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"CONSERVATION OF MONUMENTAL TREES"
TO BE PRESENTED By

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ANY LIVING TREE WE LOOK AT TODAY IS ONLY ONE YEAR OLD!

How can I make such a provocative statement? Simple - a new tree is generated on the outside of the last growth cycle tree with each growth cycle. Yes, the bark may be original on the surface, and some pine needles may be years old, but these are elements of the total organism. The fact is the living tree we look at today is the result of the last growth cycle. *Slide 1 – Eucalyptus viminalis – Manna Gum.*

I will be speaking to the topic "Conservation of Monumental Trees" by addressing thoughts on "The Mechanism of Growth and Aging".

Why do we need large old trees "Monumental Trees"? There are a few reasons.
Wild life, such as our Koala, they need large old trees for food, shelter and protection from predators. *Slide 2 Koala feeding on Eucalyptus ovata (Swamp Gum)*

- Then there are other types of wild life that hide in the cavities within trees, *Slide 3 wild life resting* in a *Atherosperma moschatum (Southern Sassafras)*
- This tree is between 1,000 – 1,500 years old. *Slide 4 1,000 – 1,500 years old Eucalyptus viminalis – Manna Gum.*
- Internal decay – Picture of central hollow in *Eucalyptus regnans (Mountain Ash)* and Eucalyptus viminalis – Manna Gum. *Slides 5 and 6*

The thrust of the lecture to you as consultants and practitioners is that most, if not all, Arborists in their management practices attend to the crown of the tree and pay little attention to the root systems of the tree.

While the crown provides a symptomatic snapshoot of a tree, at any time of its life cycle, it does not truly reflect the tree's total health and condition. Rather it expresses the health, condition and conditions of its root system. "Seldom does the cause of a problem, manifested within the crown of a tree, truly lie within the crown". While we will talk later about the difference between Dieback and Decline these manifestations within a tree are not directly age related.

We know that age in a tree, unlike in an animal, is not an accurate yardstick to judge the condition of the crown. Why do we know this, because a tree, a plant, is a "generating organism" – generating new tissue in a new place every year! We know plants that are propagated by vegetative means, plants with a life expectancy of perhaps only decades, have been propagated using vegetative means for centuries. This is the same tissue as originally taken from the parent plant. So it must be some other reason that causes a tree to die.

Firstly perhaps we should identify why a tree dies. The answer to this question was provided by Dr Alex Shigo when he identified the injury management processes within the tree. The CODIT model identified the compartmentalisation of injured tissue within the tree. Of particular importance is the fact that, starch storage organs, located within such compartmentalised areas, are no longer available for storage and retrieval of energy. *Slide 7 Picture of CODIT model.*

Think of energy as money in the bank. You have one big bank account that is comprised of millions of sub-accounts. You can draw against some or all of these and then replenish them when new funds become available. However, as sub-accounts become compartmentalised, (closed) you face two problems. You now have limited energy reserves available to call upon at times of need and limited areas to replenish and store, surplus energy.

Perhaps some will think that this is not a problem, the tree will just grow new sub accounts. True! But growing tissue is just that, growing and maturing, and as such is not fully available for storage until the next growth cycle. One critical issue, that I am sure you are all aware of, but we do tend to overlook in the energy bank equation, is that trees are users first and producers second, of energy.

How does this translate into how we manage trees? Well, new growth is infact parasitic upon the old trees. It relies on the old trees in two ways, firstly to supply the energy to grow the new tissue, organs, and secondly for the structural strength to hold them in the new growth location.

OK so what does that mean? It means that large amounts of energy have been invested into the growth of these new organs, new trees in the new position. To achieve a return on this investment it is important that this new tree reaches the productive stage, the maturity of those organs. However, a tree, or a new tree, is not "A" tree but rather a collection of millions of trees within the one cohesive community of trees, that we call "A TREE". Such "A" tree is a collection of these trees, within same time zone, ie: one seasonal growth increment that are built up one upon the other. Shigo refers to these as Trees 1 & 2.

A pivotal moment in our knowledge of how to manage trees came in the 1980s when Dr Shigo wrote the 1,465th paper on the correct method of pruning trees. 1464 previous papers, dating back some five (5) centuries had been written on this subject. What was different about Shigo's paper was that his was the first (1) to show how a branch was connected, or rather clamped, onto a tree. Hard to understand how to cut something off if you don't know how it's attached. *Slide 8 Branch attachment model*

Shigo with the members of his laboratory team, practitioners' from around the world that collaborated and interacted with him, and through his diligent observation and dissection, showed the hierarchy of connections from the smallest twig to the largest branch. We all now know and appreciate how this process works. The branch cylinder unwraps at its connection to the next larger stage within the structure. Subsequently the overlaid tissue is itself overlaid by a new layer of cells from the edges of the underlying structure.

In my College Nursery I first saw this structure in the mid 1960s. When stripping small branchlets of larger twigs to produce propagation material with what was called, a heeled cutting. The branchlet was pulled out at the connection. The heel has a thickening that was about twice the thickness of the stem of the branchlet. This thickening tapered down three dimensionally to a point.

Inspection under a x10 hand lens showed consecutive layers of the twig tissue and the branchlet tissue. The significance of this, from a structural point of view, was not appreciated by my College lecturer, or me at that time. I was told having the heel provided energy for the branchlets to form roots. Specific plants had a much higher strike rate with heels than without, whereas other plants it made no difference or was undesirable.

