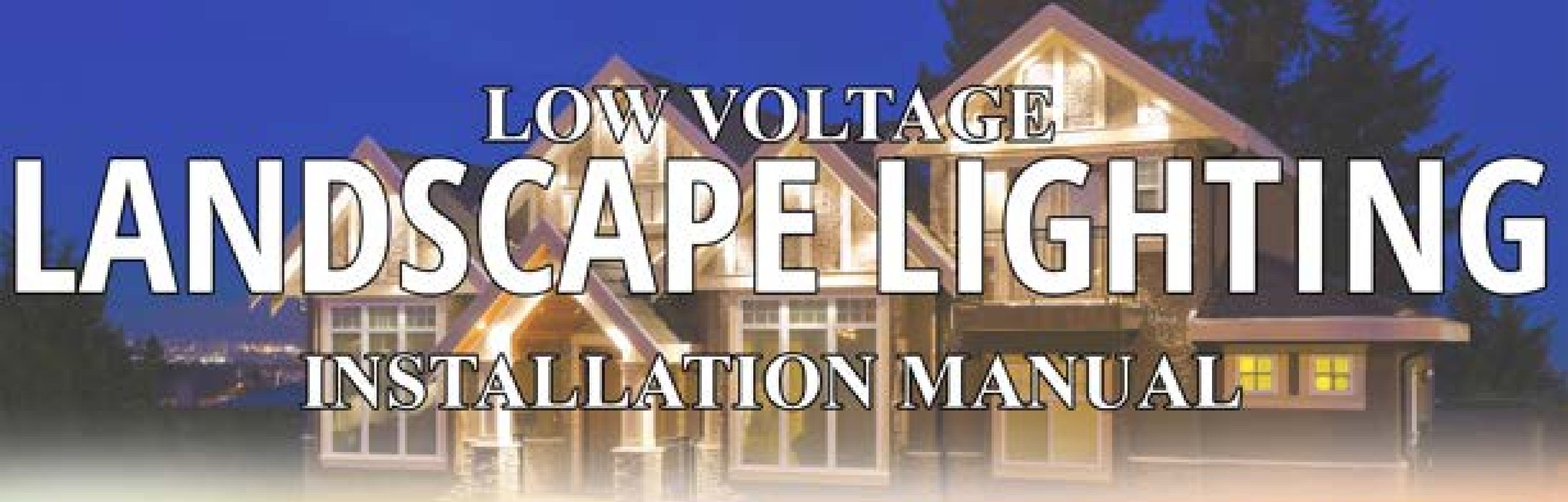

LOW VOLTAGE LANDSCAPE LIGHTING INSTALLATION MANUAL

INTRODUCTION TO DESIGN

The purpose of this manual is to provide you with a precise **step-by-step method** of designing and installing low voltage landscape lighting. This manual will take you through fixture choice, bulb selection, wire sizing, fixture installation, and a reference section.

When a landscape is designed, attention is focused on **highlighting the architecture**, **dividing public areas from the private ones, creating unity, flow, safety, and harmony between different elements** used whether it's plants or hard-scape. Landscape lighting serves to do the same thing.

Beginning the design process starts with the **focal point of the landscape, the home.** Look at the architecture, the texture of the building materials and landscape materials. Think about fixtures that wash the walls or cast light into dark corners and to highlight doorways and trim. Consider **illuminating** shrubs, especially if they serve to **accent the architecture, or lead a visitor to your door.** Walks and drives are some of the hardest landscaping tasks. The lighting should be done in a way that **avoids the "landing strip" appearance**. Casting light horizontally will wash the surface with light, increasing **ambiance and safety.** The last items to light are the lawn areas, front and back. First, **frame the home** by uplighting large trees in the front, back, and sides. Next, provide excessively dark areas of the lawn then use accent lighting: either uplighting or directional lighting to **highlight points of interest.**

TYPES OF LIGHTING

Well Lights are among the most **versatile** fixtures. They are used in 80% of all landscape lighting applications. Lenses and grates can easily be installed on these fixtures for custom lighting applications. Well lights are used mainly in areas where **uplighting is required to illuminate an object or wash an object with light.**

Path Lights are best used to give **down lighting on pathways**, sidewalks, breezeways, driveways, or beds with seasonal color.

