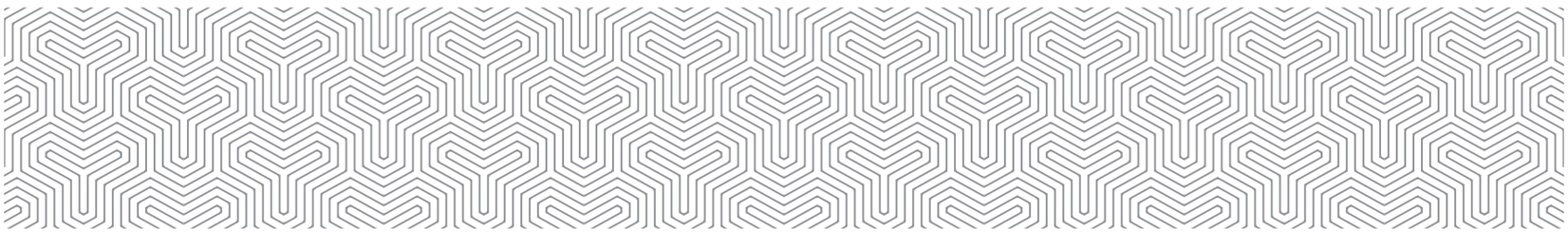
EXTERIOR PRODUCTION OPERATIONS AND HORTICULTURE

Recommended study material for the Landscape Industry Certified Manager exam



Business Management Training Manual for Landscape Professionals

Produced by
National Association of Landscape Professionals
Canadian Nursery Landscape Association

Developed by
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landscape industry certified manager

Canadian Nursery Landscape Association
Association Canadienne des Pépiniéristes et des Paysagistes

NATIONAL ASSOCIATION OF LANDSCAPE PROFESSIONALS

Contents

List of Figures

Introduction

The purpose of this training manual is to cover the technical aspects of exterior landscaping from the perspective of management. We realize that managers cannot be technical experts in all areas of the operation, but they must have a general understanding of the aspects of technical issues that impact their ability to manage. A more detailed coverage of the technical knowledge needed by landscape contractors is covered in the following publications (available in both English and Spanish):

- *Landscape Training Manual for Installation Technicians*
- *Landscape Training Manual for Maintenance Technicians*
- *Landscape Training Manual for Irrigation Technicians*

Chapter 1

Interpret and Implement Landscape Plans

Landscape Specifications

During the course of a manager's day-to-day work, it is clear that landscape specifications need to be dealt with, both to develop a bid for a project and to provide landscaping crews with a road map to follow when completing the project itself. To ensure that the company will be successful and profitable, it is critical to be able to accurately read and understand specifications.

Landscape specifications refer to both the *drawings and written specifications* that accompany landscape contracts. Large companies normally have estimators whose job it is to understand the specifications, to be able to do quantity takeoffs from drawings, and to develop a cost to carry out the project on the basis of the specifications and drawings. Although the larger companies have estimators, the manager/owner needs to have a good understanding of specifications to enable him or her to review the work carried out by the estimator. In smaller companies, it is very often the owner/manager who prepares the bids; thus, in these instances, it is essential that the owner/manager have a clear understanding of the drawings and specifications in order to bid properly.

The goal in using landscape specifications is pretty straightforward. In Canada, large dollar tenders will often be drafted according to CCDC standards (Canadian Construction Documents Committee, www.ccdc.org/home.html). In the United States, standardized contracts are available from the Association of General Contractors of America, and contract information is also available from the National Institute of Building Sciences. These can be very complex documents that require a great deal of expertise to understand and to comply with the terms and conditions they contain.

We will concentrate our discussion on smaller scale projects, which will not be as complex, but which will still require an understanding of the basic components and concepts of specifications. To start, let us look at a more detailed difference between drawings and written specifications. The first thing to understand is that, when there is a legal problem, written specifications take precedence over drawings in the eyes of the court. Therefore, the written specifications cannot be ignored just because "they are too complicated," nor should they be viewed as "guides" to the work being performed.

Drawings are a visual representation of the shapes, location, dimensions, and measurements of the work to be done on a particular project. Specifications are a more precise, formal, and detailed description of the work to be done. They generally include the way the work is to be done and include procedures, the materials to be used, and the quality required. Experience will show that a combination of good drawings and good specifications makes the job much easier to bid accurately and complete successfully.

Where necessary, specifications also precisely describe how assemblies go together (e.g., a new garden pergola) and the necessary quality and quantity of materials required to meet code (e.g., patio

construction). Well-written specifications will generally exhibit much the same format in that they will include the following three parts for each specification:

1. **General:** This section spells out the specific administrative and procedural requirement unique to the situation.
2. **Products:** This section gives a detailed description and quantity of items that are to be incorporated into the project.
3. **Execution:** This section provides a detailed description of preparations required and how the products are to be incorporated into the project.

A good example of a standard specification would be the following simple specification relating to the protection of existing trees on a job site. (The following is an example of the format typically seen in landscape contracts.)

1. General

1.1. All trees identified and marked for preservation are subject to all parts of this specification.
1.2. All work and practices must meet ISA standards and specifications.
1.3. Plant material should include genus/species, size, and quantity.
1.4. Include manufacturer, color, and pattern for hardscape materials.
1.5. Include weight quantities and visual description of natural stone products; use as descriptive language as possible.

2. Products

2.1. Tree protection fence shall be an orange snow fence of 4 ft. (1.2 m) height installed on metal or wooden stakes of 7 ft. (2.1 m) length at 4 ft. (1.2 m) intervals.

3. Execution

3.1. Execution: Tree protection fences shall be erected so as to encompass the protection zone identified for each tree or group of trees.
3.2. No materials such as fill, chemicals, construction material, or other plant material may be placed within these protection zones.

Well-written specifications should be clear and unambiguous. One should be able to understand what is being required. The whole package should be uniform in format and style, so the reader can quickly get used to the writer's style and way of saying things. This is more of a concern with smaller projects, as the writer will tend to have less experience at specification writing than the writer of large-scale projects.

One caution to keep in mind when reading specifications are "open" and "closed" specifications. Open specifications are those that use a generic description of an item to be supplied. An example would be a wooden patio table of a certain size and dimension. A closed specification uses a specific description of the item. In our example, the specification could call for a specific model from a specific manufacturer. A closed specification must be handled carefully because it may not be possible to obtain the exact item specified, or if it is available, it may be at an uncompetitive price.

Carrying Out Basic Landscape Calculations

Managers should have the technical ability to check landscape calculations and to carry them out on their own. The *Landscape Training Manual for Installation Technicians* provides most of the major calculations that you will require. These can be found in Chapter 2 (Landscape Plan Reading & Calculations) and in Chapter 3 (Surveying, Grading & Drainage).

Chapter 2

Landscape Standards

Good management of landscape firms requires the owners/managers to have a working knowledge of the landscape standards that apply to their geographic areas of business. In both Canada and the United States, landscape associations, usually in cooperation with landscape architects, have developed these landscape standards. The standards are usually voluntary unless they are written directly into contract specifications. If they are in the specifications, they form part of the legal contract that the landscape company enters into with its customer.

Many municipal and city governments have landscape standards that they set for developers. The level of inspection and enforcement varies greatly among jurisdictions; however, it is important as a landscape contractor to be aware of any local government landscape standards.

Canada

In Canada, there are national standards/specifications for plant material produced by the Canadian Nursery Landscape Association. This standard is the Canadian Standards for Nursery Stock, which is available from the CNLA. Recently (2016) the CNLA has modified the British Columbia Landscape Standard into a national landscape standard that is applicable to all provinces. These documents are voluntary standards and are not enforceable by law unless the standards are specifically referred to in the contract specifications.

United States

American Standard for Nursery Stock is available online from AmericanHort and can be downloaded at http://americanhort.org/documents/ansi_nursery_stock_standards_americanhort_2014.pdf

This document provides standards for nursery stock size and quality in the United States. The document is a voluntary standard and is not enforceable by law unless it is specifically referred to in the contract specifications.

Chapter 3

Hardscape Installation

To provide professional advice on hard landscape installation, managers must have a working knowledge of the main hard landscape materials and installation process for their region. If hard landscape knowledge is not a strength of the manager, then it is important to recognize this and have other personnel in the company who have the required expertise to provide advice to customers.

Chapter 4

Grading and Drainage Implementation

Codes and Regulations

Most city and regional governments will have regulations or codes for the grading and drainage that must be installed on both commercial and residential sites. On commercial projects, the grading and drainage will be specified in the contract and contract drawings. Either an engineer or a landscape architect prepares these specifications, and it is the landscape contractor's job to install the grading and drainage per the specifications. On residential sites, it is often the landscape contractor doing the design. In this case, the landscape contractor must ensure that the grading and drainage meets all government codes and/or regulations.

It is also important to be aware that many municipalities require a sewer layer license or other special license to lay drain line of any type. Check your local authority to find out what the requirements are in your area.

Drainage Systems

Drainage systems refer to subsurface and surface drainage systems that are used for the interception, collection, conduction and disposal of storm runoff and subsurface water. Drainage systems need to be designed and sized to deal efficiently with projected precipitation, infiltration, and flow rates. On large projects, all of the surface and subsurface drainage should be designed by an engineer to meet local building code requirements.

Drainage systems also need to ensure the safety of the property owner and the protection of dwellings, site elements, and properties from water damage, flooding, and erosion. Where storm drainage is concentrated, permanently maintainable facilities, such as storm water retention ponds, are often provided to prevent erosion and other damage or flooding on the site or on adjacent properties.

It is critical that the landscape contractor be aware of what measures and installations have been made off-site and on-site as part of the "hard" construction to ensure that the work specified in the landscape contract can be properly carried out with respect to site drainage. During landscape construction, the landscape contractor must ensure that measures are taken to prevent siltation of existing drainage systems and watercourses during all on-site work.

Subsurface Drainage

Subsurface drainage is any drainage method installed below the surface of the soil to move water out of the soil. Normally, a detailed subsurface drainage plan is prepared by engineers and is not the responsibility of the landscape contractor. Landscape contractors are, however, often called on to install subsurface drainage on residential and commercial sites. A drainage plan should be supplied as part of the contract drawings, if it is in the landscape contract, and it should include the following:

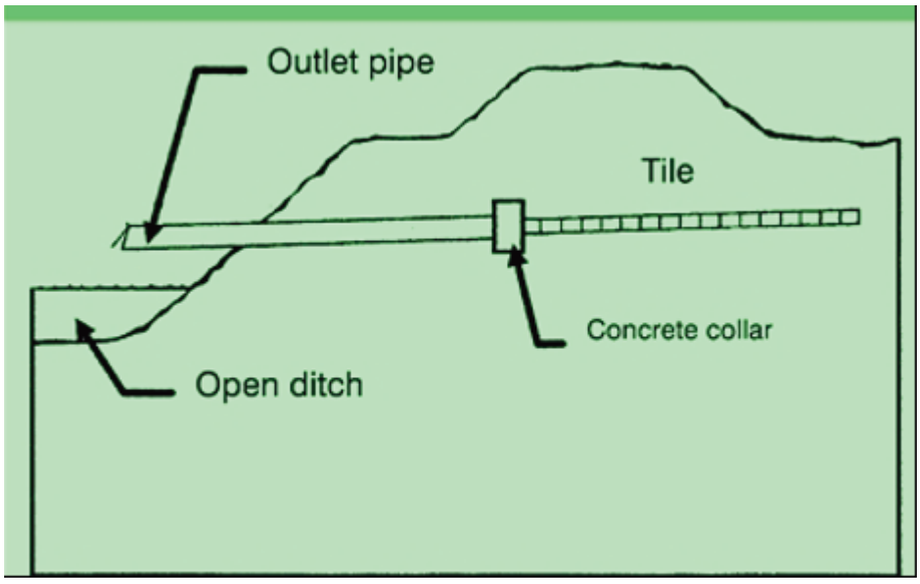
- Drain outlet locations;
- Location, size, depth, spacing, and slope of drains;
- Locations of any obstructions, such as trees, buildings, and so forth;
- Surface runoff from adjacent properties;
- Back-filling requirements.

Drain Outlet Locations

There are two types of outlets for subsurface drains, gravity and pump. For most landscape purposes, gravity drains are the most common type. Gravity outlets discharge water into storm sewers or open waterways.

Figure 1 shows a typical gravity outlet that discharges into an open ditch. It is critical when installing the outlet that the end of the pipe should not extend too far beyond the ditch bank, since the force of the falling water will cause erosion, creating the potential for serious environmental problems. The installation of riprap below the outlet to prevent erosion is a common procedure.

FIGURE 1: GRAVITY DRAIN OUTLET



Types of Subsurface Drain Materials

Landscape contractors are most likely to encounter five main types of drainage systems that are commonly used for subsurface drains. These drain types are:

- Flexible corrugated plastic tubing (this is the most common subsurface drainage material);
- Perforated hard plastic pipe (PVC);
- Concrete tile;
- Clay tile (very seldom used — more common in older landscapes);
- French drains.

Flexible Corrugated Plastic Tubing

Flexible corrugated plastic tubing is the most commonly used material, due to its ease of installation, light weight, and relatively low price. Depending on the application, the pipe may be solid or perforated and come with or without a fabric sock filter to prevent material from clogging the perforations. Shallow installations may be subject to crushing damage where machinery is used. It should be noted that some municipalities require the use of smooth interior-walled corrugated tubing only.

Perforated Hard Plastic Pipe (PVC)

Perforated hard plastic pipe (PVC) is relatively expensive and is usually used in areas such as perimeter drains around buildings.

Concrete Tile

Concrete tile is a durable material, but it is heavy, expensive, and requires installation by hand.

Clay Tile

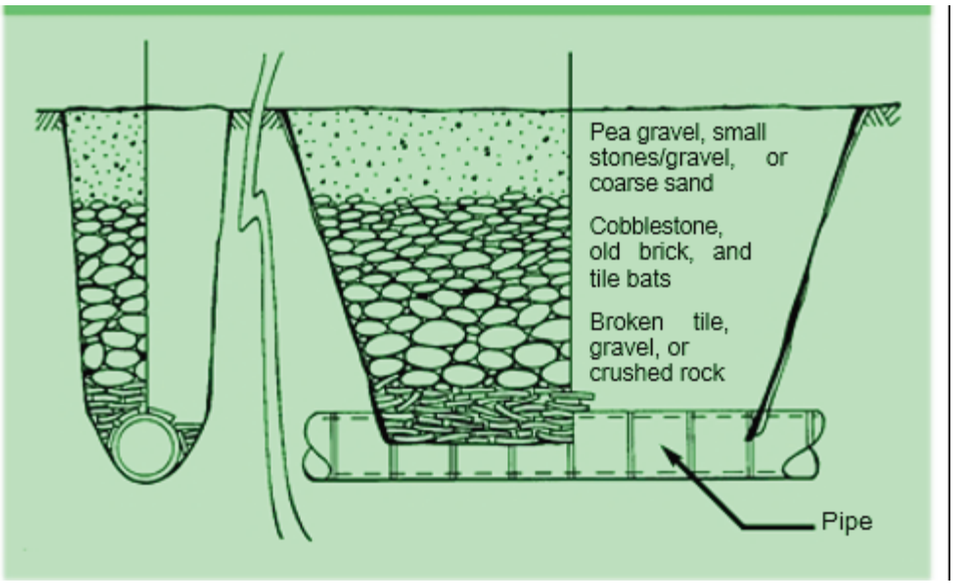
Clay tile is a relatively durable material, but it is heavy, expensive, and requires installation by hand. Until the advent of flexible plastic pipe, these tiles were used extensively in agriculture and are often found still functioning in fields today.

French Drains

One subsurface drain that is used occasionally on landscape sites is the French drain. A French drain is basically a trench back-filled with porous material such as gravel, which allows water to flow easily. French drains can be used by themselves to move water, or they can be used in conjunction with (i.e., placed over) perforated pipe or drain tile.

Figure 2 shows a typical French drain construction. French drains can be installed with or without the pipe at the bottom of the drain. The more typical installation is one without the pipe at the bottom of the trench. It is a rock-filled trench used where drain tile is not considered feasible, typically to intercept water for short distances. Thus, the figure with the pipe removed would be more typical of French drains used in the Pacific Northwest.

FIGURE 2: EXAMPLE OF FRENCH DRAIN CONSTRUCTION



Surface Drainage

To ensure good surface drainage, growing medium (topsoil) should be fine-graded after placement. This helps maintain positive surface drainage, since all the surface irregularities are filled during the final fine-grading process. Landscape contractors need to ensure that the finished grading conforms to the grade elevations and contours shown on an approved landscaping plan. The finished surface should be smooth and uniform, and it should be firm against deep foot printing, with a fine, loose surface texture.

Finished grades must ensure that water flows away from all buildings and structures (positive drainage). Before the landscape is complete, make sure that there are no depressions, settling, or irregularities in the finished grade. In general, settling of the finished grade should not be more than 1¼ inches (30 mm) from specified elevations, and if settling is greater, the landscape contractor should bring the grade to the specified elevations.

If the surface drainage is complete and problems with the surface drainage are noticed, even though it has been installed as specified in the plans, the project manager should be informed.

Open Channel Drainage

Open channel drainage refers to the use of ditches, swales, or larger waterways to carry water from a site. Vegetated waterways can be extremely effective in the movement of water and, if properly designed, ensure that soil erosion does not take place. Vegetated waterways also dissipate large amounts of potentially erosive energy during periods of heavy rainfall. Such waterways should not, however, be used in situations where there are continuing flows or continual wetness, since the vegetation will begin to suffer from prolonged flooding.

The proper functioning of these ditches is based on open channel design criteria. The capacity of an open channel or ditch is calculated using these factors:

- Potential runoff;
- Shape of the waterway;
- Selection of appropriate vegetation;
- Design velocity;
- Roughness coefficient.

It is not the responsibility of the landscape contractor to do the actual design of open channel drainage structures, since they need the expertise of engineers for proper functioning.

Rain gardens

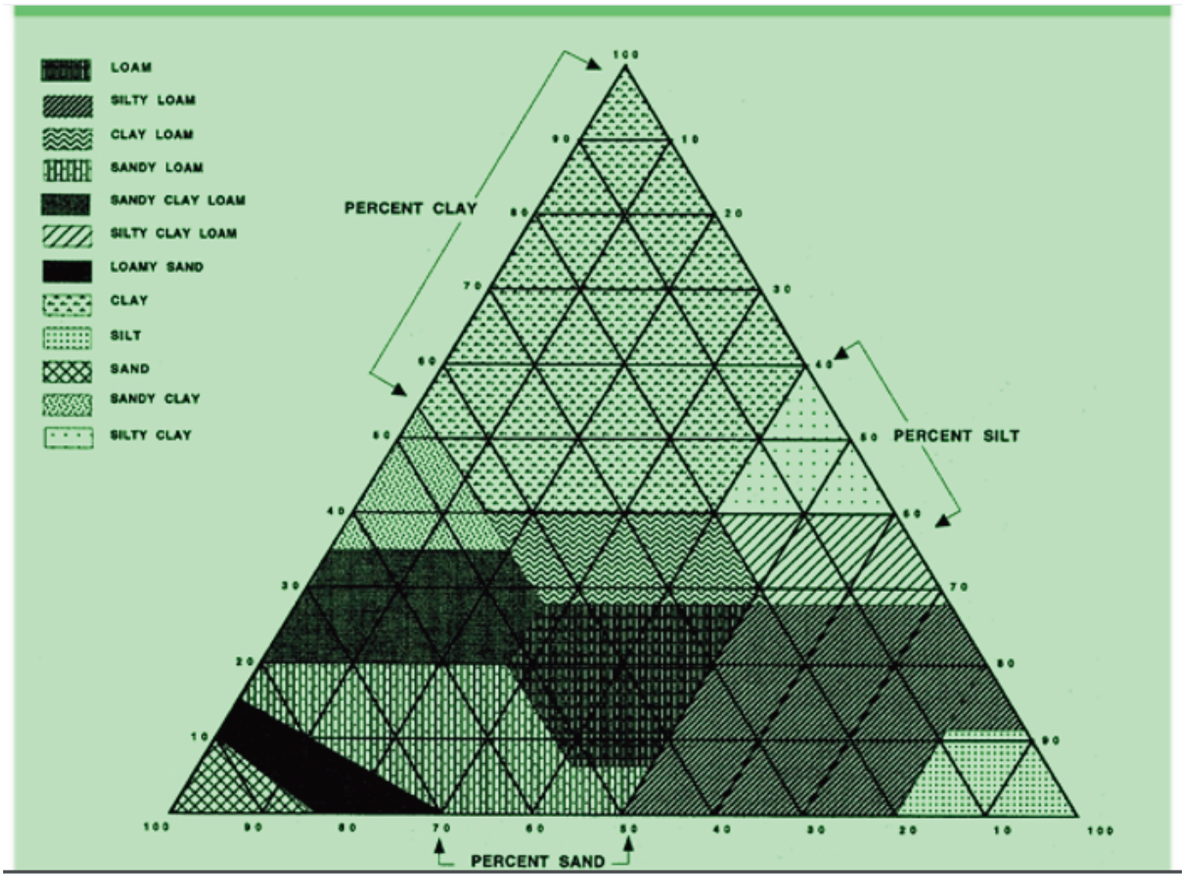
In recent years, rain gardens have become commonplace in urban drainage design. Rain gardens are planted swales or depressions that capture water from impervious surfaces and allow the water to absorb into the soil. This reduces the amount of water entering storm drains and surface water courses. The plants in rain gardens also help improve the water quality be reducing sediment and absorbing pollutants.

Chapter 5

Important Soil Properties

It is important to understand some of the basic properties of soils that have a direct impact on the success of plant and turf establishment and on the degrees of compaction that may take place during construction. Soil texture is the most important concept to understand. The particles of soils are classified by size as sand, silt, and clay. Sand particles are the largest, and clay particles the finest. Figure 3 shows the textural classification of soils.

FIGURE 3: SOIL TEXTURE TRIANGLE



Soil Structure and Plant Growth

Clay soils, which are very finely textured with small pore spaces, can impede root growth. This structure makes soils with a high percentage of clay unsuitable for growing many types of plants. Clay soils typically have poor aeration qualities. Lack of oxygen to plant roots can lead to root diseases and poor growth. Sandy soils have poor binding ability and are prone to wind erosion.

