is present in the soil, then one knows that the trees are removing contaminants from the soil.

Plan for End Use of Poplar Trees

Once hybrid poplar trees are established on a brownfield site, which make take one to two years, the trees should add two to six feet of growth (perhaps more) and $\frac{1}{4}$ to $\frac{3}{4}$ of inch of diameter each year. If allowed to grow for ten years or more, the sites will resemble a tree farm with economically viable products upon their harvest. By year 10, the trees could likely be harvested as wood fiber for biochar, landscape mulch, wood pellets for residential wood stoves or as biomass for electricity generation. By year 20, the trees would be considered pulpwood and potentially available for paper product. By year 30, the trees will be entering sawtimber size, where they could be sawn for low-grade lumber.

Residual contamination within the plant biomass is not a concern. Organic materials, like PAH's or TPH's, move through the tree and are transpired into the air at the leaves through a process known as phytovolatilization.⁷ Heavy metals remain trapped within the root system through phytostabilization, eventually returning to the soil when the tree dies.⁸

By considering the end use of the hybrid poplars, one can tell a very compelling story of how communities can re-establish the productive use of vacant industrial land, while reducing soil and water contamination, creating economic opportunity and enhancing the quality of life for local residents.



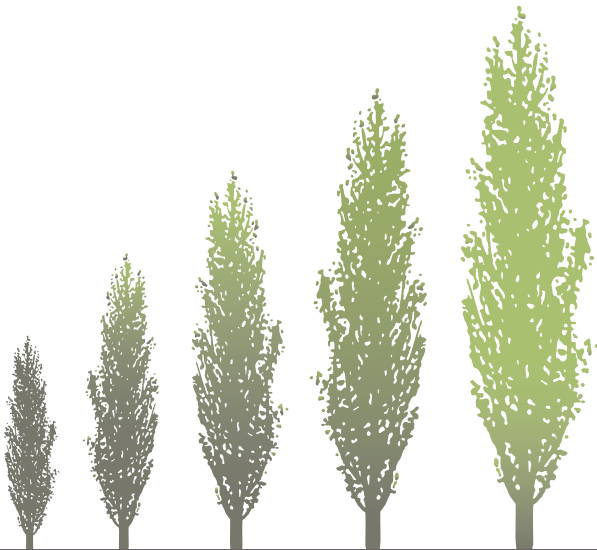
7 U.S. ENV'T'L PROT. AGENCY, PHYTOREMEDIATION RESOURCE GUIDE viii (June 1999), available at <http://www.epa.gov/tio/download/remed/phytoresguide.pdf>.

8 Id. at vii-viii.

Conclusion

Phytoremediation is the use of plants to remove pollutants from the environment or render them harmless. Hybrid poplar trees excel at phytoremediation due to their rapid growth. They absorb and stabilize contaminants such as toxic heavy metals, chlorinated solvents, and volatile organic compounds (VOCs) from soil. Before being released into the air, the contaminants are converted or degraded within the plant creating less harmful substances. The elimination of contaminants from the soil is crucial as they are toxic to marine life and can eventually make their way into a community's drinking water. Additionally, the establishment of the poplar tree farms will absorb significant amounts of water, greatly reducing storm water runoff. Stormwater runoff, an uncontrolled source of water pollution, carries many pollutants that are deposited into nearby storm drains which then move into our local waterways.

The land that has been chosen for planting areas are vacant, unused, brownfields. Unmanaged vacant land is often seen as an eyesore and a sign of economic decline. Projects such as this turn abandoned land into productive use more quickly than may be possible otherwise and help to raise property values. Ideally the community will benefit from the resulting improved aesthetics and increased property values these poplar tree farms will provide. By planting hybrid poplar tree farms on brownfield sites, we demonstrate that community forestry provides an opportunity to turn vacant industrial land into an economic asset.



APPENDIX I – PROPERTY ACCESS AGREEMENT

PROPERTY ACCESS AGREEMENT

This Property Access Agreement (this “*Agreement*”) is entered into effective as of _____, 2013 by and between _____, a _____ (the “*Property Owner*”), whose address is _____, and the Phytoremediation Organization (“*Phyto Organization*”), a non-profit corporation, whose address is _____.

Background.

The Property Owner is the owner of the real property located at _____, Michigan, as legally described on Exhibit A attached hereto (“*Property*”).

Property Owner has agreed to provide the Phyto Organization access to the Property as further set forth below to plant trees within the Activity Area (as hereafter defined) to determine whether planting such trees can limit the impacts of Hazardous Materials located on the Property.

Definitions.

“*Environmental Laws*” means any federal, state or local statute, regulation or ordinance currently in effect, as amended, that pertains to the protection of the environmental, health or safety, including but not limited to the Resource Conservation and Recovery Act, as amended, 42 USC § 6901 et seq. and the Comprehensive Environmental Response, Compensation and Liability Act, 42 USC § 9601 et seq.

“*Hazardous Materials*” means any substance or material defined or designated as a hazardous or toxic waste, a hazardous or toxic material, a hazardous or toxic chemicals, a hazardous or toxic substance, a pollutant, a contaminant, or other similar term, by Environmental Laws.

