Presidio Trust Phytophthora Management Guidelines

March, 2021

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APPENDIX

1 EXECUTIVE SUMMARY

The plant pathogen *Phytophthora* can cause severe damage to landscapes. It is currently causing significant dieback in the forests of Western Australia, chaparral ecosystems in the Sierra Nevada foothills, and oak woodlands on the California coast.

Phytophthora can become established wherever there are host plants, sufficient moisture, and moderate temperatures. These conditions exist in much of the Presidio.

Because these conditions also exist in plant nurseries, nurseries can easily and unwittingly produce *Phytophthora*-infected plants. When infected plants are in the nursery, they often do not appear symptomatic. Some plant species never develop symptoms but are good carriers. For others, it is not until after they have been planted in a landscape and experience stressors such as drought or nutrient deficiency that disease symptoms develop. By that time, the landscape has been irreversibly contaminated, jeopardizing the plant communities.

The Presidio Trust has consulted with academic and regulatory plant pathology experts. These experts recommend a conservative approach: as close to zero-tolerance as is feasible. The Presidio Trust has considered these recommendations, evaluated our land management practices, and conducted testing to document the current *Phytophthora* status of many of our landscapes. We have determined the following:

- More than a dozen species of *Phytophthora* presently exist in our landscapes, particularly where water or long-term irrigation is present.
- Risk to our rare and endangered woody plant species is high.
- Methods for eliminating *Phytophthora* in the field are not reliable or economically feasible.
- Methods for eliminating *Phytophthora* in a nursery setting are reliable but costly.
- Commercial nurseries and plant brokers are not providing reliably *Phytophthora*-free plants.
- The resources required to test all incoming commercial nursery plants for *Phytophthora* are not available within our project timelines or budgets.
- Available *Phytophthora*-testing methods can result in false-negative results, making detection difficult.

Because Presidio-wide zero-tolerance is not feasible, the guidelines presented here aim to minimize *Phytophthora*-associated risks to the character and ecological integrity of the Presidio's most vulnerable plant communities. They allow a tolerance of *Phytophthora* in some areas of the Presidio while aiming for no new introductions in the Native Plant Community Zone:

- Train field and nursery personnel on plant disease prevention.
- Use plant disease prevention Best Management Practices (BMPs) at Presidio Nursery and in Presidio field sites.
- Based on risk evaluations, selectively test commercially grown nursery plants, and reject plants that test positive for *Phytophthora*.
- Ensure project and contractor compliance with *Phytophthora* management BMPs.

2 DEFINITIONS

import soil: Any soil originating from outside of a project site. For example, soil originating from Fort Scott in the Presidio would be import soil if used at the Main Post in the Presidio.

pear bait: *Phytophthora* species can be difficult to isolate directly from infected plants. So a bait, in this case green pear, is used to attract and detect *Phytophthora* in soil, root, or water samples.

plant lot: plants of the same species, all propagated and grown at the same place at the same time.

sanitize: Clean or brush to remove debris and soil particles and subsequently treat with a disinfecting agent such as bleach, quaternary ammonium compounds, isopropyl alcohol, or heat in a manner that destroys plant pathogens.

site (as in project site, or work site): An area with common physical boundary or boundaries (such as a road or curb) and common storm water drainage direction. Examples:

> *Korean War Memorial* is surrounded by roads and water drains directly to inlets which all flow to Crissy Marsh, so is one site.
>
> *Presidio Blvd. Wood Fence* is bordered by common roads, but drains in two directions, so is two sites: a NNE site that drains to the north, and the ESE site that drains to the east.

symptomatic: Aboveground symptoms on *Phytophthora* infected plants can include obvious stunting and shoot dieback. Leaves can be smaller than normal and have chlorosis or interveinal chlorosis. Wilting can occur even with adequate soil moisture. When *Phytophthora* infects at or develops into the root crown near the soil line, leaves may droop, and the plant dies. Cutting just under the bark at or just above the soil line may reveal dead inner bark tissue. The dead tissue may be reddish brown, brown, or black and will differ from healthy tissue, which can be white, green, or pink depending on the type of plant or tissue.

Qualified Grow Contract: A contract with a production nursery that requires the BMPs listed in Appendix A. Plants grown under such a contract do not need additional quality control testing prior to use in the Presidio.

3 *PHYTOPHTHORA* WORKING GROUP

The Presidio Trust maintains a *Phytophthora* working group, which establishes BMP protocols, ensures BMPs are implemented, develops contract language, stays up to date on Presidio *Phytophthora* detections, plant testing, *Phytophthora* research, and uses adaptive management to make changes to BMPs.

This working group includes the IPM Specialist, Forester, Presidio Nursery Manager, Director of Landscape Stewardship and Director of Park Design and Construction, or their designees.

4 PRESIDIO NURSERY BMPS

4.1 TRAINING

1. The Presidio Nursery is responsible for training all staff and interns on plant disease prevention during their orientation period, and annual updates. Staff and interns are responsible for informally training volunteers. Training includes:
    a) How to recognize plant disease symptoms including symptoms of *Phytophthora*
    b) Procedures for plant disease monitoring
    c) Proper and safe use of disinfectant to sanitize boots, tools and growing surfaces
    d) Procedures for record keeping
    e) Clean growing practices:
        i. when to disinfect boots, tools and growing surfaces
        ii. procedures for keeping potting mix clean
        iii. procedures for handling propagules
        iv. procedures for handling plants
        v. procedures for releasing plants to field staff for out-planting
    f) Procedures for handling and disposing of symptomatic or diseased plants.

4.2 WATER MANAGEMENT

1. Where possible, locate growing structures upslope, to avoid contamination via storm water runoff.
2. Use municipally treated water for irrigation.
3. Use low water pressure and small droplet size to minimize splash.
4. Where drip irrigation is used, sanitize before reusing it in new plants.
5. Group plants according to water needs, and irrigate accordingly. Do not overwater.
6. Avoid the accumulation of standing water anywhere in the nursery. Keep all growing structures free of standing water.

4.3 SANITATION

1. Do not allow plants grown outside of Presidio Nursery in growing structures.
2. Sanitize the soles of footwear and tools before entering and after exiting growing structures.
3. Maintain general nursery cleanliness by removing plant debris and spilled potting mix.
4. Avoid creating dust and splash.
5. Do not allow hose nozzles to sit on the ground or come into contact with potting mix or soil. Sanitize hose nozzles that do become soiled.
6. Store tools and equipment in clean storage areas.
7. Use only clean, sterile growing containers.
8. Keep plants on benches at least 2-feet above the ground.
9. Avoid unnecessary handling, rearranging, and moving of plants.
10. Do not place container stock on the ground. Place plants only on sanitized surfaces. Discard or quarantine any plants that have come in contact with the ground.
11. When handling potting mix in plant pots, clean hands/gloves and tools between plant lots.