Water-Holding Capacity

In sandy soils, water drains rapidly. Sandy soils have low water holding capacity and quickly dry out. This makes them very useful in the construction of sand-based playing fields, which are usable even following relatively heavy rains.

In contrast, heavy clay soils have a high water-holding capacity that makes them less susceptible to drought. Clay soils may stay saturated for a considerable time, and plants may drown as a result.

Nutrient-Holding Capacity

The higher the clay content of a soil, the greater its nutrient-holding capacity is. Sandy soils have low nutrient-holding capacity and must be fertilized more often to support healthy plant growth.

Soil Management

Clay soils (often referred to as “heavy soils”) are easily damaged by wheeled and pedestrian traffic, quickly becoming compacted and rutted, especially when they are wet. They must be handled very carefully when worked, or they will become completely unproductive.

Sandy soils can generally take higher traffic without becoming compacted or damaged. This is important both from an agricultural and from a landscape perspective. The sandy soils used to construct playing fields, for example, retain their structure and do not compact or rut under heavy foot traffic or the wheels of grass mowers.

Chapter 6

Soil Compaction

Soil compaction on landscape sites leads to problems with drainage and plant establishment. Compacted soils have very low saturated hydraulic conductivities, and, thus, water infiltrates them slowly and overland flow and erosion increases.

Highly compacted soils also have poor aeration and poor water holding capacity, and, therefore, the levels of oxygen, water, and nutrients reaching the roots is often below what is needed for good plant growth (see Figure 4).

The causes of soil compaction include foot traffic, heavy equipment, vehicular traffic, and landscape maintenance equipment. Compacted soils can lead to tree and shrub mortality, high occurrence of compaction-tolerant weeds, and difficulty in properly establishing good turf.

Good planning prior to construction can help reduce some of the soil compaction that takes place during building and landscape construction by limiting the areas that construction equipment can drive on. Topsoil can be removed prior to construction so that only the subsoils are being driven on. After construction, the subsoil should be de-compacted by ripping or subsoiling and the topsoil should be replaced.

FIGURE 4: IMPACT OF SOIL COMPACTION ON AERATION POROSITY AND WATER-HOLDING CAPACITY

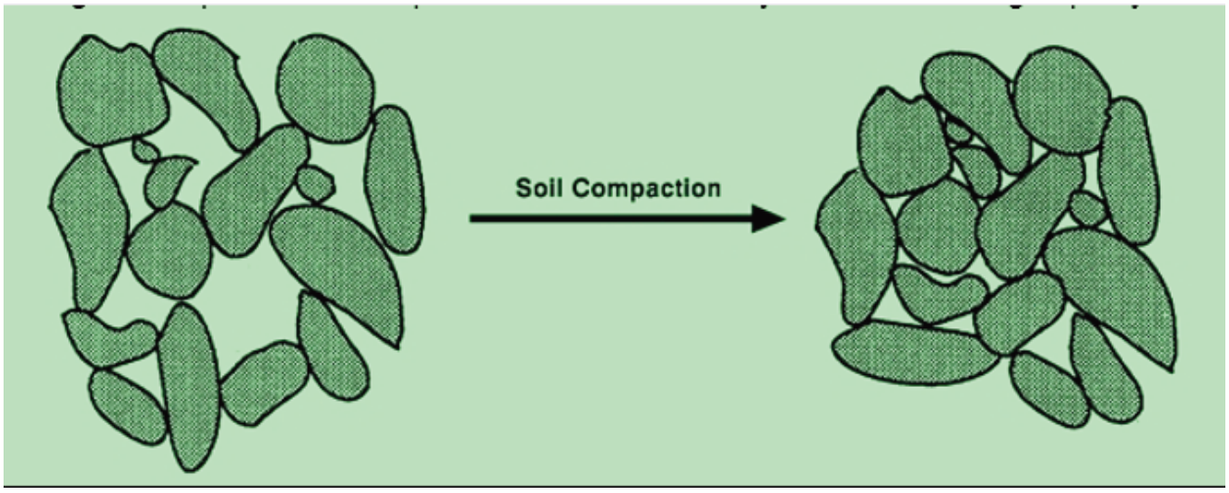


Figure 4 above demonstrates how the volume of pore space is drastically reduced after compaction.

Some direct consequences of soil compaction are:

- Impaired root growth;
- Poor aeration;
- Reduced drainage.

Compacted soils can have a very significant impact on landscapes, since the pore space is decreased. Specifically, as the larger pores are reduced, the resistance to root penetration increases. As the pore spaces are reduced with soil compaction, less air is able to fill those pores, resulting in poor aeration. Compacted soils have a low water-infiltration rate, which slows the drainage of excess water out of the soil.

Some indirect consequences of compaction include:

- Nutrient deficiencies;
- Flooding;
- Soil erosion;
- Susceptibility to root rot.

Since there is reduced root growth in compacted soil, the ability of plants to absorb both nutrients and water is reduced. Compacted soil also increases the overland flow of water (surface water flow), which can cause flooding and soil erosion downstream from the compacted soil areas. Since water cannot infiltrate compacted soils as easily as it can in uncompacted soil, it flows along the surface, affecting adjacent areas. The reduced drainage results in soils that stay wet longer, providing ideal conditions for root rot organisms.

Impact of Soil Moisture on Compaction

Wet soils tend to compact more readily than dry soils. Water acts as a lubricant between soil particles, allowing them to slide more easily when pressure is applied to them. This sliding action permits small particles to move into larger soil pores. The greatest compaction will occur when soils are at field capacity (i.e., the water content of the soil after all the excess water has drained out of the soil due to gravity).

Soils that are completely saturated cannot be compacted, since the pores are completely filled with water (i.e., water does not compress). However, this does not mean that these soils will not be severely damaged by traffic. As a muddy soil is squeezed out from under tires or feet, the soil structure is harmed. Soil aggregates are sheared and rearranged. These soils can quickly become puddled, and, on drying, shrink and become almost impermeable.

Impact of Soil Texture and Particle Size Distribution on Compaction

The distribution of soil particle sizes has a significant impact on the soil's susceptibility to compaction. A well-aggregated soil will compact more than a poorly aggregated soil. For example, a sandy soil with a wide range of particle sizes will compact far more than a sandy soil in which most of the particles are of a uniform size. In a well-aggregated soil, smaller-sized particles are forced into the pore spaces between the larger-sized particles during compaction. In a soil with more uniform particle sizes, there is less

opportunity for small particles to move between the spaces of the large particles. This example is significant, since it is commonly thought that all sands are well drained and, thus, not susceptible to compaction. This is, however, not the case unless the sand is made up of uniformly sized particles. In general, loose and well-aggregated soil is most susceptible to compaction.

Impact of Pressure Applied to Soils on Compaction

Most soil compaction in horticulture is due to pressure applied by wheels, tillage implements, and foot traffic. It is very important to limit the amount of traffic over soils on both landscape construction sites and in fields where crops are being grown.

On landscape sites, subsoils tend to get very compacted during the construction phases of development. The impact of traffic on subsoils is often ignored because contractors are usually more concerned with the condition of stored or purchased topsoil. When subsoils are compacted by heavy traffic, free drainage is impacted and saturation of the topsoil will occur.

Vehicle tires exert a pressure on the ground, which is the combination of the area of the tire contacting the soil and the load the tire carries. Any turning, starting, or stopping will increase the pressure, as will heavily treaded tires. The compacting force spreads and decreases with depth. Thus, the most damaging effects of compaction by wheeled vehicles are usually within the top 4 inches (10 cm) of the soil. The greatest compaction also occurs on the first pass over the soil. It is estimated that 80 percent of compaction will occur with the first wheel to travel over the soil. Heavier construction equipment, such as dump trucks, will compact to a greater depth, but usually the most serious compaction is in the upper 6-8 inches (15-20 cm) of the soil.

The following rules of thumb should be kept in mind to reduce soil compaction as much as possible:

- Always keep foot and vehicle traffic to a minimum.
- Always use the same track, since this will confine the compaction to a single area that can be repaired.
- Keep wheeled traffic away from tree roots.
- Keep soil tillage to a minimum acceptable level.
- Schedule work when the soil is dry.
- Use low ground pressure vehicles whenever possible.
- Place a coarse mulch, like woodchips, straw, or hog fuel, over heavily trafficked areas and then remove when the project is complete.

Chapter 7

Soil Erosion

Soils erode when particles of soil are detached and transported by either water or wind. On landscape sites, the major problem is usually erosion by water. The initiation of water erosion is the impact that raindrops have on bare soil. It is estimated that raindrops fall at a rate of approximately 20 miles per hour[1] (32km/hr.). This is a tremendous amount of energy, and if it is falling on bare soil, it will lift the soil and break apart exposed soil aggregates. This is the primary reason that soil should be covered, mulched, or seeded with annual grasses if it is being exposed to the elements for significant amounts of time.

Erosion is generally classified as gully, rill, and sheet erosion. Any or all of these can take place on construction sites if appropriate erosion control measures are not implemented.

- **Gully erosion** occurs when water concentrates in channels, which then deepen rapidly. This will usually happen during heavy rainfall and on sites where water is being concentrated into areas that have a high susceptibility to erosion.
- **Rill erosion** is the removal of soil on a side slope, where there are small channels formed. These are very common on construction sites when erosion protection measures are not in place.
- **Sheet erosion** takes place where there is little or no vegetation cover and where the slopes are not steep enough to cause rill or gully erosion. In sheet erosion, soil is removed in a relatively even plane.

Erosion Control Measures

On-site erosion control is an important factor in reducing environmental damage caused by water moving from landscape sites and carrying high quantities of suspended solids (soil particles). In addition, on-site erosion must be repaired prior to finishing the landscape project. In many jurisdictions, there are environmental regulations that specify the use of erosion control measures on construction sites.

The first line of defense against on-site soil erosion is good planning prior to the commencement of construction. During planning, identify areas that may have a high susceptibility to erosion and avoid disturbing these areas if at all possible. If you must disturb areas with high erosion potential, then ensure they are well protected until vegetation is re-established. In all instances, establish vegetation as soon as possible on sites. If the area is to be left in an unfinished condition for some time, cover the soil with mulches, annual grasses, or erosion control fabric.

Since water erosion of soil is a direct result of overland flow of water, the higher the water velocity, the greater the erosion. Therefore, it is important to keep runoff velocities as low as possible. Installing

[1] Harpstead, M.R., Hole, F.D. & Bennet, W., 1988. *Soil Science Simplified* 2nd ed., Ames, IA: Iowa State University.

straw bales or silt fences in areas where water velocity is likely to increase often provides an answer to this problem. Where possible, it is a very good idea to divert water away from disturbed areas.

Finally, try to retain on the site any sediment generated from the construction/landscape site. This can be done by the construction of small retention ponds in appropriate areas or by the use of silt fences or straw bales.

Chapter 8

Irrigation Systems and Water Management Strategies

The manager of a landscape company that installs irrigation systems or hires irrigation subcontractors should have an understanding of irrigation on the following five levels:

1. **Legal**
    a. The manager should possess an understanding of all state/provincial, city, local, and municipal codes, including licensing and permitting requirements, education requirements, design requirements and restrictions, water use regulations and restrictions, indemnity bonds, and insurance.
2. **Design**
    a. The manager should understand the basic concepts of matching precipitation rates, square versus triangular head spacing, and compensating for slope, prevailing winds, and soil types. Design would also include the concept of even water distribution and precipitation efficiency.
3. **Physics**
    a. The manager should possess an understanding of the basic physics of water flow, friction and pressure loss, pipe sizing, and low voltage limitations.
4. **Mechanics**
    a. The manager should have a basic understanding of the mechanics of an effective irrigation system, which would include a working knowledge of the differences between types of backflow presenters, controllers, wiring, valves, pipe material, head types, and nozzles.
5. **Installation Methods and Techniques**
    a. The manager should have a working knowledge of the methods used to install the system as well as the qualifications required to design, install, and maintain the system.