“*Activities*” means Phyto Organization planting and maintaining hybrid poplar or other tree species within the Activity Area in order to determine whether the planting of such trees can limit the impacts of Hazardous Materials located in, on, under, or migrating from the Activity Area, and includes the analysis and related investigation of environmental conditions, which can include conducting baseline and follow-up sampling in the Activity Area as Phyto Organization may reasonably deem necessary as well as the removal and analysis of the trees themselves.

“*Activity Area*” means that portion of the Property upon which Phyto Organization may conduct the Activities, as identified on Exhibit C attached hereto.

Access.

For a period of two (2) years from the effective date of this Agreement, the Property Owner hereby grants Phyto Organization, its agents, employees, affiliates, consultants, contractors, and assigns, access rights to the Activity Area to conduct the Activities. In connection therewith, the parties agree as follows:

Phyto Organization shall have ingress and egress rights on and over that portion of the Property identified on Exhibit B attached hereto for the purpose of accessing the Activity Area.

The Activities shall: (a) be limited to the Activity Area, and (b) be at Phyto Organization' sole cost and expense, except as otherwise expressly provided in this Agreement or agreed to in writing by the parties.

Phyto Organization shall ensure that any Activities performed under this Agreement by Phyto Organization or its representatives shall be completed in material compliance with all applicable codes, ordinances, laws, regulations, orders, and Environmental Laws.

At least two (2) days before entering onto the Property for the purpose of conducting the Activities, Phyto Organization shall notify the Property Owner of its intent to enter on to the Property pursuant to this Agreement, reasonably describing the nature of the specific activities to be conducted, and to coordinate its activities to the extent possible to minimize any interference or disturbance of the Property Owner's operations.

Performance of Activities.

In connection with the Activities, the parties further agree as follows: (a) the location of the trees planted within the Activity Area shall be mutually agreed upon by the parties, (b) such trees shall be located within the Activity Area for approximately three (3) years after the planting thereof, and in connection therewith, Phyto Organization shall have the right to either cut down all, some or none of such trees, (c) if Phyto Organization does not cut down all of the trees planted within the Activity Area prior to the expiration of this Agreement, such trees shall remain in the Activity Area for the Property Owner to dispose of such trees as it may wish, and (d) Phyto Organization shall have no liability for such trees, including any costs to maintain, remove, or dispose of them.

The Property Owner agrees to cooperate with Phyto Organization in its undertaking of the Activities, including but not limited to, providing Phyto Organization with all reasonably available information about the location of all subsurface wells or structures located within the Activity Area as well as other information concerning the Activity Area that Phyto Organization reasonably believes is necessary in connection with conducting the Activities.

The Property Owner and its environmental consultant shall have the right to observe all Activities performed under this Agreement and to take splits of all samples collected; provided, however, that all costs to collect and analyze such split samples shall be borne by the Property Owner at no cost to Phyto Organization.

Indemnification.

Phyto Organization shall indemnify and hold harmless Property Owner for any and all damages, losses, claims, penalties, costs and expenses, including reasonable attorney fees (the "Damages"), to the extent such Damages are caused by Phyto Organization's negligence arising from or relating to its Activities under this Agreement.

Property Owner shall indemnify and hold harmless Phyto Organization for any and all other Damages that Phyto Organization may suffer in connection with the Activities.

Notices.

All notices, requests, demands and other communications which are required or permitted to be given under this Agreement will be in writing and will be deemed to have been duly given (a) upon receipt if delivered in person, or (b) on the third business day if mailed, first class certified, registered or express mail, return receipt requested and postage prepaid, or (c) the following business day if sent by recognized overnight courier, with proof of delivery requested and charges prepaid, to the addresses first set forth above or to such other address as a party may specify by written notice to the other parties.

Miscellaneous.

This Agreement shall be binding upon and inure to the benefit of the parties and their respective heirs and successors. No party may assign its rights or obligations under this Agreement without the prior written consent of the other parties.

This Agreement will be governed by the laws of Michigan and resort by the parties to any litigation regarding this Agreement shall only be to courts of applicable jurisdiction and venue located within Michigan. In the event of such litigation between the parties, the losing party shall pay the costs and expenses incurred by the prevailing party in connection with the litigation, including, but not limited to, reasonable attorneys' fees.

This Agreement may be executed in two or more counterparts, with the same effect as if all the signatures on the counterparts were on the same instrument.

[SIGNATURE PAGES FOLLOW]

IN WITNESS WHEREOF, the parties have executed this Agreement as of the date set forth below their respective signature to be effective as of the date first set forth above.

APPENDIX II – LANDSCAPE PLAN

Site Name: No-name Site

Site Location: 100 Main St, across from manufacturing complex

Size of Planting Area: 2 acres

Expected # of Trees: 1400

Poplar variety: I45/51 – “Italian” clone

Spacing: Machine plant at 6 feet by 10 feet spacing; Leave 40 foot buffer around parking area

Site Preparation: Mow & spray planting rows with glyphosate, one week prior to planting

Mulch: Yes – around individual trees

Obstructions/Hazards: Buried electrical cable runs parallel to bike path from tree line on northern boundary to electric sign on southern boundary. Cable location is visible in some spots where grass has not covered trench line. Stay 40 feet away from electrical cable.

Planting Schematic:

