Chapter 14 - "Meeting Quality Requirements"

In this section, we're going to learn about Quality Assessment systems. If you don't plant your trees to a certain quality standard, your company will be penalized, which means that you're going to have a problem to deal with. We'll talk about why quality assessment systems exist, and we'll take a detailed look at BC's most predominant quality assessment system, the FS 704 system. Even though we are once again looking at BC standards, the concepts used in BC are similar throughout the rest of Canada.

Figure 14.01
British Columbia's FS 704 Quality System.

The quality assessment system used by BC's provincial government is also used as the basis for quality assessment at many private companies throughout BC and the rest of western Canada. Source: BC Government.

When you start work, you'll probably be confident that it will only take you two or three days to master planting. You couldn't be more wrong. First, although you'll be able to grasp the very basics of how to plant trees within a few days, planting trees to the quality standards required of you is a challenge. Your trees will be checked constantly during your training period. Your crew leader or instructor will usually check almost every one of your trees, especially as you're starting out. In the long term, however, not every tree is checked. Random sample plots will be taken instead, but this doesn't mean that you don't have to worry as much about your quality. If your trees don't meet the minimum acceptable quality levels, you may have to fix them, so your company doesn't end up getting penalized. In some places, only certain quality faults can be corrected after the fact, so you might not be permitted to dig trees up for a second chance.

The implications of poor quality are varied. Most planting contracts stipulate that the pay that your company receives is dependent on the quality of the trees that you plant. Depending on the quality system in effect, very complex formulas determine the company's rate of pay. Above a certain point, usually above 92.6% in BC, the company is deemed to have achieved full payment, and receives 100% of the tree price that was originally contracted for. If the quality on the block falls below the

percentage for full payment, the pay rate starts to drop very quickly as the quality drops, with blocks under 85.0% quality often being designated as no payment. So in other words, if your crew plants roughly fifteen percent of your trees improperly, you run the risk that your company doesn't get paid at all for the block. That's a big problem.

No matter what, if you work in BC, your employer is not legally allowed to pass financial penalties for non-payment along to planters. You, as a planter, will be paid in full, 100%, assuming that you actually planted the claimed number of trees. However, in a situation where financial penalties are being assessed against your company, the company definitely has a way to deal it: you must plant your trees according to certain minimum standards, or you'll be fired. It sounds like a harsh environment to work in. It is. What makes things even worse is that as you move from contract to contract, you'll find quality standards enforced to varying degrees, and different faults or problems will be emphasized in different areas. It's enough to drive a person crazy, trying to figure out if you're doing things the way that the foresters want, or at least good enough to pass.

Figure 14.02
A Forester, Checking a Tree.

This forester is walking through a block, doing an informal assessment of a number of randomly scattered trees, to determine if he should give any general advice to the crew about their planting style.

Be aware that penalties for quality non-compliance are treated differently in other provinces. In most provinces, companies can pass quality fines on to planters so long as minimum wage regulations are still met.

Determining quality is a very, very inexact art, even though it's based on a detailed mathematical science. Quality results depend on the system used, the interpretation of various rules in place, the location of random sample plots, the mood of the checker or forester at the time that the trees are checked, and a dozen other variables. We're going to touch on common reasons for individual trees to be faulted, common variations on the key systems, and how to mitigate situations that work against planters. I'll also touch on the impact of density on quality, although a lot of that will be left for the section that talks about Density. By the end of this section, you'll realize that when it comes to quality, many things are not set in stone. There are often many shades of grey.

As mentioned, quality and density measurement and assessment systems vary significantly from province to province, and can also vary significantly from company to company within a specific region. Understanding the FS 704 system is a good starting point, but be prepared for different rules on almost every new contract.

FS 704 System Overview

Within British Columbia, the FS 704 system is a provincial standard. It was developed by the BC provincial government, and therefore, it applies on all Ministry and BCTS jobs. Many private mills and licensees have also adopted this system as being relatively simple to use, yet versatile enough to meet a variety of complex quality assessment issues. Instead of trying to explain various other systems as stand-alone entities, it's usually easier just to explain where they differ from the 704 system. By the way, if you're wondering where the name came from, I have no idea.

To give you a bit more background on the 704 system, it was originally developed in the 1980's. There have occasionally been major revisions to the system since then, especially in 1989 and 2012. Some of the items that were considered to be faults in the original system are effectively considered to be non-issues in the modern industry. The mindset of planting in the 1980's, when it was usually mandatory for trees to be screefed fastidiously down to pure mineral soil, was turned on its head in the mid-1990's with the introduction of LFH and FH planting. And of course, some scientific beliefs which were common at the time are no longer subscribed to by the majority of foresters. However, those are just a few thoughts on the system as a whole. There are major differences in the approach taken throughout British Columbia, even though the 704 system as a whole can encompass those variations.

Throwing Plots

Within the 704 system, quality is measured by taking a series of sample plots. Each plot is taken by counting the number of trees and studying the placement of seedlings within an area that contains 50 square meters. This area is exactly 1/200th of a Hectare, because a hectare has 10,000 square meters. To take a plot, a person uses a plot cord which is 3.99m long. The cord is affixed at one end to the center of the plot to be taken, usually by looping it over a shovel that's stuck in the ground at plot center. The person then swings the cord around in a complete circle. Everything that falls inside the circle outlined by the tip of the cord is considered to be part of the plot.

Figure 14.03
Throwing a Plot.

One end of the plot cord (the end with the loop) is hooked over the shovel. The place where the shovel is embedded in the ground is called the plot center. The plotter walks around the shovel in a circle, with the plot cord extended out as far as possible, to measure what is inside the plot.

You may wonder why the cord is 3.99 meters long, instead of exactly 4.00m. It's because that's the length required to get an area of 50 square meters. The formula for the area of a circle is pi * r^2, where "r" is the radius of the circle, so in this case, 3.1415 * 3.99 squared is 50.0 square meters.

You may also wonder why fifty square meters is important. It's because this number was just picked as an arbitrary standard. It equals 1/200th of a hectare, but the system could just as easily have used a plot cord length of 5.68 meters, which would give a plot of 100.0 square meters or 1/100th of a hectare. In fact, the plotting system for brushing or spacing is often based on a plot cord of 5.68m, but someone just decided one day that the FS 704 system for planting would use a plot size of 50 square meters, so 3.99m plot cords are used, and that was that.

Let's examine why we're measuring 1/200th of a hectare. The reason is simple: because it saves work. A checker could certainly use a quality measurement system whereby every single tree is checked, and this would result in an accurate assessment of the quality of the block. However, it would be a lot of work to check every single tree on an entire block. The checker would rather just check some of the trees and get a rough idea of approximately what the quality is equal to.

You might wonder at this point if the entire quality of the whole block is dependent upon this one plot, but that's not the case. Although the checker doesn't want to measure all of the trees, he or she does have to measure a sufficient number to be assured that they have a statistically accurate approximation of the quality. Checking just one plot wouldn't give you that accuracy. What if the plot was thrown in a really tough or a really easy part of the block? It would be biased. Or what if the plot landed in an area where a planter was having a bad morning and put in a high number of faults, but then corrected the problem and planted nearly perfect trees on the rest of the block? In either case, using a single plot would lead to misleading results. Quite a few plots have to be thrown to come up with the statistical accuracy that we are looking for.

Within the 704 system, a checker is required to throw a minimum of five plots on any block that is five hectares in size or less. The checker is required to throw one plot per hectare on any block measuring between five and one hundred hectares. If the block is larger than a hundred hectares, the checker is allowed to throw one plot for every two hectares. I won't go into the exact mathematics behind these requirements, but anyone who's ever taken an advanced statistical measurement course

will understand the background behind this next statement: If a checker throws the correct number of plots as just outlined, and if the plots are truly random and dispersed evenly, then the quality measured by the 704 system will be within 5% of the true quality of the block (as if every single tree were assessed individually), nineteen times out of twenty. So in other words, the sampled quality results of the 704 system, when applied properly, are "good enough."

Some of you will now say, "Wait a minute, what happens in that one time out of twenty when the quality IS off by more than five percent, and the statistically measured quality happens to be lower than the true quality? Doesn't that hurt the company by giving an incorrect low quality assessment, which means a lower rate of pay?" Yes, that's true. That's why the system builds in a payment tolerance factor of about eight percent to compensate for statistical aberrations. So to make a long story short, because I want to avoid paragraphs of additional detailed information about statistical analysis, you can get away with planting slightly less than 100% acceptable trees and still get paid 100%, because the system does not want to discriminate against companies due to the sampling error.

Now you know the basics. To take a plot, swing a 3.99m cord around a shovel, count the trees within the circle, then figure out how many are good and how many are bad. Do that as many times as the 704 system asks you to, which is a plot count that's based on how big the block is. Add all the plots together, come up with a quality percentage, and that quality percentage determines what your company gets paid. You don't have to memorize all of this, you just need a rough understanding of how the system works. What you do need, however, is a perfect understanding of the ways that your trees can be faulted. Let's get into that next.

Figure 14.04
Crew Leader and Checker Assessing Quality.

Here we see a crew leader walking around the block with the checker, assessing the quality of the planted trees.

Within the FS 704 system, there are approximately two dozen separate fault types listed. Some of them are more prevalent in the field than others. They're divided into three groups. The first group, the "A" group, are faults relating to Damage to Seedlings. These are bad, very bad. I rarely see these on plot sheets. The second group, the "B" group, are associated with Microsite Selection, which of course refers to where you picked your spots for your trees. Pick a good spot, and you can't get faulted with this group. The final group, the "C" group, consists of faults related to the actual Planting Quality. Several of these faults are unfortunately seen on plot sheets fairly commonly.

Let's look at each of the two dozen faults individually.

Specific Faults – Damage To Seedlings

First, let's cover the five assessments in the "A" group of FS 704 faults, all of which relate to damage to the seedling being examined.

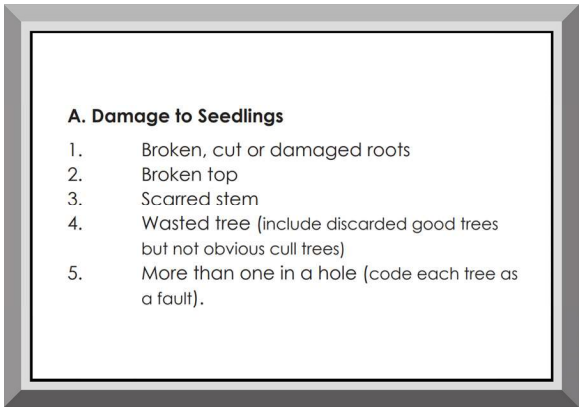

Figure 14.05
"A" Group Faults – Damage to Seedlings.

There are five types of faults within the "Damage to Seedlings" category.
Source: BC Government.

A1 – Broken, Cut, or Damaged Roots. This fault occurs when you physically damage the roots or plug of the seedling. The most common way for this to occur is if you push the plug into a hole with your shovel blade, and slice the roots. Since we teach people not to do this, it's not a common fault to see. Tuck the roots in with your hands.

A2 – Broken Top. When the top is broken off a seedling, it will lose a full year of growth, assuming that it even survives. Be careful when pulling trees from your planting bags. Don't grab them by the top. Grab them by the stem and plug simultaneously.

A3 – Scarred Stem. This damage might occur if you kick the hole closed and accidentally kick the tree at the same time, removing some of the fragile bark or otherwise damaging the stem.

A4 – Wasted Tree. A wasted tree is one that's not properly planted. Commonly, this fault is used to indicate when you drop a tree onto the ground and don't notice. Remember that none of the "A" Group faults that we've looked at so far show up on plot sheets very often.

A5 – More than One Tree in a Hole. This is a fault that I've almost never seen on a plot sheet. It's very difficult to plant two trees in a hole unless you're doing it intentionally. Twenty years ago, it was common to plant very tiny trees that came with as many as a thousand trees per box. Frequently, this was bare-root stock. With stock that was that small, sometimes the roots of a couple trees could stick together tightly, and when you pulled them out of your bags, you didn't notice that it was actually two trees. You'd have to be really negligent not to notice this happening with the larger stock that we plant today, so this fault is extremely rare.

Specific Faults – Microsite Selection

Next, let's cover the eight assessments in the "B" group of FS 704 faults, all of which relate to the microsite selection of the seedling being examined.

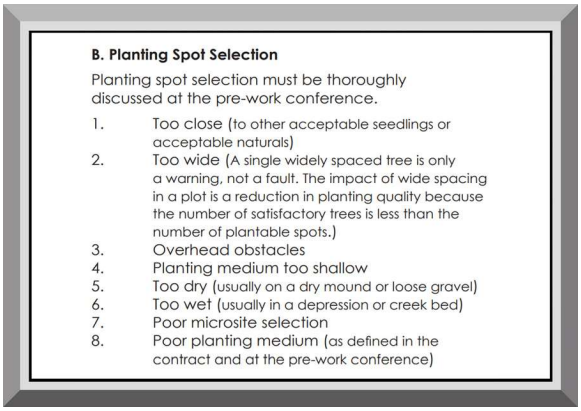

Figure 14.06
"B" Group Faults – Planting Spot Selection.

There are eight faults within the "Planting Spot Selection" category.
Source: BC Government.

B1 – Too Close. If a pair of trees are planted closer together than the contract's "minimum spacing" requirement, then one of the two trees is considered to be faulted as "too close." This is the only spacing problem that can get directly listed as a quality fault. Note that both trees are not faulted, under the rationale that if you removed one of the close trees from the plot, the remaining tree would be fine. This is a fairly common problem on plot sheets if planters are not paying careful attention to their spacing.

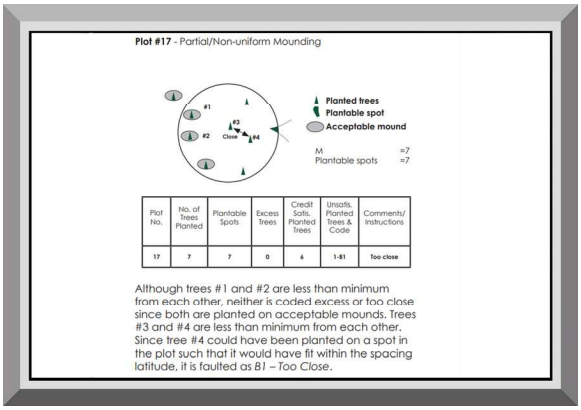

Figure 14.07
B1 – Tree Too Close.

Here's an excerpt from the FS704 Handbook. It's very useful for including diagrams to explain how various example plots should be assessed properly.
Source: BC Government.

B2 – Too Wide (Not A Fault). This again is a spacing issue, but a very curious one. Spacing that is too wide is NOT considered to be a fault. This is the only example of the two dozen so-called faults that doesn't actually have a direct negative impact on the quality percentage. It's only included in the list of faults, and recorded on the plot sheet, as an "explanatory item" to clarify why there were less trees in the plot than the target number. If this code is not recorded, then it would be assumed that the low number of trees planted is due to a "missed spot" which DOES count against quality. Be aware, however, that even though consistent wide spacing does not get recorded as a quality fault, it will still ultimately cause problems with low density when density results are being assessed, and there can be penalties in that separate process.

B3 – Overhead Obstacle. As a tree grows, it needs to grow into open space vertically. If you plant a tree underneath the branch of another tree, or under a large piece of slash, there could be problems as the tree grows. Eventually, the top of the tree is going to hit the obstacle above it, so the tree will have to try to grow around the obstacle. This is bad for commercial value, plus there's the risk that as your tree sways in heavy winds, the top of your tree will be damaged and it will fail to keep growing.

B4 – Medium Too Shallow. This happens when the depth of the acceptable planting medium is insufficient. For example, consider a contract which specifies that the plug must be in 100% mineral soil. Let's assume that the planter is working on mounds that were created when a piece of sod was flipped upside down by an excavator. If the planter puts the seedling in the middle of the upturned mound, the plug will probably be in 100% mineral soil. If the planter puts the seedling at the edge of the mound, it's possible that there might not be enough dirt there, and the roots and plug end up planted partially in the grass layer of the upturned sod. In that case, the planting medium was too shallow. Another example could be when there's just an inch or two of dirt covering a sheet of slate rock, and the planter tries to compress the plug in that narrow layer of dirt.

B5 – Too Dry. Planting medium that's "too dry" is anything that is so well drained that it doesn't regularly hold sufficient moisture. If you're planting in a microsite full of gravel, any water that reaches that gravel will filter through and seep away, and won't stay there to benefit the plug. On the other hand, if you're planting in good planting medium and the weather is hot and dry for a couple weeks, so the ground dries out, you won't be faulted for that. Ground that dries out because of a temporary weather condition is beyond the control of the planter. A tree planted in loose gravel, which is perpetually dry, should have been planted elsewhere.

B6 – Too Wet. Determining what is "wet but ok" and what is "too wet" is a bit of a gray area, and your forester will attempt to provide clarification. After all, the moisture content of the ground at the time of planting can be very different than the moisture content two weeks later when the block is checked. The general rule is usually that if you open a hole and, at the time of planting, it immediately fills up with water to the surface, the area is too wet. You should look for a higher microsite, above the water table. If the ground is fairly wet and makes a big sucking sound, but takes five or six seconds to fill with water, or only partially fills, the forester might consider the spot to be Ok. Ask your crew leader for clarification, as this fault will be interpreted slightly differently on every contract.

B7 – Poor Microsite Selection. This fault is recorded when the planter simply made a bad choice for a microsite, which is not covered by one of the other faults. For example, on a contract that specifies that trees must be planted in high spots, if a tree is found to be planted in a low spot while just twelve inches away there's a beautiful high microsite that could have been used, you'll probably be assessed with this fault. This fault is probably more common on plot sheets than most of the other "B" Group faults, although it's still not too common.

B8 – Poor Planting Medium. This fault refers to unacceptable planting medium. On a number of contracts, organic soil may be considered to be an acceptable or even preferable planting medium. However, the forester may say that although organics are encouraged, any non-decomposed organics, such as chunky red rot, are unacceptable. So if you then plant a tree in non-decomposed organics, you would be assessed with this fault.

Specific Faults – Planting Quality

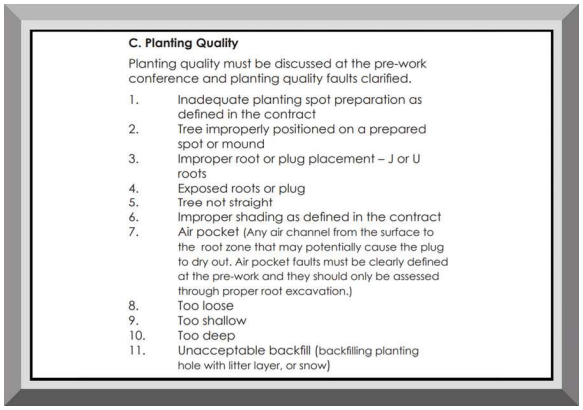

Figure 14.08
"C" Group Faults – Planting Quality.

There are eleven separate faults within the "Planting Quality" category.
Source: BC Government.

Finally, let's cover the eleven assessments in the "C" group of FS 704 faults, all of which relate to the actual quality assessment of the seedling being examined.

C1 – Inadequate Microsite Preparation. If you have screefing requirements that you're not meeting, it would be a good example of inadequate microsite preparation. For instance, if the contract specified that you needed a 20cm x 20cm screef and you were only making 10cm x 10cm screefs, you'd be faulted on each screef.

C2 – Improper Position. Improper position can arise when your tree is in the wrong spot on site prep or in a screef that you've prepared. For instance, if you're asked to plant your trees at or above the hinge on a trenched block, and you plant all of your trees in the bottom of the trench, they'll all be faulted. If you're asked to make a 10cm x 10cm screef and you do so, but you plant the tree at the edge of the screef, touching the grass, then you'll be faulted for not having planted the tree in the center of your screef. This can be a moderately common fault on some plot sheets, especially if planters get lazy or don't understand the specs.

C3 – Improper Roots. Improper roots are roots or a plug that are not straight and vertical. Usually, the term "J-Root" is used to describe a plug that's bent. Roots that aren't straight will not grow as quickly and effectively, because they'll be putting some of their energy into straightening out rather than growth, which compromises the ultimate success of the tree. Even if the plug is straight, if it's at an angle in the ground, rather than vertical, it's considered to be a problem. This is probably the worst possible fault to find on a tree, and it's very important for planters to learn good technique in the beginning to ensure that roots are planted properly. Your instructor or crew leader should pay

very close attention to your planting technique, and dig up some of your trees to check your results. Always make sure you have your fingers on the bottom of the plug, so you'll know just by feel that the roots are good.

Figure 14.09
Sad Crew Leader Discovering J-Roots.

This crew leader is sad because she was looking at some trees that a different crew planted the previous year, and a lot were dead. Upon digging them up, she discovered that most were j-rooted.

C4 – Exposed Roots. This fault is a bit of a holdback from the days when most of the trees planted in BC were bare-roots, not plugs. If some of the roots were planted properly in the hole, but some root strands stayed out of the hole and were left exposed on the ground, this fault would apply. This fault is rarely seen on plot sheets anymore.

C5 – Tree Not Straight. Trees grow best when they grow vertically. If your trees are leaning over, the trees need to put some of their energy into straightening out, rather than growth. Of course, they'll straighten out on their own in a few weeks, thanks to a process called phototropism, but this means that vertical growth hasn't been optimized. If you hear a reference to a "leaner," it refers to a seedling that's leaning. It's a really good idea to plant straight trees. A big part of quality assessment is perception. If a forester walks into your piece and sees straight trees everywhere, he or she will assume that the planter cares about their work, and is less likely to dig around, looking for problems. If a forester sees lots of leaners, he or she is likely to be annoyed and will do a more thorough examination of the planting, and is more likely to discover faults. If you want to keep the forester off your back, plant nice-looking straight trees.