Legal

In most instances, the irrigation contractor connects their equipment directly to the public water supply. This provides the opportunity for contamination to enter the public water supply. The responsibility for protecting public health by preventing contamination of the water supply through an irrigation system falls directly on the shoulders of the irrigation contractor. This is done through laws, regulations, permits, and licensing requirements. It is the responsibility of managers to be sure that their companies, or any company that may do the work for their companies, abides by all the regulations set forth by their community.

1. **License**
    - It is the manager's responsibility to find out which local governing board is responsible for licensing. Once this is determined, you may be required to test to receive a license or you may simply pay an application fee. In many locales, you must demonstrate proficiency in your knowledge and comply with continuing education requirements. Check with your local city, county, or other municipal licensing boards.
2. **Permits**
    - Once the license is obtained, most local authorities will want to track and inspect the work being done in their jurisdictions. This is accomplished through the Permits and Inspections Department. Know who permits are obtained from.
3. **Codes**
    - The codes for irrigation systems vary greatly from area to area and change often. Contact your Permits and Inspections Department for a current copy of the codes in your area. Even if you are subcontracting, be educated in order to assure your contractor is complying.
4. **Indemnity Bonds**
    - You may be required to carry a certain level of insurance or indemnity bonds specifically pertaining to irrigation. It is the manager's responsibility to know what is required in your area.
5. **Service Location**
    - You are most likely required by law to contact a "One Call" or "Digger's Hotline" locating service prior to beginning work

Design

Although the manager is most likely not doing the actual design, they should be extremely familiar with the basic concepts that should be included in any good irrigation system. The basic design requirements include water pressure and volume availability, head spacing, matched precipitation, compensation for unusual site conditions, and local codes, which may dictate anything from head placement to pipe type to backflow prevention.

Most irrigation systems are designed by accredited irrigation designers. The landscape contractor should ensure that the designers consider:

- Water conservation;
- Durability;
- Efficiency and uniform distribution of the water;
- Safety issues;
- Aesthetic issues;
- Site-specific requirements;
- Soil type;
- Slope;
- Root depth;
- Plant materials;

- Microclimates;
- Weather conditions;
- Water source;
- Plants watered separately from turf;
- Sun and shade areas watered separately;
- Time of day to operate irrigation system;
- Site usage (i.e. commercial vs. sports area vs. Residential)

An accurate water pressure and water volume test is essential to assure the system is designed properly. This will dictate the size of zones and number of valves needed.

Head spacing is crucial to assure that the irrigation provides even and complete coverage. The heads should be laid out in either a square or triangular spacing, whichever is best suited to the shape being irrigated, in order to provide head-to-head coverage.

The correct head type (spray, rotor, drip) should be used for the area to be irrigated. Placement must also consider the future growth of surrounding plant material so that the spray will not be blocked in the future or the system can be adapted later to accommodate a mature landscape.

A third consideration in placing the heads is ensuring that like areas in a landscape are irrigated together and unlike areas are watered separately. It is not only important to separate turf and shrub beds, since they have different water requirements, but it is also essential to separate southern and northern exposures, which might receive vastly different amounts of direct sun, or other areas that require different amounts of water on different schedules.

Once the heads are separated into zones, it is crucial to understand the concept of matched precipitation. This method ensures that different heads in the same zone distribute the same amount of water per square foot. For example, in a properly designed zone, taking matched precipitation into account, a sprinkler head that covers a full circle arc of 360 degrees must emit two times the amount of water as a sprinkler head covering a half circle of 180 degrees with the same radius because the full circle is covering twice the area. The easiest way to accomplish this is to use only like heads in any irrigation zone. Never mix rotors or pop-up sprays in the same zone. Avoid combining similar heads of different manufacturers on the same zone, as well. The manufacturers make it easy to assure that their products, when properly spaced and nozzled, will provide matched precipitation every time.

Aside from pure geometry, other considerations such as slope and prevailing winds might require you to skew your spacing to allow for drift and gravity to affect the distribution. The manager should have a working knowledge of the basic concepts for adapting to these site conditions.

Finally, each local jurisdiction has its own set of requirements that affect design. For example, the city of Omaha requires that no head be placed within 24 inches of a city curb, and they do not allow the use of double-check valves for backflow prevention, whereas other cities may allow you to place a head within two (2) inches of the back of the curb and to install double-check valves. It is the responsibility of the manager to be aware of all local codes pertaining to design.

Physics

Although the actual designer should be well versed in the principles of physics, there are many charts and programs available to help managers become familiar with the elements of physics involved in their projects. It is, therefore, important for the manager to have a basic understanding of a few basic principles of physics in order to communicate decisions and design considerations effectively.

1. **Volume vs. pressure**
    a. One such consideration is volume vs. pressure. It is important to know that these are two different things and that they must both be addressed. Volume is the amount of water being moved, and once it is lost, it cannot be regained. It is the top limit of how many gallons per minute you have available to you and will affect the number of zones on a system and how long you will have to water to get the proper amount of precipitation.
    b. Pressure is the force moving the water or speed at which it is moving. It can be increased by use of a booster pump in low-pressure situations and is decreased by every raise in elevation, every fitting in the pipe, and every restriction in the size of pipe. Friction also reduces pressure. The manager must be aware of these principles to understand pipe-sizing basics and length-of-run considerations.
2. **Electricity**
    a. Like water, electricity also experiences volume (volts) and pressure (amps) loss. This is important to know in determining if a system will operate with 18-gauge multi-strand wire or if it is necessary to install 14 degree or larger wire. Although the designer or design software can easily make these determinations, the manager should be aware of these considerations to assure the design and installation is done in accordance with project requirements.

Mechanics

This section is the nuts and bolts of the irrigation system. It includes the components and how they operate together to make an effective system. There are many reference materials available to gain a full understanding of each component and the differences among them. For the purposes of the manager, it is important to understand the options available, the applications of different heads and components.

1. **Backflow prevention**
    a. Backflow prevention is required in most communities for one simple reason: the protection of the municipal water supply from contamination. There are many documented cases of poison or toxins entering the public water supply through an unprotected irrigation system. The manager should have a working knowledge of the difference between air gap, atmospheric, and pressure vacuum breakers, double-check valves, and reduced-pressure-assembly-type backflow preventers and how they protect the water supply.

b. In addition to distinguishing between the types of backflow prevention, the manager should be aware of the legality of these different types. Some are banned in some communities or allowed only in very specific situations. It is the manager's responsibility to be sure his company is complying with all codes and regulations.

2. **Remote control valves**
   a. The manager should have a basic understanding of the basic components of a remote control valve, including the direction of installation, flow control, solenoid operation, causes of failure, and troubleshooting.
3. **Wiring**
   a. The manager should have a basic knowledge of voltage drop and the need to determine which type and size of wire are needed on the basis of the system's design.
4. **Pipe**
   a. The manager should have a working knowledge of types of pipe and their application.
   b. *PVC ridged pipe* comes in different wall thickness, categorized as "class" or "schedule." Schedule pipe is generally heavier duty and more durable. It is primarily used in mainline applications, but in some regions, it is used for lateral lines, as well. PVC is resistant to burst failure and joint failure from pressure but is not as flexible, and it is more vulnerable to freeze break.
   c. *Poly pipe* is used in some regions for lateral lines, since it is more flexible and resistant to freeze damage. It is, however, not as resistant to burst failure from high pressure. Poly pipe can be used in mainline applications if it is protected by a master valve.
   d. *Swing pipe* is a small, highly flexible pipe that connects the sprinkler head to the lateral line. It offers resistance to impact damage from traffic.
5. **Sprinkler heads**
   a. There are many different types of sprinkler heads and many different manufacturers. It is the manager's responsibility to understand the usage of these different heads. Each of these heads has a distinct application that is based on the conditions, soil, plant material, and area to be irrigated.
      - Fixed spray head;
      - Impact rotor head;
      - Gear drive rotor head;
      - Mist head;
      - Microspray head;
      - Drip emitter.
6. **Nozzles**
   a. A nozzle is the orifice that determines the amount of water emitted by any given head and the distance it distributes that water. This is where a system is metered to the most precise degree, and the manager should understand the options available and how they are applied.

Installation

There is more than one way to skin a cat, and more than one way to install an irrigation system. It can depend on soil conditions, new or existing landscape, or even personal preference. The manager should have a good working knowledge of the pros and cons of each of these considerations.

1. **Pipe installation**: There are three types of pipe installation: trenching, plowing, and boring.
    1. Trenching
        a. Trenching advantages
            - Increase installation speed;
            - Allow for installation of larger pipe;
            - Allow multiple pipes to be installed in the same trench;
            - Allow for visual inspection of the entire assembled system.
        b. Trenching disadvantages
            - More damage to existing landscapes requiring more extensive cleanup;
            - Settling can occur in future.
    2. Plowing
        a. Advantages
            - Reduced damage to existing landscape;
            - Reduced cleanup time and better final appearance.
        b. Disadvantages
            - Slower installation;
            - Difficulty of working with larger pipe;
            - Multiple pulls for adjacent lines required.
    3. Boring
        a. Boring is used primarily to install lines under hardscape, like driveways and streets, but could aid in getting a line installed under large existing landscape to reduce root damage and speed installation.
2. **Swing pipe vs. nipples**.
    a. This is the connection between the head and the lateral line. Nipples allow for faster installation, whereas swing joints provide for more accurate head placement and more protection of the joint from impact damage.

Guarantee or Warranty

- It is the contractor's responsibility to insure and guarantee complete balanced coverage of the areas shown on the drawings to be irrigated, without excessive overthrow. Plant and turf areas should be watered separately where possible, to meet their specific water requirements.
- The contractor normally guarantees the satisfactory operation of the entire system and the workmanship and restoration of the work area.
- The entire system is normally guaranteed to be complete and efficient in every detail for a minimum period of one year from the date of its acceptance and will include initial startup and end-of-season shutdown of the system.

Submittals

A suitably scaled as-built drawing should be provided to the owner, whether commercial or residential. All components of the irrigation system should be shown as installed. The dimensional locations of the following items should be indicated:

- All valves;
- Main and distribution lines;
- Plugged tees;
- Routing of control wires;
- Controller and its circuit breaker;
- Main water connection;
- Blow-out connection;
- Pump and its connections;
- Backflow prevention assembly;
- Flow and rain sensors;
- Electrical conduits;
- Sleeves;
- Other similar features.

Testing and Maintenance

Inspection

On completion of the irrigation system installation, all components need to be adjusted to optimize the operation of the system and allow for final inspection and testing. This inspection should be carried out with the consultant or owner's representative present to ensure that the work has been completed according to specifications and that it meets the intent of the installation standards.

Testing

On completion of the irrigation system, and after sufficient time for the solvent weld joints to cure, the entire system should be tested for proper operation. All debris and air needs to be flushed from the system, and all components must be checked for proper operation. The test requires that the system be operated sequentially with the controller in the presence of the owner's representative.