12. Remove suspected diseased plants as soon as symptoms are seen.
13. Promptly dispose of culls and contaminated materials in a closed waste container away from growing structures and clean areas.
14. Sanitize benches after plants have been removed for planting.

4.4 PROPAGATION

1. Propagate by seed whenever possible,. Seeds should be collected from plants with no disease symptoms, and preferably far enough from the ground that they are not muddy or soiled. When possible, avoid collecting seed in sites with known *Phytophthora* infestations.
2. When use of vegetative propagules is necessary, do not collect vegetative propagules in sites with known *Phytophthora* infestations.
3. When possible, avoid collecting seed or propagules in wet or muddy conditions.
4. Conduct all seed and cutting processing in a clean work area with clean equipment.
5. Keep plants propagated from vegetative materials separate from plants propagated by seed.

4.5 POTTING MIX

1. Use pasteurized potting mix and/or sterile amendments for all growing operations.
2. Pasteurize potting mix by heating to at least 140^{o}F (60^{o}C) for 30 minutes.
3. Store potting mix in a clean, covered area. Establish a protocol for keeping the storage area uncontaminated.

4.6 MONITORING

1. Monitor each plant lot for disease symptoms weekly.
2. Keep monitoring records.
3. If significant symptoms are observed, including unexplained water-stress, leaf blight, root collar and/or stem cankers, or whole plant wilting or necrosis, remove symptomatic plants plus all plants within two meters of those plants. Take samples for *Phytophthora* testing and cull or quarantine these plants.

4.7 TESTING

1. Maintain a list of *Phytophthora* host plant species being grown by the nursery that are high-risk for infection. Base this list on current literature and findings of *Phytophthora* researchers. Use pear baiting of effluent water as described in the Nursery *Phytophthora* Testing Protocol, which is maintained by and available from the Golden Gate Parks Conservancy Nursery Pathology Program Coordinator. Test all lots of these species prior to releasing them for planting.
2. Test all plant lots that Golden Gate Parks Conservancy Nursery Pathology Program Coordinator determines might be symptomatic of *Phytophthora*.
3. Dispose of all *Phytophthora* infected plant lots. Discard the whole lot if any plants from that lot test positive for *Phytophthora*.
4. Keep plant test records.

4.8 Disposal

1. When disposing infected plant lots, securely bag and dispose in landfill waste, or ensure composting of plant material according to US Composting Council standards.

5 Landscape Stewardship Fieldwork BMPs

5.1 Training

1. Departments are responsible for training all staff and interns on plant disease prevention during their orientation period, and annual updates. Staff and interns are responsible for informally training volunteers. Training includes:
   a) How to recognize plant disease symptoms including symptoms of *Phytophthora.*
   b) Presidio sites where *Phytophthora* is known to occur.
   c) Proper and safe use of disinfectant to sanitize boots, equipment and tools.
   d) Procedures for maintaining a clean nursery environment when picking up plants from Presidio Nursery.

5.2 Water Management

1. Avoid irrigation where feasible, or manage irrigation to minimize wet soils and runoff.

5.3 Sanitation

5.3.1 All Landscape Stewardship Zones

1. Use clean tools and equipment that come in contact with soil. Brush, blow, rinse, or knock off dirt and vegetative debris on tools and equipment before use at a new site.
2. Sanitize tools used to prune plant species at high risk for infection by foliar *Phytophthora* species (see Appendix B) before being used at a new work site, or in the case of trees, before being used on a new tree.
3. Do not take vehicles off-road during the rainy season except in cases of emergency. On any vehicle taken off road during the rainy season, brush soil off of tires prior to leaving the site. Brush, blow, rinse, or knock off dirt and vegetative debris off tires and undercarriage before use at a new site.
4. Unless intentionally moving clean material, do not to transport soil, mud or plant debris between sites.

5.3.2 Additional Requirements in Native Plant Community Zone

1. Sanitize soles of boots or shoes before entering a work site.
2. Sanitize tools that come in contact with soil, wounded or diseased plant tissue, or plants in poor vigor, before using at a new site.
3. Wash dirty gloves with hot water and detergent before using them to perform soil-disturbing work at a new site.

5.4 PLANTING

5.4.1 Species Selection

1. If the project site is known to contain *Phytophthora* (see current *Phytophthora* baseline map maintained by Presidio Trust IPM Specialist), plant species selection shall take *Phytophthora* susceptibility into account.

5.4.2 Source of Plants

1. *Phytophthora* is not transmitted on seeds, so whenever possible, use seed to grow plants at project site.
2. When direct-seeding is not feasible, use plants grown at Presidio Nursery or other Golden Gate National Recreation Area nurseries.
3. When use of plants grown at Presidio Nursery or other Golden Gate National Recreation Area nurseries is not feasible, use the *Presidio Trust* Phytophthora *Management Guidelines for the Use of Nursery Grown Plants* below (and in Appendix D), to determine if plants need to be tested, and if tested plants can be planted. In general, if storm water flows from the project site directly into a storm drain which then discharges to the Native Plant Community Zone, or the overland storm water flow does not come in contact with a vegetated buffer along its route between the project site and Native Plant Community Zone, high-risk host plants must either be grown by a GGNRA nursery, be grown under a Qualified Grow contract, or be tested.

Do I need to test the plants I'm using in my landscape project for *Phytophthora?* And what would the test results mean for me?

*Qualified Grow: a nursery grows a project's plants to order, and the Presidio Trust Integrated Pest Management Specialist can document that (a) the nursery has been inspected and meets Presidio Trust Qualified Nursery BMPs, and (b) the project grow is in a distinct part of the nursery with sufficient controls to keep from becoming contaminated by areas containing brokered plants.

**plant lot: a group of plants all the same species, grown at the same place at the same time.

Presidio Trust *Phytophthora* management guidelines for the use of nursery grown plants. 2021_04_01

Presidio Trust list of high-risk *Phytophthora* host genera
updated: 2021-03-18
based on data compiled from:

California Department of Food and Agriculture
Golden Gate National Recreation Area field and nursery testing
Phytosphere Research
Presidio Trust commercial nursery testing
United States Department of Agriculture, Agricultural Research Service, Fungal Database
University of CA Berkeley Forest Pathology and Mycology Lab
Royal Horticultural Society

Genus			
Acer	*Camelia*	*Fremontodendron*	*Prunus*
Achillea	*Ceanothus*	*Grivillea*	*Pseudotsuga*
Aesculus	*Cistus*	*Hardenbergia*	*Quercus*
Agonis	*Cornus*	*Heteromeles*	*Rhododendron*
Alnus	*Correa*	*Juncus*	*Rosmarinus*
Anaphalis	*Corylus*	*Juniperus*	*Rubus*
Arbutus	*Cottoneaster*	*Lantana*	*Salix*
Arctostaphylos	*Cupressus*	*Leucadendron*	*Sarcococca*
Artemesia	*Diplicus (=Mimulus)*	*Lonicera*	*Stuckenia*
Aucuba	*Elymus*	*Myoperum*	*Taxus*
Azalea	*Eriophyllum*	*Myrica*	*Umbellularia*
Baccharis	*Frangula (=Rhamnus)*	*Pinus*	*Viburnum*


Presidio Trust *Phytophthora* management guidelines for the use of nursery grown plants. 2021_04_01

4. Project Manager is responsible, in partnership with Presidio Trust IPM Specialist, for either confirming that testing is not required, or developing a *Plant Testing and Holding Plan* to identify how and where plants will be staged sampled, and tested, and by whom.
5. When excavating plants and moving them to the Native Plant Community Zone, a testing plan is required. Work with Presidio Trust IPM Specialist to develop and implement a testing plan. Complete testing prior to transplanting and do not transplant plants that test positive for *Phytophthora*.
6. When excavating plants and moving them to the Designed Landscape Zone or Forest Zone, prior to transplanting, conduct an analysis of the site the plants are to move to: determine if storm water flows from the site overland directly, or directly discharges to the Native Plant Community Zone. If so, test individual plants, or plant lots if propagation history is known. Do not transplant plants or plant lots containing:
    a. *Phytophthora* of limited or unknown range in California (CA Department of Food and Agriculture A, B, or Q rated species)
    b. *Phytophthora* known to cause significant plant dieback in native plant communities
    c. *Phytophthora* not otherwise documented in the Presidio

5.4.3 Testing Plants

1. Testing shall be done by rapid test (e.g. Agdia Immunostrip or Pocket Diagnostics) and/or pear baiting, following the protocols in Appendix C: *Testing for Root-borne Phytophthora in Nursery Plants: Rapid Testing and Pear Baiting*.
2. If testing results show a plant lot needs to be rejected, plants and potting soil should be disposed of in a green bin for composting by Recology, and pots should be sanitized with isopropyl alcohol and disposed of in a blue bin for recycling by Recology.

5.4.4 Holdover Plants

1. Plants that are not used for their originally intended project, and are being held at the location specified in the Plant Testing and Holding Plan, can be used for another project, as long as they are used within one year. If they are held longer than one year, they must be either disposed of, or re-tested.

6 PRESIDIO COMPOST PRODUCTION BMPS

6.1 TRAINING

1. Presidio Trust IPM Specialist is responsible for training compost yard manager. Training includes:
   a) Site layout considerations to prevent contamination of compost by surrounding vegetation or incoming feedstocks.
   b) Compost pile temperature requirements to kill pathogens including *Phytophthora*.
   c) Proper and safe use of disinfectant to sanitize boots, tools and equipment.

6.2 SITE LAYOUT

1. Store green debris downslope of active compost piles or windrows. Locate active compost piles or windrows downslope of storage piles.
2. Locate active compost piles or windrows and storage piles on asphalt or other non-soil surface. Use curbs to prevent materials from moving off-site during production.

6.3 TEMPERATURE & FEEDSTOCKS

1. Turn green debris compost windrows to ensure uniform heating. During the active composting phase, document that each windrow reaches a minimum temperature of at least 140^{o}F (60^{o}C) after each turn.
2. Ensure that vermicompost feedstocks contain only food items, no green debris, ornamental plants, plant roots, or soil.

6.4 SANITATION

1. Sanitize tools and machinery before moving compost to storage piles.
2. Transport finished compost in a clean container or vehicle.

6.5 TESTING

1. Annually test compost windrows for presence of *Phytophthora*. Take one half-gallon sample per one hundred cubic yards of compost. Pear bait each sample, and send any pears with *Phytophthora* lesions to a plant pathology laboratory to verify *Phytophthora* and determine *Phytophthora* species.
2. Re-compost all *Phytophthora*-infected windrows or piles.

7 INFRASTRUCTURE STEWARDSHIP, PARK DESIGN, AND TRANSPORTATION

7.1 TRAINING

1. Annually train and update staff with field-based duties or projects. Training includes:
   a) Impacts of *Phytophthora* in ecosystems, and in the Presidio.
   b) Presidio sites where *Phytophthora* is known to occur.
   c) BMPs practiced by field staff.

8 IMPORTING COMPOST, MULCH AND SOIL

8.1 COMPOST, MULCH & OTHER NON-SOIL IMPORTS

1. Only import material for which documentation of the history of the material is available, and can be shown to be produced under low-risk conditions, i.e. compost produced according to US Composting Council standards, and mulch made from disease-free material. Such materials can be used in the Forest and Designed Landscape Zones without testing.
2. If material is to be used in the Native Plant Community Zone, and soil or plant tissue is present in the material, test prior to use. Work with Presidio Trust IPM Specialist to develop and implement a testing plan. Reject *Phytophthora* infected material.
3. Project managers to review all imports with the Presidio Trust IPM Specialist for concurrence with these guidelines.

8.2 SOIL

8.2.1 Testing and Using Import Soil

1. In most cases, soil should be tested prior to importing to a project site. Use the Presidio Trust *Phytophthora* Management Guidelines for Importing Soil, seen on the following page (and in Appendix E), to determine if soil must be tested, and if tested soil can be imported.

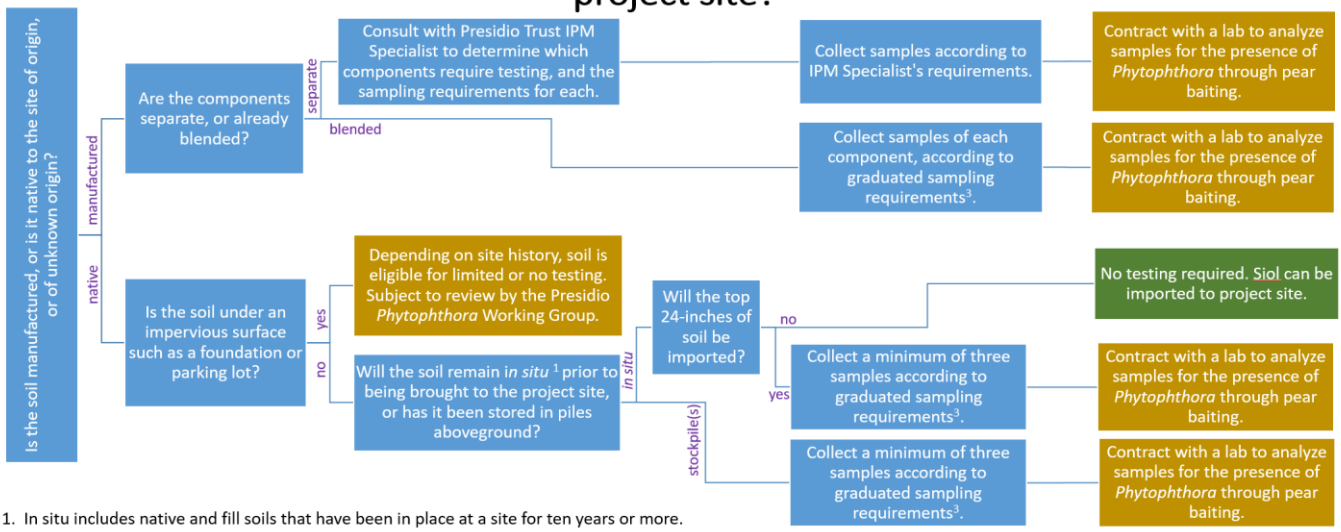
8.2.2 Excavating, Handling and Transporting Clean Soil

1. Clean soil should be excavated, handled, and transported with sanitized equipment. Sanitize all parts of equipment that will come in contact with soil prior to handling soil.

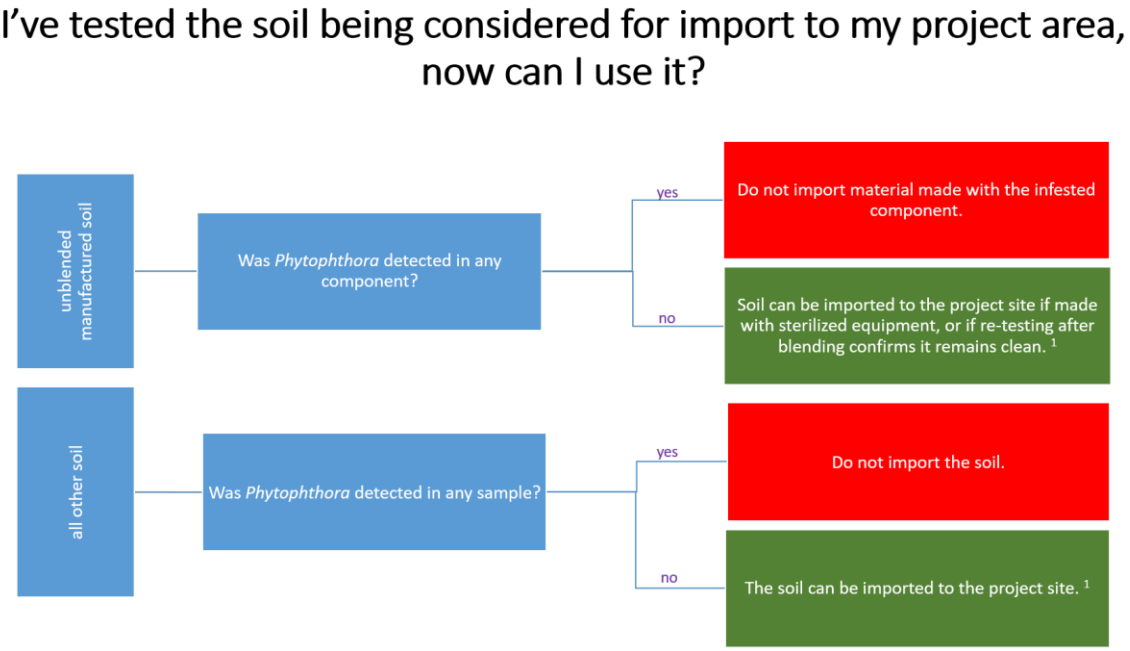
8.2.3 Stockpiling Clean Soil

1. When stockpiling more than 100 cubic yards of soil, regardless of soil source or stockpile location, a *Phytophthora* management plan must be incorporated into the soil management plan. The project manager shall work with the Presidio Trust IPM Specialist to develop the *Phytophthora* management plan, subject to the Presidio Trust *Phytophthora* Working Group approval.
2. When stockpiling 100 cubic yards or less of clean import soil, stockpile it at the project site, or on a surface such as asphalt or a tarp, to create a barrier between the stockpile and soil. Cover the stockpile until it is used.

Do I need to do *Phytophthora* tests on soil being considered for import to my project site?



1. In situ includes native and fill soils that have been in place at a site for ten years or more.
2. To use the soil from the top 24-inches, testing is required. Requirements regarding importing weed seed are separate.
3. Sampling stockpiled material: for the first 1 to 500 CY's sample at a rate of 1 per 100 CYs, for the next 500 to 1000 CYs use a rate of 1 per 250 CYs, for amounts over 1,000 CYs use a rate of 1 per 500 CYs. Include roots from any plants present, with preference for woody plants. Samples should be taken from multiple depths, at 12-inch intervals. If stockpile is not uniform, include samples from areas with differing soil appearance. Each sample should contain at least one-third of a gallon of soil plus roots (if roots are present in stockpile). A proposed sampling and testing plan shall be submitted to the Trust's IPM Specialist for review by the *Phytophthora* Working Group prior to sampling.



1. *Phytophthora* risk assessment to be confirmed by Presidio Trust Integrated Pest Management Specialist prior to import.

9 Landscape Construction Contracts

All construction contracts for work that could penetrate soil or have potential to transfer soils off-site via boots, equipment or tools, such as work on exposed soils during wet conditions, must contain the following requirements.

9.1 Training

Employees tasked with jobs which could penetrate soil or have potential to transfer soils to another Presidio site via boots, equipment or tools will receive training prior to performing these jobs, to learn the safe use of disinfectant to sanitize boots, equipment and tools.

9.2 Water Management

When using irrigation in a project site, minimize watering to avoid wet soils and runoff.

9.3 Plant Disease Prevention Plan

1. The project manager shall work with the Presidio Trust IPM Specialist to develop a *Plant Disease Prevention Plan*, subject to the Presidio Trust *Phytophthora* Working Group approval. The plan shall include a site drainage determination, using topography and storm drainage systems to determine in what direction storm water moves off the project site. If the project site drains directly to the Native Plant Community Zone, *Phytophthora* prevention measures will be identified.
2. For projects with non-contiguous project areas, the *Plant Disease Prevention Plan* shall include a *Plant Disease Prevention Sanitation Map*, showing which areas are to be managed as discreet

sites. Where sites contain Native Plant Community Zone land, Native Plant community Zone standards shall apply.

9.4 SANITATION

9.4.1 Boots and Hand Tools

Prior to conducting work that will disturb soil or involves contact with exposed soils, all boots and hand-tools must be sanitized before entering a work site. Sanitize by cleaning or brushing to remove debris and soil particles and subsequently treating with a disinfecting agent such as bleach, quaternary ammonium compounds, isopropyl alcohol, or heat in a manner that destroys plant pathogens.

9.4.2 Vehicles and Heavy Equipment in Unpaved Areas

9.4.2.1 Entering a Work Site

Prior to entering an unpaved area of a landscape renovation jobsite, tires of trucks and heavy equipment must be free of soil and debris. Cleaning of tires should be done prior to entering highways in route to the Presidio as per Department of Transportation regulations. When highway travel will not occur, tires should be cleaned prior to entering the Presidio. This can be accomplished by rumble strips, or pollution control measures that remove soil and debris from tires as described in California Storm Water Quality Association's Entrance/Outlet Tire Wash BMPs. Otherwise, cleaning can be done with high-pressure water, or brushing debris with a hard-bristled brush.

9.4.2.2 Exiting a Work Site

Vehicles that have been on unpaved areas of a jobsite, must clean tires prior to exiting the site. This can be accomplished by rumble strips, or pollution control measures that remove soil and debris from tires as described in California Storm Water Quality Association's Entrance/Outlet Tire Wash BMPs. Otherwise, cleaning can be done with high-pressure water, or brushing debris with a hard-bristled brush.

9.5 PLANTING

All planting specifications must comply with the guidelines outlined in section 5.4 of this document.

9.6 SOIL OR NON-SOIL MATERIALS IMPORTS

Must comply with guidelines outlined in section 8 of this document.

10 REFERENCES

The following were used to develop the BMPs presented here. These documents are available through the Presidio Trust IPM Specialist, and contain additional details for implementing BMPs.

Best Management Practices for Preventing Phytophthora Introduction and Spread: Trail Work, Construction, Soil Import, 2018. Prepared by Phytosphere Research

Guidelines to Minimize Phytophthora Pathogens in Restoration Nurseries, 2016. Prepared by the Working Group for *Phytophthora* in Native Habitats.

Phytophthora Management Recommendations, 2016. Prepared by Laura Sims for the Presidio Trust.

APPENDIX A

Presidio Trust Qualified Nurseries pathogen prevention BMPs

1. Site selection, preparation, and maintenance

- All production and holding areas are well drained: no standing water or puddles even after a long rain.
- Roads and pathways are paved, graveled or rocked.

2. Water management

- Irrigation water comes from a municipal source or deep well, or you disinfest irrigation water using a proven and effective method.
- Plants with similar irrigation needs are grouped together.

3. Plant procurement

- All incoming stock is visually inspected for pest and disease symptoms prior to introducing them into the nursery facility.
- All shipments that contain plants with pest or disease symptoms are refused.

4. Plant propagation

- Propagation area is isolated from the rest of production facility.
- All sorting areas, cutting benches, cutting surfaces, production and holding benches are disinfested between crops to minimize the introduction or spread of pathogens.

5. Greenhouses

- Greenhouses are thoroughly cleaned and disinfested between crops.
- Containers are only placed on clean, well-draining surfaces, such as raised benches or gravel beds, to prevent splash contamination from soil.

6. Field production areas

- Soil used for in-field or pot-in-pot propagation is free of pests, pathogens and plant-parasitic nematodes. If yes, what is your method for documenting this?

7. Potting media and containers

- Growing media is free of pests and pathogens. If yes, what is your method for documenting this?
- Used containers and trays are disinfested before re-use, or new containers and trays are used.

8. Container yards

- Potential for dispersal of pests and pathogens is reduced by creating breaks between blocks of plants.

- A barrier is maintained between the soil and containers, so that potential pathogens on the ground can't be splashed into containers. Sufficient barriers include raised beds, gravel, a layer of rock, or mesh cleaned on a regular schedule. If mesh, what is the cleaning frequency?

9. Symptomatic plants

- Infested or diseased plants that are found in any production or holding area are treated to remove the pest, or plants are removed to a cull area, or plants are destroyed.

10. Training and Certification

- Employees undergo sufficient training to be able to implement BMPs and recognize and report common *and* quarantine pests and pathogens.
- Nursery participates in disease management certification program or programs. If yes, please list.

11. Scouting

- Plants in propagation areas and greenhouses are inspected at least once per week.
- All other production and holding areas are inspected for pests and diseases at scheduled intervals frequent enough to prevent or manage outbreaks. If yes, what is the frequency?

12. Biosecurity

- All employees who may have visited areas with pest and disease problems are required to wash or sanitize their shoes, tools and vehicles before re-entering the nursery.
- Before entering production areas, shoes are cleaned or sanitized, or shoe covers are used.

13. Recordkeeping

- All plants processed or produced can be traced back and forward through the process.
- Records are kept of all treatments that are undertaken as a result of finding infested or diseased plants in container production areas.

APPENDIX B

Plant species present in the Presidio Forest and Designed Landscape Zones at high risk for infection by foliar *Phytophthora* species

host plant	**foliar *Phytophthora* known to cause significant disease, or pathogen load increase, in this host plant**
Laurus nobilis	*Phytophthora ramorum*
Lophostemon confertus (syn. *Tristania conferta*)	*Phytophthora ramorum*
Morella californica (syn. *Myrica callifornica*)	*Phytophthora* taxon *morella*
Quercus agrifolia	*Phytophthora ramorum*
Sequoia sempervirens	*Phytophthora ramorum*

Date: 4/24/19

APPENDIX C

Testing for Root-borne *Phytophthora* in Nursery Plants: Rapid Testing & Pear Baiting

Definitions

Plant lot: Plants of one species that were propagated at the same time at the same nursery.

***Phytophthora* symptoms**: Whole plant or leaf blight, leaf tip dieback, root rot, serious stem necrosis, bleeding lesions, root collar canker, wilting or the appearance of water stress, water soaked lesions on roots and/or necrotic flecking. Advanced symptoms include whole plant blight or dieback, root rot, serious stem necrosis, bleeding lesions, root collar canker, serious wilting with adequate watering, dead water soaked root mass or necrotic roots.

Guidelines

1. **Inspection**
    a. Confirm no fungicide applications on the plant lot within the past 45 days. Fungicides can mask *Phytophthora* symptoms, and will reduce pathogen levels making detection difficult, while not eliminating the pathogen.
    b. Perform a visual inspection of each plant lot. Plant lots with obvious *Phytophthora* symptoms should be rejected. Plant lots that do not exhibit obvious symptoms can be sampled.
    c. To be suitable for sampling, plants must have fully developed root systems and soil must be moist.

2. **Sampling**
    a. **Sample Size**

    Collect roots plus soil from 20% of the plant pots in each lot, to create one composite sample per lot. Minimum number of pots to be sampled per lot is two, maximum is thirty.

    b. **Sampling Procedure**

    Wear Latex gloves.

    Sterilize gloves and sampling tools between each lot. Brush any large chunks of soil off tools and gloves, then spray-drench parts of tool that have come in contact with soil, and spray-drench gloves, with 70% isopropyl alcohol or Lysol™. Wipe with clean cloth, or let air-dry.

    Place samples in a clean sealable container. Close and carefully label each sample bag so that the sample can be identified to date, nursery, and plant species.

    Pots up to one gallon

    Remove plant from pot. Inspect root system. Take approximately two tablespoons of root plus surrounding soil. Capture any discolored root in the sample. If no discolored root is found, take sample from bottom of pot and lower half of root zone.

    Pots larger than one gallon

    Remove plant from pot. Inspect root system. Take approximately ½ cup of root and surrounding soil. Capture any discolored root in the sample. If no discolored root is found, take sample from bottom of pot and lower half of root zone.

If unable to remove plant from pot, expand drainage holes in bottom of pot using a utility knife. Take approximately 1/4 cup of root. Do this at two drainage holes per pot.

If unable to expand drainage holes at bottom of pot, use a trowel or soil probe to expose roots approximately half way down the edge of the pot, and take approximately ¼ cup of root and surrounding soil. Do this in two places per pot.

3. Testing

Test roots from each plant lot using rapid tests such as Agdia-brand *Phytophthora* ImmunoStrip® tests or Pocket Diagnostic© *Phytophthora* tests. Rapid tests can result in false positives in the presence of some *Pythium* species, so if any rapid tests are positive for a plant lot, do an additional test by pear baiting the entire remaining composite sample.

a. Rapid testing

i. For each lot, run a number of tests equal to 15% of the number of plants in the lot. For example, if a lot contains 100 plants, run 15 tests. However, the minimum number of tests to be run per lot is two, and the maximum is twenty.
ii. Ensure test kits are at room temperature.
iii. Wear Latex gloves.
iv. Examine roots in each sample. Using the worst looking roots in the sample, use 0.15g to 0.3g of root to run each test.
v. Sterilize gloves and tools between each plant lot.
vi. Record results of Pocket Diagnostic test at 10 minutes after initial processing, or each ImmunoStrip® test at 30 minutes after initial processing.

b. Pear bait testing

i. Submit each composite sample to a commercial lab to:
    1. run pear bait test, and
    2. PARP or VARP plate cultures obtained from pear baiting, and
    3. Confirm *Phytophthora* by morphology or PCR
    4. If desired, use PCR to identify *Phytophthora* to species

4. Accepting or rejecting plant lots based on test results

If *Phytophthora* is not detected through rapid tests, that plant lot is cleared for planting in the Presidio.

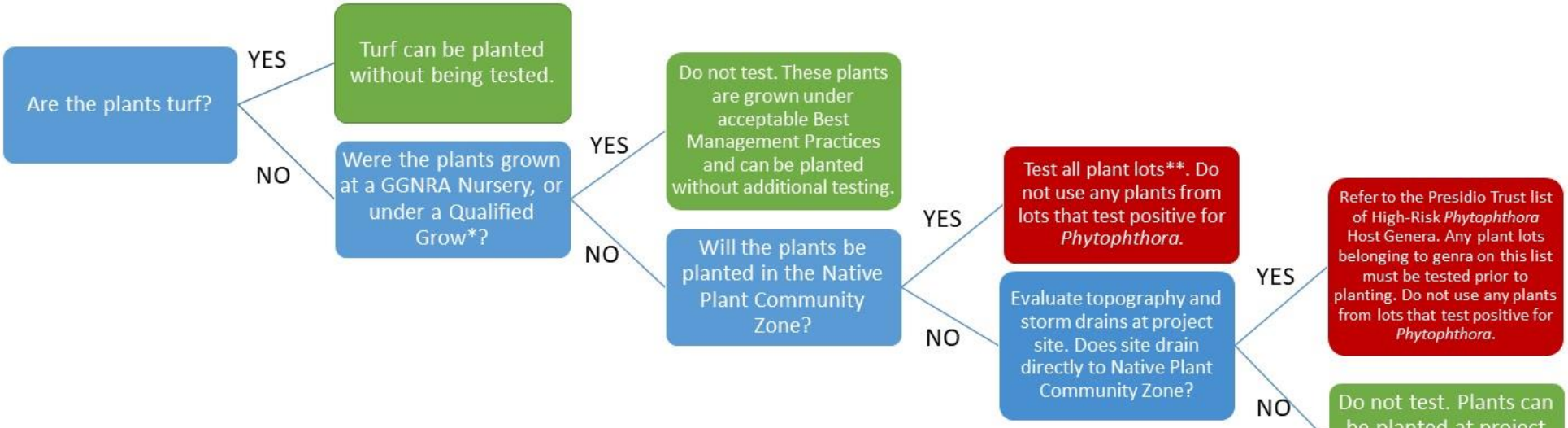
If rapid test(s) are positive, but *Phytophthora* is not detected through pear baiting, that plant lot is cleared for planting in the Presidio.

Plant lots that test positive for *Phytophthora* through pear baiting, or positive through strip-test but not pear baited, should be rejected for use in areas that drain to the Presidio Native Plant Community Zone.

APPENDIX D

Presidio Trust *Phytophthora* management guidelines for the use of nursery grown plants. 2021_04_01

Do I need to test the plants I'm using in my landscape project for *Phytophthora?* And what would the test results mean for me?



*Qualified Grow: a nursery grows a project's plants to order, and the Presidio Trust Integrated Pest Management Specialist can document that (a) the nursery has been inspected and meets Presidio Trust Qualified Nursery BMPs, and (b) the project grow is in a distinct part of the nursery with sufficient controls to keep from becoming contaminated by areas containing brokered plants.