C6 – Improper Shading. This is a fairly rare fault. An example might be when planting directly beside a large boulder, on the north side of the boulder. Direct sunlight won't hit the tree very often. If the planter had moved the tree a few feet to the side of the boulder, more sunlight might hit it, which would be better for the growth of the tree. Thus, this fault could apply.

C7 – Air Pocket. There used to be a couple different faults relating to air pockets. The first was an "underground cavern" type of air pocket, where the ground surface was sealed, but the roots of the tree were dangling in a small cavity. The second type occurred when the hole was not properly closed, and therefore air could leak down from the surface along the side of the plug, which tends to dry out the plug and kill the tree. Foresters often referred to this latter type of air pocket as a "hole not closed." Eventually, the FS 704 system changed. Underground air pockets are no longer a big focus, because they're really hard to identify. Also, if the ground is sealed at the surface, there's not

as much risk of desiccation, or drying out of the plug. The modern focus is upon making sure that the hole is closed properly. This fault can appear fairly commonly on plot sheets, especially in grass mat, if planters are not taking care to close their holes properly.

C8 – Too Loose. If a hole is closed properly, it's fairly unlikely that you'll have problems with this fault. To check to see if a tree is too loose, a forester will grab onto two or three needles and give a very light tug. If the tree pops out of the ground, then it's too loose. More pressure should have been exerted when closing the hole. This fault is not very common on plot sheets. It usually only results when holes are not closed properly, therefore, it would be more common to see a C7 fault than this one.

C9 – Too Shallow. If the depth of the tree is insufficient, you'll see this fault. The depth requirements can vary significantly from contract to contract, and your crew leader will communicate the specs to you. This is by far the most common fault for first-year planters as they're learning to plant. In most places, if there's going to be some leeway in the depth requirements, foresters would rather see a tree planted slightly too deep instead of slightly too shallow. A shallow tree runs a high risk of desiccation in the plug. After you plant your tree, give it a little twirl and make sure that you can't see the top of the plug. If you can, chances are on most contracts that it's probably too shallow. This can be a common fault.

C10 – Too Deep. This is obvious, as it's the opposite of a tree being too shallow. If you don't have the absolutely perfect depth, most foresters would probably rather see your tree as being a bit too deep rather than too shallow. Just don't overdo it. If the bottom laterals of the seedling are underground, you're probably planting too deep.

C11 – Unacceptable Backfill. When you close a hole, the planting medium matters. If you have a seedling planted in a hole and the plug is completely surrounded by a good mix of mineral soil and/or organics, and then to close the hole you stuff it full of dried grass and twigs, then obviously the forester will not be pleased. This is not a very common fault on the plot sheets.

Depending on the client, it's possible that they'll have a quality system of their own, rather than using the FS 704 system. It's also possible that they'll use most of the elements of the FS 704 system with just a few modifications. No matter what system is in use, the types of faults that can be assessed will be very similar to the list of faults that are possible under the 704 system. If you understand all the faults that we just talked about, coupled with information about the required specs for the blocks that you're working on, you'll have a great understanding of how to plant a proper tree, no matter where you are in Canada.

Figure 14.10
A Checker Throwing a Plot.

Your trees will be checked by a number of different individuals, to ensure that everyone is in agreement about the quality on the project.

Incidentally, it is quite common for contracts to specify that seedlings be planted on the highest possible microsites, or in the lowest possible microsites, depending on the region and climate. In cold regions, with short growing season, or when working at higher and colder elevations, it's common for a forester to ask that each tree be planted in the highest possible microsite. Even if a tree is planted only a few inches higher in elevation than in potential surrounding microsites, the temperature difference can be a few degrees, and the growth of the tree can be significantly impacted for the better. In hot, dry, desert-like regions, such as Kamloops and Merritt, it is more common for foresters to ask that seedlings be planted in the lowest possible microsites (with plugs fairly deep) to ensure that the plug retains moisture as much as possible.

For more photo and video resources associated with this chapter of the book, including a download link for a copy of the FS 704 quality assessment guide, visit:
www.replant.ca/training/quality