Efficient Water Use

To get the most efficient water use possible, there are three rules that should be followed when setting up watering schedules:

1. Deep, infrequent irrigation is much better than shallow, frequent irrigation.
2. Never allow the precipitation rate to exceed the soil infiltration rate.
3. Allow a minimum of one (1) hour between irrigation cycles.

The first rule applies to all plants whether they are trees, shrubs, perennials or turf-grass. Deep, infrequent irrigation allows the water to penetrate more deeply into the soil, thereby more fully reaching the water-holding capacity of the soil (field capacity) and encouraging root systems to grow deeper. This approach generally uses less water as well.

The second rule recognizes that varying types of soil (differing percentages of clay, sand, and silt) have different infiltration rates (i.e., they will only take in a given amount of water in a given amount of time). Different sprinkler heads and nozzles have different precipitation rates (i.e., the amount of water they will put out in a given amount of time). If water is applied faster than the soil can absorb it, the excess water pools or flows away. In either instance, there is a waste of water.

Rule three recognizes that, because of watering restrictions and the possible need for multiple cycles resulting from the second rule, it is best to leave at least an hour between cycles. This will allow the soil to fully absorb the water from the first cycle before the water from the next cycle is applied. Starting the second cycle too soon will also waste water.

Your local irrigation supply company should be able to give you information about the applicable infiltration rates for the soils in your area and can help you set up the best schedule on the basis of calculations of the precipitation rate for the installed system.

Refer to Landscape Training Manual for Installation Technicians or the Landscape Training Manual for Maintenance Technicians for more basic information about Irrigation System Components and Maintenance.

Refer to Landscape Training Manual for Irrigation Technicians for more detailed information about irrigation systems and water management

Chapter 9

Lighting Systems

Lighting in the landscape industry consists of the installation of a system to efficiently light areas of the landscape. For a landscape contractor, the construction of the lighting system usually includes furnishing, installing, and testing all lighting equipment and hardware as well as restoring the site to its original condition. These requirements are usually provided as detailed specification documents; however, in design/build firms, the landscape company may be expected to design the lighting system for the customer.

There are three general goals for landscape lighting:

1. Beauty
2. Safety
3. Security

The goals listed above can be achieved by using one or more of a variety of lighting techniques listed below:

- Down lighting (placing soft, diffused lights high in trees to cast patterns through the branches and/or leaves);
- Area lighting (illuminating paths, stairs, interesting ground cover, and flower beds);
- Up lighting (lighting the landscape from below plant material or objects);
- Front lighting, side lighting, and backlighting;
- Shadow Lighting (lighting a plant or object on a wall);
- Accent lighting;
- Silhouetting.

Lighting systems can be low voltage or regular voltage. The low voltage systems are much easier to work with and are not as subject to rigorous regulations governing their installation. However, regardless of the type of system, the manager of a landscape firm must ensure that the following requirements are met:

- Electrical work and installation is in accordance with the prevailing codes.
- Equipment specifications and installation procedures are followed according to drawings and contract specifications.
- Installation crews are aware of where all utilities are located on the property.

Prior to the commencement of any work, it will be the responsibility of the contractor to notify the appropriate utility companies to confirm the locations of all services. It is also a very good business practice to prepare an updated proportion ally and diagrammatically correct drawing of the system indicating the locations of such items as:

- Controller;

- Fixtures;
- Junction box;
- Transformers and remote ballast boxes;
- Wire run;
- Sleeves under hard surfaces.

Refer to Landscape Training Manual for Installation Technicians for a summary section on lighting.

Legislation and Regulations

If the lighting systems are designed as part of a design/build business, it is essential that all local and municipal/city/county rules and regulations relating to any portion of work be incorporated into the specifications and the provisions. Make sure that information contained in the specifications does not conflict with any of the regulations or requirements mentioned above.

Make certain that all 120-volt connections and electrical panel hookups are performed by, or under the direct supervision of, a licensed electrician.

Materials

In Canada, all fixtures installed in the landscape lighting system must meet CSA standards and must be suitable for outdoor installation. Underwriters Laboratories is the standard in the United States.

Chapter 10

Softscape Installation

Softscape refers to the installation of plants into the landscape. A manager must be aware of the selection of appropriate plants for any given site, ensure that the plants purchased meet the size and quality needed, and see that they are shipped to the landscape site in good condition. Once on-site, the plants must be handled and planted properly to ensure success. Qualified people should be responsible for both the selection and installation of plant material.

Plant Selection

Refer to the Landscape Training Manual for Installation Technicians for more detailed information of the major factors to take into account for good plant selection. The manager of a landscape company should have a good understanding of which plants to select for certain site conditions. This includes understanding:

- Climate and microclimates;
- Plant hardiness zones;
- Effects of exposure;
- Impact of soils on plant selection (refer to the section on “Soil Properties” in this manual);
    - Soil texture
    - Soil depth
    - pH
    - Fertility
- Impact of site drainage characteristics on plant selection.

Plant selection is usually under the jurisdiction of the landscape architect or designer on larger jobs. However, the manager should understand plant selection from an aesthetic point of view. This includes understanding the:

- Required size, form, texture, and color of the plants;
- Growth rates and expected size of the plants when they reach maturity;
- Water, soil, and sun requirements of the plants;
- Special requirements (i.e., root barricades for invasive plants like bamboo).

If the manager is not a trained horticulturalist and does not understand the fundamentals of plant selection, then it is critical that a staff member is hired with this type of knowledge.

It is critical that the manager understand the concept of “getting what you pay for.” This is as true for plant purchases as it is for most other purchasing decisions. If quotes on the supply of plants vary greatly between supply nurseries, it is necessary to ensure that they are supplying the same quality and size as the contractual specifications stipulate. Caution is to be used in this part of the project, as some suppliers may have based their bid on supplying poorer grades and undersized plants.

Probably the most important aspect of the plant supply portion of landscaping is for the manager to ensure that the quality and size are what the customer is expecting. If the size, quality, or variety of plant is not available, then it is important to involve the customer as early as possible in picking appropriate substitutions or making alternate arrangements.

Container and Field-Grown Plants

Plants can be purchased in a number of different "packages" that are either containerized or field-grown. Field-grown plants may be balled and burlapped (B&B), wire baskets (WB), or bareroot (BR). Each medium has advantages and disadvantages.

Container Plants

Container plants have many advantages over field-grown plants, B&B, WB, or BR plants. These plants are:

- Usually much lighter and easier to handle than B&B or WB plants;
- Easier to maintain prior to planting, since they are in containers that are easy to water;
- Able to be planted most months of the year, unlike other types of plants, which can only be dug when dormant.

A disadvantage of container-grown plants is that they tend to be more expensive than field-harvested material of the same size. In addition, if they are grown too long in their containers, they will become root-bound. They also need water much more frequently than field-grown plants.

Balled and Burlapped (B&B)

Balled and burlapped plants refer to field-grown plants that are usually hand dug, wrapped in burlap, and then tied. In general, these tend to be smaller caliper trees; however, some nurseries also sell shrubs as B&B (see Figure 5).

FIGURE 5: BALLED AND BURLAPPED TREE

Tree Spade/Wire Basket (WB)

Many nursery growers have switched from hand digging their trees and shrubs to machine digging and placing the root balls in wire baskets. Plants provided to the landscape site in wire baskets are usually heavy, due to the size of the root balls, and require equipment to move them on-site. The major advantage of wire-basketed plants over those that are hand-dug is that they are easier to move with equipment. The baskets are constructed to allow them to be picked up using a chain hook. They also fare better when they are lifted using the forks on a forklift or skid-steer loader.

Bare Root (BR)

Bare root plants are plants that have been field-grown and harvested with no soil, thus the name “bare root.” Bare root plants are seldom used in landscaping, due the difficulties in maintaining them during transportation to the site and storage and transportation at the job site. They also have limited storage life and can quickly desiccate on-site. However, bare root plants have the advantage of being much less expensive and easier to transport.

Quality and Performance of Trees

Given their cost and visual presence in a landscape, trees (and shrubs) must be selected with extra care. No matter how the plant has been grown at the nursery, there are several factors to consider. One is that the selection of a particular tree will normally be driven by availability, cost, and most probably by personal preference. The production method will not normally be the deciding factor. Another factor relates to the consumers’ concern for the performance of the tree/shrub after it has been planted and the amount of effort necessary to maximize the plant’s performance.

In an era when many customers want "instant" gardens, they should realize that the larger the tree is at planting, the longer it will take to establish itself. Studies have shown that larger trees grow more slowly after planting and actually can be smaller after several years when compared to a tree that was smaller at the same time of planting.[2]

Post-planting irrigation is also critical. When irrigation is available, there does not appear to be any difference in performance among the production methods. Where irrigation is limited, container-grown plants are more likely to experience water stress following planting.

Long-term quality and performance will require you to understand a few points:

1. Branch pattern and size of the tree at planting have little influence on long-term growth.
2. Levels of vigor, laterals on the trunk, and height-caliper ratios will greatly influence the effort required to optimize performance.
3. Shoot and root quality will have a long-term effect on performance and may impact the plant's survival.

Roots

A healthy, vigorous plant requires a well-developed and healthy root system. This is especially the case for shrubs and trees that are expected to live for many years. To maximize the probability of a long-term, healthy root system, someone on your staff will have to ensure that the trees that are to be planted do not have any root defects. These defects fall into two categories:

1. Kinked roots (where the taproot or other main roots are sharply bent)
2. Girdling roots (where the roots form circles wrapped around the trunk or other roots)

When you are selecting trees/shrubs at the nursery or when they are delivered to the job site, the roots should be inspected. Do not hesitate to remove the plant from its container or to unwrap any burlap covering and reject any plants that appear to have a major problem. Compromising quality at this point will only increase the probability of having an unhappy customer later on.

Crown Configuration

The ideal configuration of a tree to be able to withstand wind load after planting is one that has one-half or more of its foliage located on branches that originate on the lower two-thirds of the trunk. This eliminates a high-centered crown that could lever itself and topple over when wind-loaded.

Branching Pattern

For general landscape purposes, when choosing a tree or shrub with a good branching pattern, the main leader should not be headed but rather left to grow vertically. A good dispersal and spacing of branches around and up the trunk is desirable. Strongly attached branches (wide crotch angles) are preferred to weak, upright branches (narrow crotch angles). A good choice of branching pattern will greatly reduce the need for corrective pruning and will make training an easier task.

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[2] Watson, G. & Himelick, F.D., 1997. *Principles and Practices of Planting Trees and Shrubs*, Savoy, IL: International Society of Arboriculture.

All plants should be selected on the basis of their vigor, lack of injury, and freedom from pests. All these items can be checked during the process of receiving the plants at the nursery or at the job site.

Tree Caliper

Quality is paramount when it comes to plant selection. Trees are normally sized and sold by caliper. Caliper measurement of the trunk shall be taken 6 inches (15 cm) above ground level for trees up to and including 4 inches (100 mm) in size. Larger trees should be measured at 12 inches (30 cm) above ground level. In the United States, caliper is given in inches, and in Canada, it is quoted in millimeters. The AmericanHort publication, *American Standard for Nursery Stock*, gives excellent information on height and caliper for stock. The caliper of a tree only relates to its size; it indicates nothing about the tree's quality.