Directional Lights are used when a **concentrated beam** of light is needed on statuary, signage, and water features.

Underwater Lights require **complete submergence** to remain cool. They are used to light up waterfalls, statuaries, and provide diffuse lighting of features. Optional colored lenses available.

Specialty Lights are lights that serve a **specific purpose.** These lights are usually low wattage and only produce a small amount of illumination. Dock and step lights are in this category.

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Transformers

Transformers step down the normal 120v household current to voltage that can be used in the lighting system. They are available in **wattages from 300 up to 1500 watts.** The transformers have multiple voltage taps of 12 to 22 volts which enables the user to run smaller gauge wire longer distances. Transformers can be installed indoors or out and can be equipped with with timer and photo cells. They must be installed at least 12" above grade.

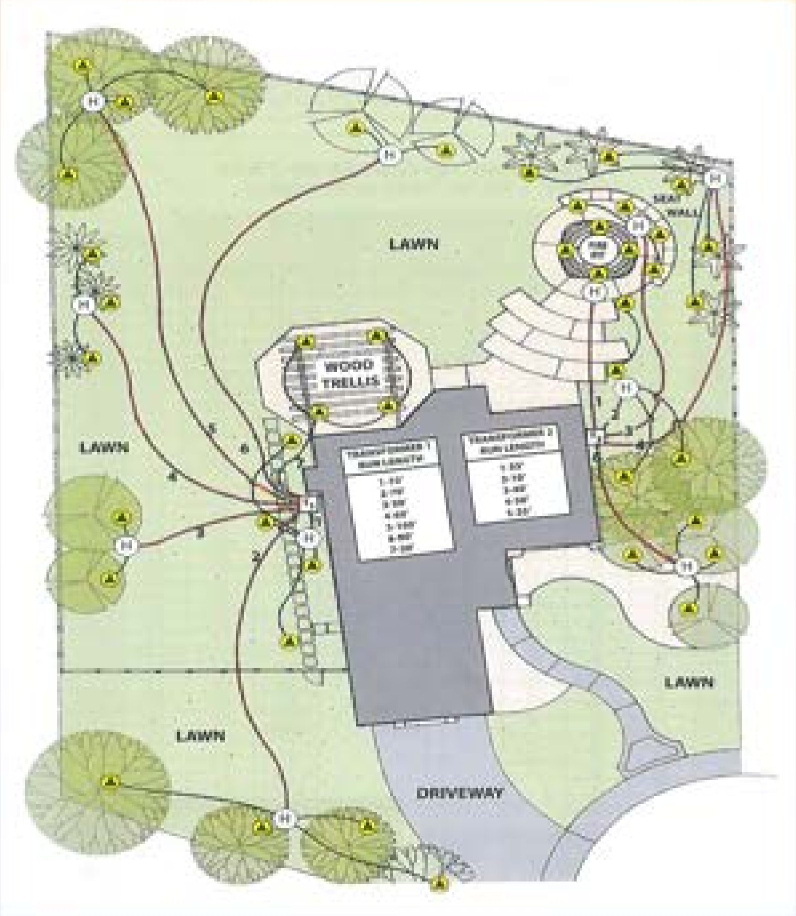
Transformer Locations

The next step involves the location of the transformer(s). First you'll want to **guesstimate how many transformers might be needed for the job.** At this point simply add up all the wattages of all the fixtures used.

It is sometimes easier to use **more than one transformer in different locations**. This will keep your wire runs to a minimum and allow for easier zoming of the lights.

Zoning the transformers this way will allow you to run areas independently. This will save you money in the operation of the system.

If. for example, the back yard and front yard including the side yards yield 800 total watts used, two transformers of some wattage will be needed. Designate an area for each transformer, preferably as **close to the center** of each system as possible.



Controlling the Lights

The lighting transformer may be turned on or off by wiring it into a seperate circuit by using a wall switch or the lighting may be controlled remotely by attaching **a timer, photocell or both to the transformer**. The timer used may be either analog or digital. For simple lighting projects where the operation time is not varied during the week, an analog timer is all that is required. This is a motorized timer with pins that can be placed around a dial to turn on or shut down the lighting at a prescribed time. This timer is limited to two start times per day. It also features a **manual override on/off switch.**

A digital timer may be used for more complex lighting sustems where multiple start times are required including start times on different days of the week. The digitial timer has an LCD display and is **programmable using push buttons.** This device has a battery back-up to preserve the memory in case of a power outage and also features a manual start cycle. Both timers fit a 120 volt outlet located on the face of the transformer. To install a timer, simply remove the plug from the outlet, insert the timer into the outlet, then re-plug the transformer into the outler on the side of the timer.

A photocell can be used **in lieu of the timers** and will operate the transformer from dusk until dawn. In order to conserve power, it is recommended to use the photo cell in conjunction with a timer to turn the power off at a predetermined time in the evening. Another advantage to using a timer/photocell combination is to avoid having to reset the timer when the yearly time changes occur.

The photocell is attached to the side of the transformer through a knock-out on its side. The photocell leads are passed through the chassis of the transformer and plugged in where the wire loop is connected. If the photocell is used, unplug the wire loop but **do not discard it.** This loop is used in conjunction with an amp meter to check the amp draw on the primary (120 volt) side on the transformer, when trouble shooting the system. The photocell must receive **direct sunlight** in order to function properly. Avoid placing the transformer in an area that will become shaded as the sun changes positions. Because locations for transformer placement do not always provide for full sunlight, **a photocell with a 25' lead is available.**

Establishing Wire Runs

When laying out low voltage lighting cable, choose the **shortest distance possible** between the transformer and the hub. It is not essential to run the cable in conduit unless it passes under sidewalks or drives. Sleeving under these areas allows for ease of installation, maintenance, or repairs. If the transformer is located outdoors, it would be wise to enter the transformer with the appropriate sized conduit to protect exposed cable from gardening equipment such as string trimmers and provide a way to seal the transformer from insects. **Landscape lighting cable can be safely installed under mulch or in trenches when crossing lawns.**

Tools Needed for Installation

Besides having the basic hand tools for digging, we strongly recommend having a **volt-ohm meter and an amp meter** for trouble shooting purposes. The volt-ohm meter is indispensable for checking the continuity of the system from the transformer to the lights and for checking voltage(s) at the hub(s) during installation or trouble shooting. The amp meter is used to ensure that the transformer is pulling the proper amperes during its operation. **"Over-amping"** the transformer will void the manufactures warranty as it causes the device to fail prematurely. Optional trouble-shooting tools are **a wire locator and a fault locator.** All these tools can be used anywhere diagnostics are required of electrical components **including irrigation systems.**

Landscape Lighting with LEDs

LED bulbs because of their nature, circumvent many of the problems associated with fluorescent, tungsten, and halogen light sources. The LED produces **instant light regardless of the ambient temperature**, unlike florescent bulbs. LED has low power requirements and produces less heat than conventional bulbs, is long lived, has a wide range of power requirements (9 to 15 volts) and is completely recyclable.

The LED uses special circuitry called a **"driver".** The driver converts AC into DC current which is what the LED requires. Because the driver accepts such a wide range of voltage, this not only protects the LED but also gives the installer great leeway in design, installation and in retrofit projects. The AC current coupled with the DC driver provides the ability to **run the LEDs greater distances than the AC alone.** This fact also helps the end user identify high quality LED's over the lower quality units. A high quality LED as stated earlier, will have a minimum voltage range of 9 to 15 volts. This unit will use the higher end driver and diode. LED's with even wider voltage ranges are available. Price can also be a tell tale sign of a quality LED.

Advantages of LED Lighting

LED bulbs depending on their quality, can have **lifespans of up to 40,000 hours** as opposed to halogen, which may only last 2,000 to 5,000 hours depending on installation factors. In a setting where landscape lighting operates 10-12 hours a night, halogen bulbs may have to be replaced every 200 days, whereas an LED may last up to 11 years or more! From a maintenance standpoint, that's a lot of time not spent buying and changing bulbs!

LEDs consumer **75% less power than their incandescent counterparts**, which translates into hefty savings especially on large projects.

Landscape lighting installation **takes less time using LED's** because more fixtures can be installed on one cable and cable run distances can be increased. BEcause of the wide voltage range noted earlier, an LED has another advantage over halogen. If for instance, 15 volts is required to power the furthest fixture on a run, the LED fixture closest to the transformer **can easily tolerate the higher voltage.** In contrast, a circuit or halogen incandescent fixtures has to be organized so that a bulb operating close to the power source does not encounter voltage above the stated 12 volts. Finally, unlinke tungsten bulbs, the LED's light output is the same whether operating at 9 volts or 15 volts.

A power reduction of 75% occurs when tranferring power to the LED, which allows for a **lower voltage drop.** This fact comes in handy because **fixtures furthest from the power source are able to gain extra voltage**. With a lower voltage drop comes the ability to use smaller cable, which **saves on material and labor costs.**

Retrofit LED's

LED's used in landscape lighting are available in **so many styles** and mimic their tungsten counterparts in appearance, though their shape may look a little bit different. These lamps are diresct replacements for existing incandescent bulbs. The fins on the larger lamps provide a method to **create convective cooling.**





Integrated LED Fixtures

Unlike the retro-fit LED, integrated fixtures utilizing LDs are a **unitized hermetically sealed unit** potted directly into the fixture itself. The main advantage of the integrated LED is the ability to keep the lamp cooler, which extends the life of the LED, and to **keep dust, dirt, and humidity out.** The internal cooling for the LED is provided by a metal heat sink, which surrounds it and allows excess heat to be "wicked" to the outside through walls of the fixture. This conductive cooling is far **more effective than relying on convective air-cooling** that takes place when using a retrofit LED lamp. The term **"light engine"** is usually applied to this type of construction. When the lighting fixture has reached the end of its life expectancy, it can be recycled and a new fixture installed. At the time of this writing, **an integrated fixture may cost two times that of a similar incandescent.** However, the initial cost is outweighed by the **longevity and utility** these lights possess. With rapid technological advances in this field, these lights will soon find themselves occupying the same niche as those once very expensive calculators once purchased decades ago.





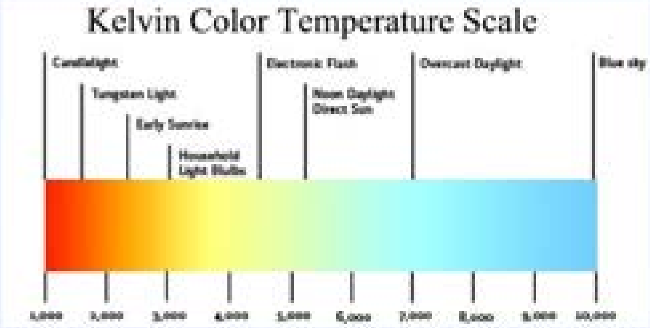

Lumens

Lumens refer to the **light output** of the source, which we think of as **brightness**. This is not the watts rating of the bulb. Watts refers to the energy consumed to produce light. LED's enjoy a low watt to lumen output. The reason an LED may appear brighter in for example, a 3,000K bulb, is that there is less yellow in it.

Light Output	LEDs	CFLs	Incandescents
Lumens	Watts		
450	4 - 5	8 - 12	40
300 - 900	6 - 8	13 - 18	60
1100 - 1300	9 -13	18 - 22	75 - 100
1600 -1800	16 - 20	23 - 30	100
2600 - 2800	25 - 28	30 - 35	150

Kelvin Rating

As with incandescent bulbs, LED's also use the **Kelvin (K)** temperature rating. This rating refers to the warmth or coolness of the light source. the **higher the Kelvin the more blue the source** appears and vice versa. Therefore, a light source with a 5,000K rating has an icy blue hue while one with a 3,000K rating has a warmer light. It is important to note that **K is not related to the heat generated by the source.**



W. P. LAW INCORPORATED
Pumping & Piping Systems

Main Office: Lexington
303 Riverchase Way,
Lexington, SC 29072
(803) 461-0599

Greenville Branch
1330 Grove Rd.,
Greenville, SC, 29605
(864) 295-3810 /
(800) 660-7569

Charleston Branch
3636 Belvedere Rd.,
John's Island, SC 29455
(843) 559-3945

Greer Branch
2400 Highway 101S.,
Greer, SC 29651
(864) 879-1045

wplawinc.com / marketing@wplawinc.com