

# Greenhouse Planning and Design

## Indigenous Greenhouse Factsheets

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### Introduction

Site selection, site preparation and pre-planning are critical steps in establishing a successful greenhouse. This factsheet outlines a number of key considerations for the early stages of greenhouse establishment.

### Site selection and preparation

The ideal greenhouse site will have full exposure to the sun throughout the day, with a minimal southern aspect (0.5-1-degree slope), a deep well draining loam soil, and easy access to existing water and power service. While this ideal combination of factors may not always be available, many growers make the most of the space they have and assess the cost-benefit of available sites. The most important consideration is solar exposure- to maximize benefit of a greenhouse structure, it would not be suitable to invest in building a greenhouse in a shady location. Any trees and vegetation shading the site during the day should also be removed.

### Greenhouse orientation

North-south orientation maximizes light uniformity, however, if you are establishing a greenhouse in a far northern climate, an east-west orientation can maximize the solar exposure of the structure throughout the day.

## Earthworks

A bulldozer will make quick work of grading a greenhouse site with a tradeoff of some potentially serious soil compaction. A large compact excavator can also get the grading work done well, proving useful for many other tasks when establishing a new greenhouse. A small excavator is excellent for cleaning up any fallen trees and debris at the site and can also dig a trench for water and power service.

## Soil compaction & drainage

Even a compact excavator will cause soil compaction during earthworks. It is important to address this prior to greenhouse construction. The greenhouse site should be ripped using a deep ripping tooth implement, or a keyline plow. These implements can be found for tractors, skid steers, or even mini dozers.

Deep ripping is an essential step at any site with loam or clay soils and will ensure loose tilth for plant roots but perhaps even more importantly ensure adequate drainage. The greenhouse structure can also dramatically alter the flow of surface water at a site by redirecting it across the surface of the structure. If drainage is a concern, it is advisable to install a drainage tile system along the length of the exterior walls.



**Figure 1.** Breaking up severe compaction in a new greenhouse at Amisk Farm.

## Water supply

Both water quantity and water quality are of concern for greenhouses. Certain crops, such as leafy greens, should only be watered with potable water as a food safety measure. The ideal scenario would be to install a water line below the frost line of your site that comes up to a water main at the main access end of your greenhouse prior to construction. Raising the waterline to a frost-free hydrant is an excellent option that will eliminate the need to blow out water lines if the greenhouse is going to be dormant for part of the winter season. Doing this in advance will ensure access to water for shoulder season or winter growing. Another consideration is the potential for cold shock from cold water negatively impacting plant growth. This can be addressed by utilizing some large water tanks, such as Intermediate Bulk Container (IBC) totes inside the greenhouse that can be filled with water, allowing it to warm to ambient temperatures prior to being used for irrigation.



**Figure 2.** A well head for a deep water well. Calculating water demand and ensuring wells have adequate supply is crucial. If the well recharge rate is too low, cisterns will have to be incorporated into the design to ensure continual supply.



**Figure 3.** Main water supply line coming from a frost-free yard hydrant installed in front of the greenhouse. This line feeds a series of IBC totes, allowing the water to reach ambient temperatures prior to being pumped into drip lines. A float switch and timer are used to automate the system in an affordable way.

## Power supply

Any greenhouse with a heating system, fans, lighting, and/or automation should have a dedicated power service installed by a professional electrician. Power service can be dropped in the same trench as the water line once it has been backfilled to within a few feet of the surface. The electrician can oversee this work and install a panel and outlets at the service entrance to the greenhouse.

## Foundations and footings

Determining what type of foundation is needed for your site requires a few considerations, primarily the manufacturers guidelines, soil type at greenhouse site, premenance and the intended use and management plan for the greenhouse. For dedicated soil-based production in permanent beds, a low-cost x-rod foundation is usually adequate.

- **X-rod:** This is the simplest and most affordable option and highly recommended for those wishing to build their own greenhouses. This type of foundation uses a short section of galvanized steel tubing, called a ground post, that is driven into the earth and fixed in place with two pieces of rebar fitted through guide holes in the post. The rebar forms an x-pattern, hence the name. The trusses are designed to interlock with the ground posts and slide right onto them. This type of foundation only requires a sledgehammer to build, but a small excavator or skid steer can also be used to carefully drive the ground post in.
- **Concrete pillar:** This approach requires pouring concrete footings around the ground posts. Sonotubing is used to create simple forms for the pillars. The footings should extend below the average frost line of the site. Although slightly more expensive than x-rod foundations, concrete pillars do make it easier to establish a perfectly level foundation that is not prone to frost heaving. It is feasible to build a concrete pillar foundation using materials readily available at any hardware store. Footings can be dug by hand and the small batches of concrete can be mixed in a wheelbarrow. The most challenging part of the process is getting everything plumb and level and this requires careful use of a string line and level. A laser level is an excellent timesaving device to use.

- **Concrete perimeter:** By far the most expensive option. A concrete perimeter foundation can be established by building lumber footings and pouring concrete with rebar. A concrete mixing truck is recommended for this volume. Concrete perimeter foundations are only necessary if the greenhouse manufacturer requires one or if your site assessment determines that the ground cannot otherwise support the greenhouse structure.

## Greenhouse installation

Greenhouse installation is a large job that requires a crew. Professional greenhouse technicians can be hired to build these structures and oversee installation with a local crew. New greenhouses will come with installation instructions; the foundation and frame must be assembled carefully following the manufacturer's instructions. When pulling the poly over the frame, be sure to double-check that the poly will come over the structure with the anti-drip coating facing down and the UV protection facing up. The poly will be labeled and if the wording is oriented correctly (i.e. not backwards), you have it correct. The poly is usually tied off to ropes that are thrown over the structure, allowing it to be pulled over by three or more people. A small piece of equipment or tractor could be used but be extra careful that the poly is coming over evenly to avoid any tearing. It is recommended to watch some instructional videos about the installation process to properly prepare; there are many available online.



**Figure 4.** Using a compact excavator to assist with installing new 80 ft greenhouse



**Figure 5.** Nutrient application in hoophouse prior to adding the poly cover