Plant Shipping and Handling

It is the manager's responsibility to ensure that crews picking up or receiving plants understand that the plant material must be protected during delivery to prevent any damage occurring to the plants or roots. When being shipped, there should be adequate protection and space between trees so that trunks are not scarred or branches broken. If the nursery does not have trunk protectors for trees when picking up an order, the contractor should either supply the trunk protectors or insist that the nursery provide adequate trunk protection during transport.

Plants should be transported in enclosed trucks or be covered with a tarpaulin. For large material transported in open trucks, the trees should be wrapped to prevent damage. Movement of container-grown, balled and burlapped (B&B), and wire-basketed (WB) plants should be restricted to closed vans or well-covered trucks with mesh tarpaulin or similar material to protect the leaves or needles from windburn and desiccation.

Plant material should never be handled by the trunk/stem. Instead, plants should always be handled by the ball or container, with support from the plant top when needed.

A note on pincher forks: Great caution should be used with mechanical pinchers to avoid crushing damage to the root ball of trees.

On-Site Plant Handling

Plants rarely go directly from the delivery truck into the ground. Normally, they have to at least be inspected and laid out according to the design. Often, plants end up being held on-site for an extended period of time, due to conflicts in scheduling, sub-contracting and so forth. When this type of delay occurs, use the following guidelines:

1. Place plants in the shade whenever possible. Remember that, on a hot summer day, soil on the sun side of a black container can hit 120° F (49° C) and can stay there for some time. This can kill the root tips of most plants.
2. Keep the plants from wilting by following a frequent-watering program.
3. Place plants close together to reduce injury from excessive movement of the tops and to keep them from falling over.

Chapter 11

Turfgrass Management

Proper management of turf requires knowledge of the local site conditions and the intended function of the turf in each project or area. It also requires an understanding of various grass species and grass seed and turf specifications.

Seed or Turf Selection

Regardless of the type(s) of grass to be used in an application, there are some quality considerations that you should be aware of when buying grass seed. In Canada, grass seed should meet the requirements of the Seeds Act and Regulations for Canada Certified No. 1, Canada Common No. 1, and Canada Common No. 2.

Seed should have a minimum germination rate of 85 percent and a minimum purity of 97 percent, except where otherwise required by the specification of the seed mixture. Seed is normally packed and delivered in original containers that are marked with the following information:

- Name of seed or seed mixture;
- Seed grade;
- Lot number;
- Name of supplier;
- Germination percent;
- Purity analysis of seed mixture (percentage of pure seed, variety, and weed);
- Year of production;
- Net weight (mass);
- Date and location of bagging.

In the United States, the Federal Seed Act provides the national legal framework for seed certification. This act states, “Seed mixtures intended for lawn and turf purposes shall be designated as a mixture on the label, and each seed component shall be listed on the label in the order of predominance.” The actual implementation of seed certification is carried out by individual states. Since the major states for grass seed production are Oregon and Washington, the certification programs from these states have the widest recognition.

The following Web site provides details of the Oregon grass and legume seed certification program, http://seedcert.oregonstate.edu/

Seed mixtures need to be suited to the climate, soil conditions and type of soil, orientation, sun exposure, terrain, establishment, and maintenance conditions under which they are to be grown.

Grass Types and Varieties

The range of grasses used in landscape situations throughout North America is extensive. It is important to know which ones are best suited to the local climate, the specific site, and the client's needs. Fescues, bentgrasses, bluegrasses, ryegrasses, and so forth, all have requirements for optimum growth. Perennial ryegrass will not grow well in very hot, dry conditions. Kentucky bluegrass should not be grown in coastal areas, where acidic soil and wet winters are prevalent. Likewise, fine fescues will normally perform much better than Kentucky bluegrass in shade conditions. Local seed suppliers should be able to give you good advice on what varieties or mix of varieties will perform best for the situation at hand.

Soil Conditions

Because successful turf management is really about good root management, there needs to be a good match of the grass type to the soil conditions. It is easy to understand that soil conditions are critical to long-term turf health. Turf growing on compacted, rocky, nonorganic soil will deteriorate over time and will require many additional hours of maintenance to keep it looking respectable. A soil test is not expensive and can go a long way toward telling you the state of the soil being dealt with—pH, nutrient analysis, and soil quality are all normally included in such a test. If a texture (silt, sand, and clay) test is included, it will be clear to see both the current situation and what needs to be done to rectify any problems. It can be decided at this point whether organic amendments will be necessary.

Drainage

Good drainage is very important to turf health. The drainage is a combination of surface drainage (i.e., the way surface water runs over the site) and subsurface drainage (i.e., how the water moves down and through the soil). The undulating sand base used for most golf greens would require a level of irrigation that is usually impractical for an average homeowner, whereas an area of clay at the bottom of a hill can turn into a large pool of water during heavy rainfalls (refer to the section on "Grading and Drainage").

Site Assessment

When dealing with established turf areas, it is essential to be able to carry out a site assessment to assist in formulating a plan of action for the long-term vitality of the grass. This may mean renovation or just a maintenance program that is based on good cultural practices.

Intended Function

One of the key aspects to any assessment is to understand how the turfgrass in question is to be used. Is it a show space in a front yard, a kids' play area in the backyard, or a designated playing field? The usage will influence how the turf appears, what conditions may be present, and what kind of maintenance practices are required or acceptable.

Pests

The term "pests" generally refers to weeds, disease organisms, and insects that feed on the grass plant (leaves and roots), but it could also include the next-door neighbor's dog that is tearing up parts of the lawn. All of these pests can cause a measurable deterioration in the functional or aesthetic aspect of turf-grass. Weed identification manuals are readily available in all areas of the continent as are guides

for identifying and treating the various blights, spots, mildews, molds, etc. that you may encounter. Likewise, insect identification and treatment information is widely available.

Soil Fertility and Fertilizer Requirements

Soil fertility refers to the soil's ability to supply and sustain nutrients for healthy plant growth. A good, fertile soil contains a balanced supply of nutrients. Macronutrients are nutrients that are required in large quantities and include nitrogen (N), phosphorus (P), and potassium (K). Micronutrients are nutrients required in small amounts. Many of these nutrients may already be available in the soil. Soil tests should be done periodically to determine the quantity and type of fertilizer that need to be added to replace lost nutrients.

Turfgrasses all require nutrients to grow, especially nitrogen (N), which controls the growth rate of turf. An analysis of turfgrass clippings can show levels of nitrogen as high as 6 percent. In addition to greatly slowing growth, too little nitrogen can lead to a weakness that results in attacks from diseases such as rust or dollar spot. Nevertheless, too much nitrogen results in lush growth, weak cell membranes, and a susceptibility to stress, poor rooting, and a different range of diseases.

Local suppliers will be able to give guidance on which fertilizers will be best suited for the need. Keep in mind that slow-release products provide a more even, long-term feeding that prevents the tremendous peaks and valleys of growth seen when using quick-release formulations. Slow-release products minimize the number of applications required and greatly lessen the chance of root burn. It should be noted as well that the use of mulching mowers can reduce the annual need for nitrogen applications.

Water Requirements

The water requirements of turfgrasses vary tremendously across the continent. Warm weather and cool weather grasses grow and go dormant at different times of the year and, therefore, have quite different irrigation needs. Grasses that have been planted on very sandy soil will need more irrigation than those planted on organic loam soils (they will also need more fertilizer because water quickly leaches nutrients out of sand). Here again, local seed suppliers can be a great information resource. Regardless of the eventual water requirements, be sure to follow the rules set out elsewhere in this manual for good irrigation practices.

Appropriate Equipment

Mowers

Mowing is considered to be one of the main cultural practices of turf management and can have a tremendous impact on the health of a lawn or playing field. Mowing causes significant stress on turf, so it must be properly managed. This involves using good equipment with sharp blades, selecting an appropriate cutting height for the variety/use of grass, and following a good mowing schedule. An aspect of grass physiology is that the depth of the root system is related to the height of the grass (Note: The soil properties and frequency of watering also have major effects on the depth of rooting). That means that grass cut very low to the ground may have a very shallow root system, which will

necessitate more frequent irrigation along with greater susceptibility to disease. It is important to note that rooting depth and recommended cutting height vary greatly with the type of turfgrass.

Categories of Mowers

Reel mowers: These mowers have rotating blades on a cylinder (the reel), which shear the grass against a stationary bed-knife. Reel mowers can give an excellent quality of cut when used properly but can be costly and maintenance intensive.

Rotary mowers: Rotary mowers have a blade or multiple blades that rotate horizontally at high speed. Although rotary mowers do not give the best quality cut and can use a lot of power, they are versatile and are relatively low maintenance. They are also the most common type of mower.

Flail mowers: Flail mowers have a series of heavy duty rotating blades on a horizontal shaft. These give a poor quality cut and are normally used on utility or very low-maintenance turf.

Other Turf Equipment

Supplementary cultural practices involve the use of other types of equipment. The major ones are described below:

Core aerators: These are machines that use hollow tines or spoons to extract cores from the turf. Although there is a resulting improvement of air movement in the resulting holes, a major benefit of this process is providing better infiltration of water and fertilizer to the root zone.

Vertical mowers: These mowers are often called “dethatchers.” They are used to break up cores left by aerators, to aid in thatch removal, and to cultivate the soil, often in conjunction with overseeding.

Seeders: Seeders are used to apply grass seed. These may be drop seeders, rotary seeders, or drill seeders.

Chapter 12

Integrated Pest Management (IPM)

One of the most controversial issues in landscaping, and certainly the one that is seeing the greatest growth in public interest, is the use of pesticides. Given that our population in North America continues to be more and more urban and that pollution of all types is seen as an increasing threat, the public's interest in pesticide use should come as no surprise to anyone in our industry. When we combine this increasing awareness with a very often ill-informed use (or, as many would argue, misuse) of pesticides, we can see that our traditional forms of pest control must evolve to a new level.

Integrated pest management (IPM), which is sometimes called "integrated crop management" (ICM) or "plant health care" (PHC), is the most broadly accepted way of dealing with all these issues and has been defined in a number of ways:

- IPM is a decision-making process that uses a combination of techniques to suppress pests.
- IPM is an approach that uses a combination of pest management techniques in an organized program to suppress pest populations in effective, economical, and environmentally sound ways.
- IPM is a holistic approach to solving the problems generated by pest and disease organisms.

For our purposes, the definition that best describes a progressive landscape contractor's approach is the one from the *Private Pesticide Applicator Safety Education Manual* "[IPM] is a balanced, tactical approach to pest control. It involves taking action to anticipate pest outbreaks and prevent potential damage. IPM utilizes a wide range of pest control strategies or tactics. The goal of this strategy is to prevent pests from reaching economically or aesthetically damaging levels with the least risk to the environment."[3]

When we refer to pests, we are referring to any living organism that causes an undesirable effect in a landscape. This can range from plants (weeds) to animals, from single-celled bacteria to insects, and to the neighbor's dog or cat. At the same time, we must understand that people's perception about what is undesirable varies greatly.

From the definition above, it is clear that there are some key aspects to IPM that should be understood:

- The process integrates a number of possible tools in its approach to pest management.
- The goal is not to eradicate pests but, rather, to suppress them to an acceptable level.
- The process requires decisions to be made as to which approaches should be used and when, all in an environmentally sound and economical way.
- Since the reduction of pesticide use is the main goal, nonchemical methods are used wherever possible, leaving pesticides to be used only when absolutely necessary.