**plant lot: a group of plants all the same species, grown at the same place at the same time.

Presidio Trust list of high-risk *Phytophthora* host genera

updated: 2021-03-18

based on data compiled from:

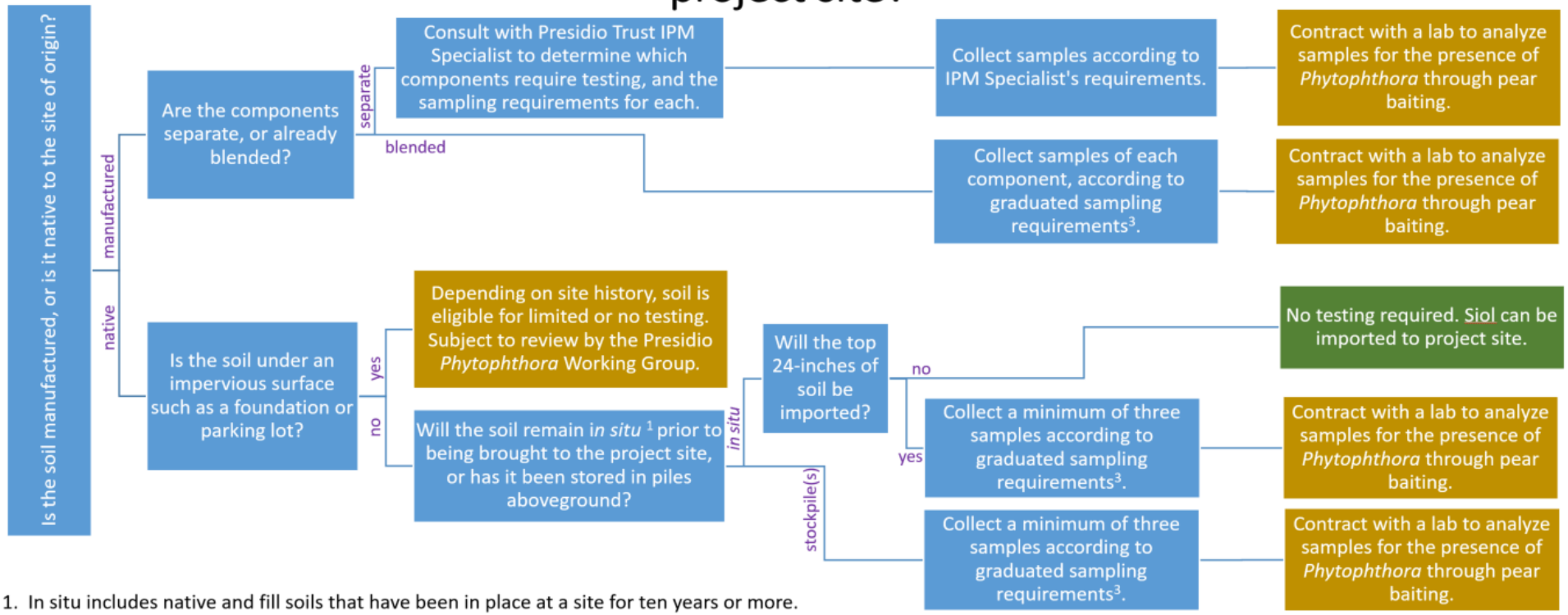
California Department of Food and Agriculture
Golden Gate National Recreation Area field and nursery testing
Phytosphere Research
Presidio Trust commercial nursery testing
United States Department of Agriculture, Agricultural Research Service, Fungal Database
University of CA Berkeley Forest Pathology and Mycology Lab
Royal Horticultural Society

Genus			
Acer	*Camelia*	*Fremontodendron*	*Prunus*
Achillea	*Ceanothus*	*Grivillea*	*Pseudotsuga*
Aesculus	*Cistus*	*Hardenbergia*	*Quercus*
Agonis	*Cornus*	*Heteromeles*	*Rhododendron*
Alnus	*Correa*	*Juncus*	*Rosmarinus*
Anaphalis	*Corylus*	*Juniperus*	*Rubus*
Arbutus	*Cottoneaster*	*Lantana*	*Salix*
Arctostaphylos	*Cupressus*	*Leucadendron*	*Sarcococca*
Artemesia	*Diplicus (=Mimulus)*	*Lonicera*	*Stuckenia*
Aucuba	*Elymus*	*Myoperum*	*Taxus*
Azalea	*Eriophyllum*	*Myrica*	*Umbellularia*
Baccharis	*Frangula (=Rhamnus)*	*Pinus*	*Viburnum*

APPENDIX E

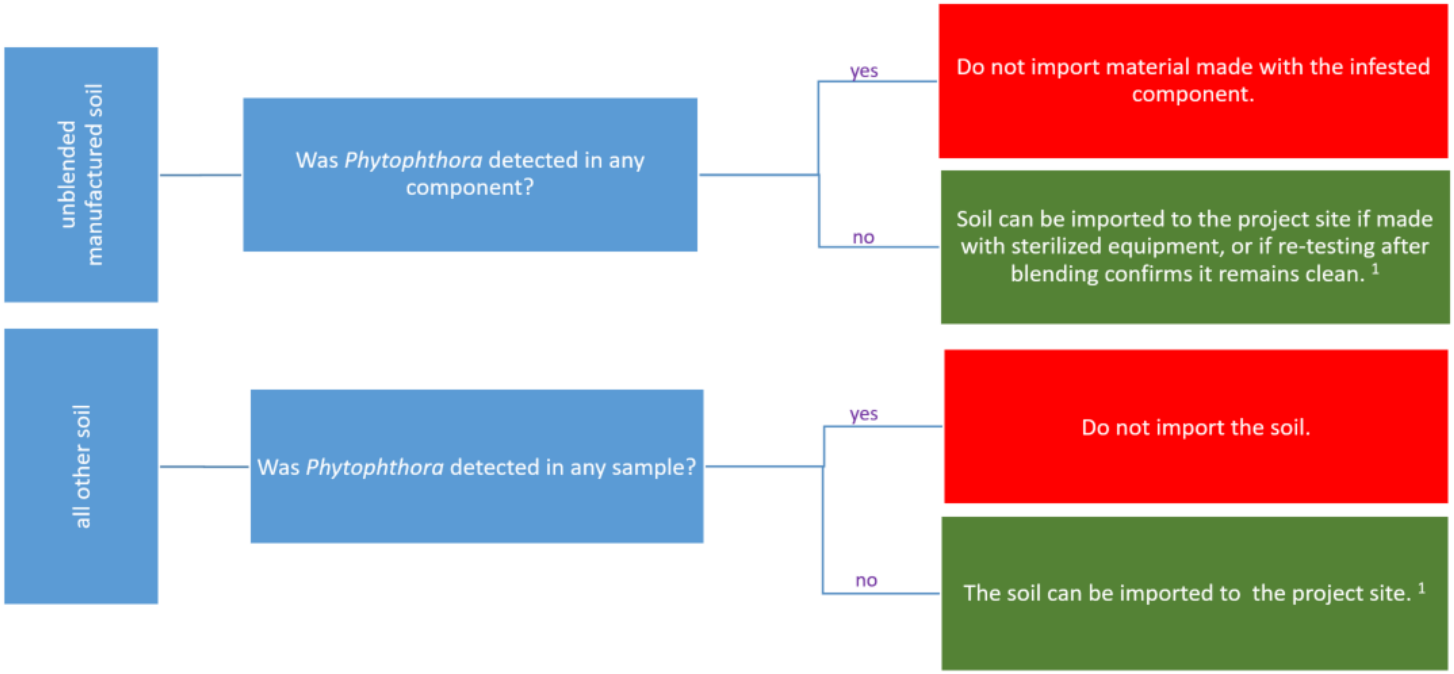
PRESIDIO TRUST *PHYTOPHTHORA* MANAGEMENT GUIDELINES FOR IMPORTING SOIL

Do I need to do *Phytophthora* tests on soil being considered for import to my project site?