[3] Herzfeld, D. & Sargent, K., 2011. *Private Pesticide Applicator Safety Education Manual* 19th ed., University of Minnesota. Available at: http://www.extension.umn.edu/agriculture/pesticide-safety/ppatmanual.html.

- Prevention is a key element of an IPM program.
- By monitoring the situation, action is taken only when necessary.

Integrated pest management should not be viewed as simply a way to deal with your customers' changing expectations. It is a much more knowledge-intensive approach and places a premium on knowledge, planning, and marketing skills. This reality becomes clearer as you look through the following list of advantages of IPM:

- There is a clear reduction in pesticide use.
- Risk to people, animals, and the environment in general is reduced.
- Costs and liability that arise from pesticide application are reduced.
- Reduced pesticide use reduces the likelihood of new pesticide-resistant pests developing; therefore, pesticides will remain effective for a longer time.
- The opportunity to use biological controls is improved.
- Good results can still be achieved when pesticides are not used.
- It is the best long-term solution to pest problems and can reduce long-term pest control costs.

It has been mentioned that prevention is a key element in IPM. The prevention of pests puts a premium on knowledge because the main criteria are the ability to:

- Work within a good landscape design that incorporates plant diversity;
- Use the right plant in the right place;
- Know and use pest-resistant plants and varieties;
- Use good cultural practices that will result in healthy plants;
- Understand and use good plant health care practices.

Constructing an IPM Program

We have looked at IPM from the point of view of definitions, key elements, and advantages, but we have not actually discussed how an IPM program is constructed and implemented. The IPM process is generally accepted to have five phases or steps, which are:

- Pest identification;
- Monitoring;
- Action decisions;
- Treatments (controls);
- Evaluation.

Pest Identification

It is obvious that, without being able to identify the pest at hand, one would have no idea of where to begin controlling it. This reality is compounded by the fact that many conditions are actually abiotic in nature and have not been caused by a pest organism at all. By correctly identifying the pest, one can learn about its biology, including its life cycle, its behavior, and its preferred habitat and host plants. Then weak points can be identified where treatments will have the greatest effect. By understanding the pest, it can be established what natural enemies it has and if they can be used/encouraged to control the pest. This knowledge can also be used when planning preventative measures.

Monitoring

This phase consists of inspecting the landscape on a regular, planned basis. The results of the monitoring are locating and timing pest presence and recording it. It is advantageous to record environmental conditions, especially ones that are "not normal," and the presence of any beneficial organisms. Such beneficial organisms may eliminate the need for other treatments/controls. Relating such information to the various growth stages of the plants will help improve monitoring schedules in the future. Monitoring can be in the form of visual methods, trapping devices (e.g., sticky traps), and beating trays.

Action Decisions

Before getting into this phase one should understand two terms:

1. **Injury level (injury threshold):** This is normally the point at which economic losses are incurred or, for aesthetic and nuisance levels, when the client deems the situation to be unacceptable.
2. **Action or treatment threshold:** This is the point at which action must be initiated to avoid exceeding the injury threshold.

One must know at what level an unacceptable condition will arise and also know how long different treatments (controls) will take to be effective. A different action threshold exists for each possible treatment. The monitoring that has been done will show how rapidly the pest population is building. This can then be used as the basis for forecasting when injury levels will be reached. Putting these two factors together allows educated decisions to be made about the actions that should be taken.

In addition, it is necessary to look at how much injury would be caused and what the cost of the favored treatments would be. When calculating this cost, one should consider direct costs, such as product, application, transportation, and cleanup. In addition, you must also calculate the indirect costs involved, such as damage to non-targeted organisms, the applicator, and the environment in general. It can be difficult to accurately total all of the indirect costs.

Treatments (Controls)

Treatments become necessary only when prevention has not been successful. They are categorized as follows:

- **Cultural:** Cultural treatments include practices such not allowing irrigation water to get on plant leaves.
- **Physical:** Physical treatments include practices such as picking insects off plants or using traps.
- **Mechanical:** Mechanical treatments are practices such as using a rototiller to expose weed roots to the sun.
- **Biological:** These treatments include using natural enemies such as Lady Bird beetles.
- **Chemical:** Chemical treatments use targeted pesticides.
- **Legal:** Legal treatments include regulatory responses to importing noxious plants.
- **Social/Educational:** These treatments focus on educating the public about good plant care practices.

Evaluation

The evaluation phase basically is used to "close the loop." An assessment is done analyzing the actions, costs, degree of success, and proposed changes for future actions. For this reason, good records must be kept, both monitoring records as outlined above and treatment records. Treatment records contain information about what was used, at what rates, when it was used, and for what. Including this stage of the IPM process allows a fine-tuning of the processes and programs, thereby improving their effectiveness and reducing their cost.

The last point to examine in IPM is the selection of chemicals, which must be used as a last resort. The two aspects of chemical selection that are most critical are selectivity and persistence.

- **Selectivity:** Broad-spectrum choices kill a wide range of organisms, and selective or narrow-spectrum choices kill a narrow or targeted range of organisms.
- **Persistence:** Persistent chemicals remain active in the environment for a lengthy period of time, and non-persistent chemicals break down rapidly in the environment.

The best choice is always targeted chemicals that are non-persistent. If there is a range of chemicals available under our established criteria, then the least toxic one is best. For example, remember that even insecticidal soap is considered a chemical treatment.

Licensing and Environmental Protection

Pollution and environmental responsibility are foremost in many people's minds, and this is an appropriate reminder that lawn care chemical applicators are under the microscope and becoming more regulated with each passing legislative session. It is the manager's responsibility to be aware of the laws and requirements in their region and to assure compliance with the local authority.

In the United States, chemical applicators are required to test for, and demonstrate a level of competence of understanding of, the federal regulations pertaining to chemical applications. This is done in conjunction with extension offices, and the licensing is with the Environmental Protection Agency (EPA).

Proficiency and continuing education is required in:

- **Labeling:** What is written on the label is federal law; it is a violation to apply the chemical in any way inconsistent with the label, including target pest, crop, and application rate and re-entry period;
- **Safety:** The proper use of PPE (Personal Protective Equipment) and;
    - The proper precautions taken to alert the public of potential danger;
    - The proper protection to prevent entry to the treated area to protect public;
    - Proper documentation in case of emergency;
    - Precautions taken to prevent drift;
    - Cleanup of equipment and PPE.

Chapter 13

Green Roofs and Living Walls

Green roofs and living walls are roofs or walls of buildings that are either partially or completely covered with vegetation and growing medium. These systems have become common throughout North America and many are being installed on new buildings and onto older buildings that are being retrofitted to accommodate the additional weight of the green roof.

This chapter provides an overview of green roofs and living walls. It is not meant to be complete and its recommended that managers become familiar with green roofs and living walls if they are installing these systems as part of their business.

Green roofs advantages and disadvantages

Green roofs provide a number of environmental benefits compared to traditional roofs, these include:

- Reduced storm water runoff;
- Reduced heating and cooling requirements for buildings;
- Creating of natural habitats in urban locations;
- Filtration of air and water pollutants;
- Carbon sequestration;
- Noise insulation.

The major disadvantage to green roofs is the initial cost of installation, which can be double that of conventional roofs.

Green roofs are characterized as extensive, semi-intensive or intensive.

Extensive green roofs

An extensive green roof has 6 inches or less of growing media, is usually not easily accessible, has low weight (due to shallow growing media), and is relatively low cost to install and maintain.

Semi-intensive green roofs

A semi-intensive green roof can have less than or greater than 6 inches of growing media, and may have portions that are accessible. The weight of the roof varies but is greater than extensive green roofs and the plant diversity is greater than extensive green roofs.

Intensive green roofs

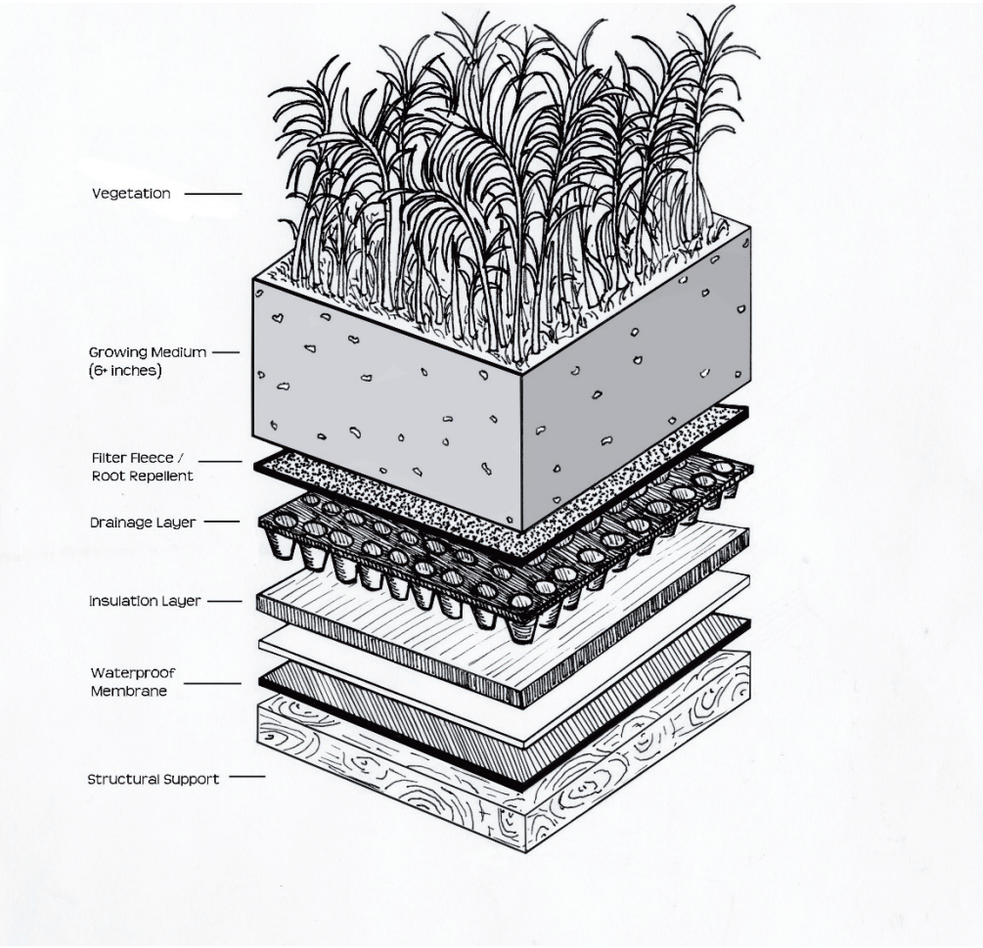
An intensive green roof has more than 6 inches of growing media, is usually accessible, has high weight due to the depth of growing media, is high cost for installation and maintenance, and has a high level of plant diversity.

Essential Components of Green Roofs

Green roofs must have (Figure 6):

- High quality waterproof membrane;
- Some type of root repellant/barrier system;
- Good drainage;
- Filter cloth between the growing medium and drainage;
- Growing medium;
- Vegetation.

FIGURE 6: EXAMPLE OF AN INTENSIVE GREEN ROOF SYSTEM



Waterproof Membrane

A waterproof membrane is essential for all green roof systems. It is usually a heavy rubber membrane that is able to resist hydrostatic pressure for long periods of time. It is a critical component of the entire green roof system that ensures water cannot enter the building.

Root Barrier

Green roofs require some type of physical barrier that prevents roots from compromising the waterproof membrane.

Drainage

The green roof drainage system must be designed to ensure that water will drain fast enough so that the roof is not compromised but that enough water remains to sustain the plants.

Filter Cloth

As part of all green roofs, a lightweight material is laid over or included as part of the drainage system to ensure that soil from the growing medium does not migrate into the drainage substrate and impede its function.

Growing Medium

The growing medium is a lightweight manufactured substrate that anchors the plants, provides nutrient and water storage, has high porosity so it drains effectively, and is free of material that may clog the drainage system.

Vegetation

A wide variety of vegetation can be grown on green roofs. Extensive systems usually use perennial plants, whereas extensive systems can grow a wide variety of annuals, perennials, shrubs and trees.

Living Walls

Green or living walls are walls that are partially or completely covered with greenery that includes a growing medium, integrated irrigation, and fertilization system. Most green walls also feature an integrated water delivery system.

Living walls have many of the same benefits as green roofs, including:

- Improving indoor air quality (if inside the building);
- Absorption of greenhouse gases and other pollutants;
- Energy savings;
- Dampening of noise;
- Shielding of the building from thermal fluctuations
- Aesthetic attractiveness.

Chapter 14

Project Management and Logistics

Project management is often viewed as something that only the "big guys" need to worry about. It is true that many small landscape contractors can, and do, manage all their projects using their experience and gut instinct as a guide. For very small projects done one at a time, this method may be sufficient and successful. However, as the projects get bigger, more complicated, and start to overlap, a more effective means of managing them is required. Combine this situation with the reality that time and resources are getting tighter while competitors are becoming more competitive and it is easy to see how proper planning, implementation, and follow-up of projects become critical to success.

This section of the module is an introduction to some key elements of good project management practices and how they can help maximize time and resources. By understanding the basic principles, you will have a good start in this key management area.

A project is defined as "an undertaking requiring concerted effort," has a defined beginning and end, uses resources (people, time and money) specifically allocated to it, and produces a unique outcome. In addition, it usually involves a team of people, follows a planned and organized approach, and has a unique set of stakeholders (e.g., staff, client, suppliers, etc.).

There are generally considered to be five processes in project management. Paralleling those laid out in the Project Management Institute's Project Management Body of Knowledge, they are:

- **Initiating:** For landscape contractors, the initiating process is really the agreement by a client for whom the work is being done.
- **Planning:** The planning process is where the scope of the project is laid out, tasks needing to be done are identified and sequenced, budgets and schedules are drawn up, and agreements from stakeholders are obtained. For a landscape professional, much of this work is done while drawing up the estimate for the job.
- **Executing:** The executing stage is where the resources are applied, leadership is provided, special talent is obtained (e.g., sub-trades), and the stakeholders are kept up-to-date.
- **Controlling:** These key controlling processes include monitoring progress, taking corrective action if things deviate from the plan, rescheduling or adding resources if necessary, and generally dealing with the problems that come up.
- **Closing:** The closing process is the finishing of the project: getting the last tasks completed, learning from the experience, and getting acceptance of completion from the stakeholders (especially the client).

Having looked at the main types of processes involved in project management, we can now look at some general guidelines or rules, which should be followed. They are quite clear and self-explanatory.

1. You must have consensus on the expected results.

2. You should build the best team you can.
3. You must have a comprehensive and viable plan that is kept up-to-date.
4. You must be accurate in the resources you will need to complete the project.
5. Your scheduling must be realistic.
6. You must remember that your people count because they do the work.
7. You must keep everyone involved informed of what is happening.
8. You are the leader.

As your experience and knowledge grow, you will be able to identify the important elements of the projects you carry out. Identifying them is one thing; keeping them in order and timing their completion is another. To help keep everything on track, one should practice putting them on paper. One of the most commonly used charts for this purpose is the Gantt Chart (also called a "project timeline").

A Gantt chart basically is a sheet of paper that shows the main tasks down the left side and a list of dates across the top. A line on the Gantt chart shows the date each task starts and ends on the basis of its duration. Many tasks cannot be started until another one is completed, and this must be taken into consideration. Likewise, there are tasks that can be done at the same time as others are being done. All of this can be shown very clearly on a simple Gantt chart (see Figure 6 for an example), but showing this presupposes that you know how long each task will take (again, this should have been determined during the estimation process).

FIGURE 7: EXAMPLE GANTT CHART, 6 DAY TREE PLANTING PROJECT

					Sept						
ID	Task Name	Start Date	Finish Date	Duration	15	16	17	18	19	20	21
1	Order Plants & delivered	9/15	9/17	2d							
2	Order Soil and delivered	9/15	9/17	2d							
3	Planting crew on site	9/16	9/18	2d							
4	Maintain for 4 days	9/18	9/21	4d							
5	Final inspection and billing	9/21	9/21	1d							

On very large or complex projects that may have a number of tasks occurring at the same time, a critical path must be determined. This is the sequence of tasks that forms the longest duration of the project. If

any of the tasks on this critical path are delayed then the whole project is delayed, although tasks not on the path generally can be handled in a more flexible manner. The critical path will be different for different types of projects, so it is necessary to clearly show and communicate each path to the staff that will be involved in completing the project.

There is process called PERT (Program Evaluation and Review Technique). In its purest form, PERT is designed for very large projects and is often cited as working best for research projects. It is more time-consuming because it is a very complex system and is not necessary for consideration by landscape contractors.

All the information presented previously is used to put together a plan and a schedule to get a project done efficiently and effectively. However, like all good plans, even the best-planned ones seldom proceed without problems arising. When a problem does arise, it will be the project manager's responsibility to react and correct the situation with as little negative impact as possible. Hence, the need for controlling processes as mentioned above.

When a problem arises that causes the project or one of its tasks to be delayed, the information should be incorporated into the Gantt chart. A line representing actual progress against planned progress will visually show everyone involved what is happening and what are the consequences of not getting tasks done on time. Remember to keep the clients up-to-date as well, so that they do not get any last-minute surprises.

As with so many management tasks, there are software programs and books available to help with the project management responsibilities. For simple Gantt charts, a program equivalent to Microsoft Excel may be sufficient. For more complex situations or for more complete coverage and follow-up, there is Microsoft's Project, among others. There is also a wide range of books available at bookstores and libraries to explain project management in greater detail.

Chapter 15

Types of Landscape Contracts

A landscape company will have to enter into some form of contract with its clients. The different types of landscape contracts are reviewed in this section. In addition, the legal aspects of contracts are discussed in detail in the "Risk, Law, and Contracts Module."

The main services that are likely to be covered by contracts are:

- Design;
- Installation;
- Maintenance.

The first two services above cover short-term projects that are completed in a relatively short time frame, whereas the third can be in effect over much longer periods of time. Some contracts will include two or all three of these services. The contracts can be drafted in a formal or informal manner, but they must include wording that explains "who," "agrees to do what," "when," and indicate the provisions that apply to both parties to the contract. An example would be "you," "agree to install the designed water feature," "by the end of the month," while "your client," "agrees to pay you the sum of $10,000.00," "upon completion of the installation."

For most small landscape firms dealing with projects under $100,000.00 an informal letter agreement, as opposed to a formal contract, works best. The benefits of this approach are:

- **Familiarity:** People are generally more familiar with letters than formal contracts, so they feel more at ease using them.
- **Legal effect is the same as a formal contract:** The letter agreement may not contain formal legal terminology, but it can include all the necessary terms of the agreement.
- **Intention of each party is easier to determine:** In the event of litigation, a judge is more inclined to determine the agreement in accordance with the intention of each party as it is indicated in the letter. However, a formal contract is carefully worded to cover the intentions of the parties and, therefore, is more strictly interpreted.

The letter agreement can take the form of an offer, which is accepted, for example, by the homeowners when they sign and return a copy of the letter. Since most homes are co-owned, signatures from both parties should be obtained. This should reduce disagreement between the owners and make them both responsible for payment. The offer should include an expiration date in order to reduce the risk of increased component prices and to make scheduling easier.

As was shown in the example above, the work to be done can be described in general terms. Where specific requirements are needed, a reference to established standards clearly fixes the level of expectations and is beneficial if legal problems arise.

The dates and amounts of payments can be incorporated into the letter as can a provision that any changes to the work must be agreed on in writing. Any other details (who gets permits, what is the guarantee, etc.) can be included as well.

Maintenance contracts require additional points. In a maintenance arrangement, the landscape contractor wants to ensure that the long-term expectations of both parties are well laid out. If the contractor normally delivers quality service, this aspect should be of less concern. If the contractor tends to cut corners and deliver a less-than-quality service, a written contract can come back to haunt them as the basis for legal action. If, at the same time, it is the contractor's goal to make the relationship with their client more permanent, longer-term contracts may be preferable.

To address the issue of expectations, the description of work should include a reference to a landscape standard. For example, the British Columbia Landscape Standard categorizes landscape maintenance levels into six categories:

1. **Well-groomed:** First-class appearance and always impeccably maintained and well-groomed.
2. **Groomed:** Neat, orderly, groomed appearance.
3. **Moderate:** Generally neat, moderately groomed appearance with tolerance for "wear and tear," some foot traffic, and natural processes.
4. **Open space/play:** Orderly appearance, well adapted to play and heavier traffic, and a considerable tolerance for the effects of such play and traffic.
5. **Background:** Preserve natural conditions and accommodate low-intensity activities.
6. **Service:** Manage vegetation for functional rather than aesthetic purposes; protect adjacent areas from the impact of service or industrial activities.

The standard goes on to establish tolerances (e.g., to weeds) and frequency of activities (e.g., mowing) for each level of maintenance, all of which can, and should, be discussed with the client.

The long-term aspect of a maintenance situation can be addressed in a couple of ways. One way offers some flexibility when negotiating the payment schedule (i.e., id cash flow is needed every month, then include 12 payment periods in the contract; if cash flow is needed only in the working months, negotiate the contract accordingly) The second way addresses the fact that maintenance contracts can be written as "evergreen" (i.e., they will continue in place from year to year for a fixed number of years). The right of termination by either party must be included and can be specified to take place at the end of any calendar year (or when services are programmed to cease for the year) with three months' notice. This approach still allows for price renegotiation from year-to-year while giving both parties a means to terminate a contract that is not working for them.

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Watson, G. & Himelick, F.D., 1997. *Principles and Practices of Planting Trees and Shrubs*, Savoy, IL: International Society of Arboriculture.

Further Reading

PLANET & Associated Landscape Contractors of Colorado, 2011a. *Landscape Training Manual for Installation Technicians* 2nd ed., Professional Landcare Network.

PLANET & Associated Landscape Contractors of Colorado, 2011b. *Landscape Training Manual for Irrigation Technicians* 2nd ed., Professional Landcare Network.

PLANET & Associated Landscape Contractors of Colorado, 2011c. *Landscape Training Manual for Maintenance Technicians* 2nd ed., Professional Landcare Network.

Note that the above manuals are available from the National Association of Landscape Professionals

https://www.landscapeprofessionals.org/

and the Canadian Nursery Landscape Association

www.canadanursery.com