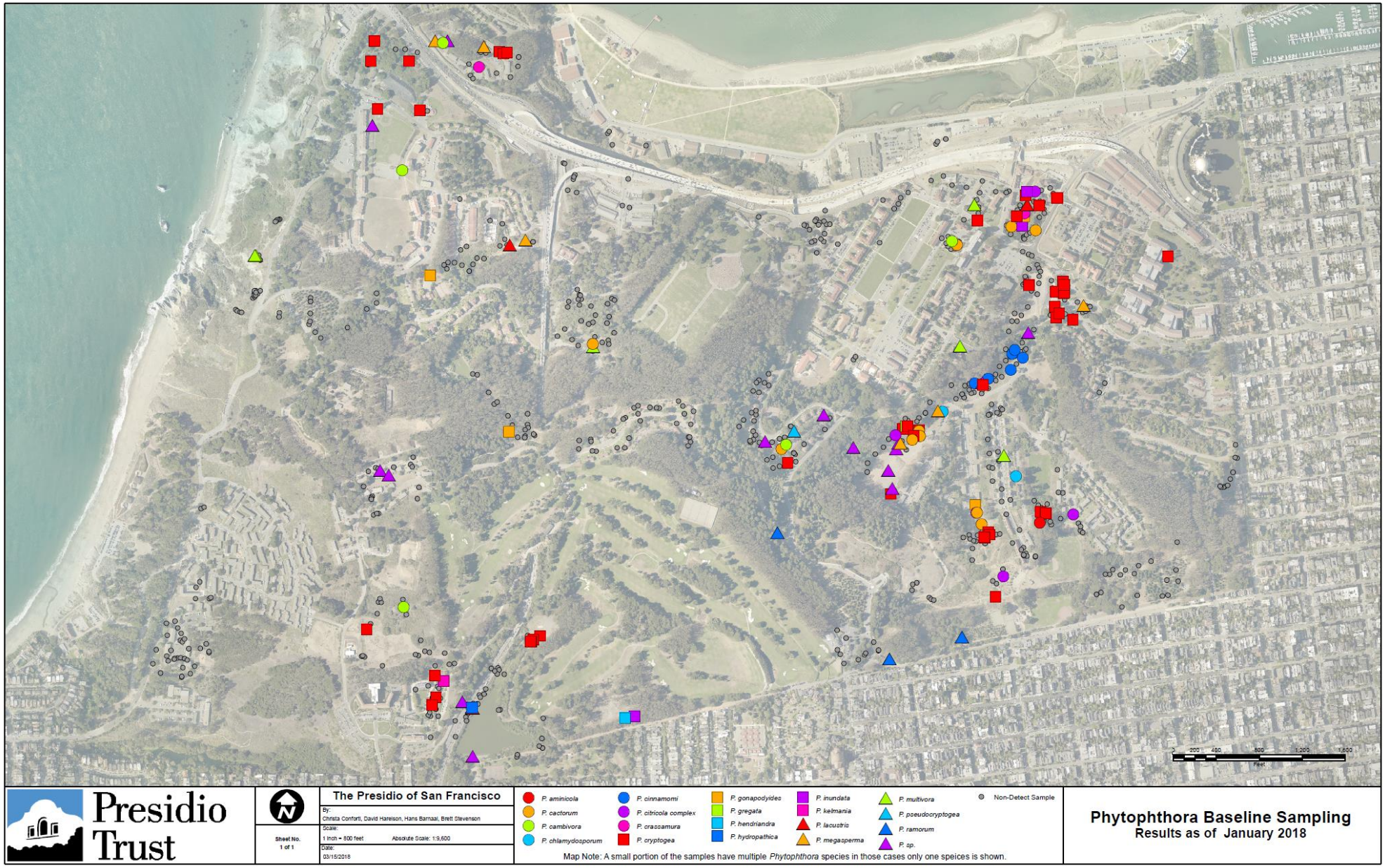
1. In situ includes native and fill soils that have been in place at a site for ten years or more.
2. To use the soil from the top 24-inches, testing is required. Requirements regarding importing weed seed are separate.
3. Sampling stockpiled material: for the first 1 to 500 CY's sample at a rate of 1 per 100 CYs, for the next 500 to 1000 CYs use a rate of 1 per 250 CYs, for amounts over 1,000 CYs use a rate of 1 per 500 CYs. Include roots from any plants present, with preference for woody plants. Samples should be taken from multiple depths, at 12-inch intervals. If stockpile is not uniform, include samples from areas with differing soil appearance. Each sample should contain at least one-third of a gallon of soil plus roots (if roots are present in stockpile). A proposed sampling and testing plan shall be submitted to the Trust's IPM Specialist for review by the *Phytophthora* Working Group prior to sampling.

I've tested the soil being considered for import to my project area, now can I use it?



1. Final review and acceptance of any soil import to be made by Presidio Trust Integrated Pest Management Specialist.

APPENDIX F


Presidio Trust
The Presidio of San Francisco
By:
Christa Conforti, David Harelson, Hans Barnaal, Brett Stevenson
Scale:
1 Inch = 800 feet
Absolute Scale: 1:9,600
Date:
03/15/2018
Sheet No.
1 of 1
P. aminicola
P. cactorum
P. cambivora
P. chlamydosporum
P. cinnamomi
P. citricola complex
P. crassamura
P. cryptogea
P. gonapodyides
P. gregata
P. hendriandra
P. hydropathica
P. inundata
P. kelmania
P. lacustris
P. megasperma
P. multivora
P. pseudocryptogea
P. ramorum
P. sp.
Non-Detect Sample
Map Note: A small portion of the samples have multiple Phytophthora species in those cases only one speices is shown.
Phytophthora Baseline Sampling
Results as of January 2018