As a result of Alex Shigo's identification of how branches are attached and with the CODIT model we regularly prune and manage the above ground sections of the tree. What is often overlooked, however, is the use of the branch collar as a management and diagnostic tool. This is more apparent on some trees like many Eucalypts that show profound collars. *Slide 9, 10, 11 Pictures of Branch collars on Eucalyptus rubida - Candlebark*

The collars only form as a pronounced region, as the growth rate of the branch falls below that of the limb. Please read here; branchlet to twig, twig to branch, branch to limb, limb to trunk and the same for the roots. When this occurs it is a manifestation that the subordinate tissue, in this case the branch, is no longer adequately productive to be fully connected to the limb. The resulting disconnection additionally starves the branch of nutrients and water further slowing the growth rate of the branch and increasing the interconnection disparity. Tissue samples taken from such a branch show, no or low levels of starch within the branch, close to the collar, but increasing further out along its length, often reaching full levels close to the end on the branch. *Show IKI*

We all know that in healthy vital trees excess energy is stored as starch. The excess starch is loaded DOWN across the starch reserves organs. Each organ must fill before the next can start to fill. This cascading of filling starch storage within the storage organ continues down each section of the tree. Starting from the shoot tip all the way down, and out to the root tip.

I have, as I am sure some of you will have, on many occasions, through management practice, reversed the demise of a branch or limb, critical for some aesthetic purpose. So we know that this is a reversible process given improved conditions. We also know from this that plant tissues / organs die through starvation. Once there are no starch reserves to call upon, and current growth being parasitic for energy, the system collapses – death.

Routinely we prune tree crowns, hopefully within the pruning laws set down by Dr Alex Shigo. Some people still like to play "Doctors and Nurses" with the trees under their care, filling cavities, painting wounds and the like. These can be acceptable for cosmetic reasons but they do not address the tree's problem and that which controls the long term health of the tree.

From an old BBC radio comedy show of the 1950s, Arthur Fallowfield said in a Yorkshire accent, "The Answer Lies in The Soil". The roots are the brains of the plant. The roots control what happens, not only within the organs of the plant / tree, but also within its immediate environs.

In life, you have a belief choice between two views; you are either a Fundamentalist or a Predispositionist. A Fundamentalist believes that whatever happens will happen and the Predispositionist believes that one thing leads to another; the end is as a result of a long process.

Being a Predispositionist I believe that it is a combination of a tree's genetic capability, "Vigour" and its "Vitality", what it can do with the resources available to it, that enable it to resist the stress/s of life. Stress is a natural part of life and is repairable. Strain on the other hand, is irreparable, leading to death of a part, shedding, in order to maintain demand in balance with supply. This is often expressed by the terms Dieback and Decline.

LET US LOOK AT THE DIFFERENCE BETWEEN THESE TWO TERMS:
DIEBACK AND DECLINE.

Dieback is a short term stress that causes the tree to reduce it mass demand to balance it with its energy supply. In Melbourne Australia this is often manifested in deciduous European trees, such as Elm, as a result of dehydration of the root plate and the low humidity of a hot summer. The leaves on the trees turn yellow, young tips die, and unproductive wood and older foliage is shed. However, with mid summer thunder storms and periods of high humidity the leaves re-green and growth recommences.

Decline is a state where the whole tree is committed to death. The time line is the variable, the outcome is inevitable. *Slide 12 – Decline Sheet from Shigo's publications*

Most Arborists, if not all, agree that pruning the crown of a tree, if properly (technical procedure) and appropriately (Appropriate Quantity) implemented, will be beneficial to the tree. The removal of dead, dying and dangerous limbs are health procedures akin, in human terms to cutting hair, debridement of wounds or perhaps washing.

A tree's crown may have competition for space from adjoining trees. *Slide 13 Shora macrophylla – meranti showing chemical control of adjacent crown.* But air space is generally far less limited than soil space. While some trees in a natural setting, example Western Australian trees growing in sand, send roots down 30m or more. A second example is the Elm Avenue of Honour at Bacchus Marsh in Victoria. *Slide 14 Ulmus procera and Ulmus × hollandica* ***'Vegeta'*** Some of this Avenue lies over a sediment river bed with an aggregate layer some 14m below the surface, in which part of the Werribee River runs. These trees trunks go straight into the soil and have no side roots, according to excavation of up to 2m deep against the trunks.

They have, like the Western Australian trees, developed a lateral root system at great depth. However, the majority of woody root plate of most trees is within the top 300 - 400mm. *Slide 15 lateral surface roots in Malaysian remnant woodland.* While root depth is somewhat soil type dependent and dropper / vertical roots may originate at various points under the root plate, deep roots do not form the majority of the "working roots" of the tree. Further, root population can be considered to progressively reduce with depth.

Trees fundamentally have three types of root systems, white roots, woody roots and fungal roots. The total volume of soil resources / space that a tree has is finite. Thus the tree relies upon the death and decomposition of shed sections of its root systems, within the available volume, to perpetuate required space within that delineated zone.

In a natural setting the delineated zone of the root system is three dimensional; depth, width and height.

- Depth is determined by soil type, oxygen and bedrock,
- Width is determined by lateral spread (width), competition and physiological factors,
- Height, the Organic horizon depth on top of the A horizon of the soil, competition from herbs and shrubs.

In nature trees are part of a community, Shigo expresses this as Tree1, 2 and 3.

- Tree 1. An iteration within a tree; branchlet, twig, branch, limb, that could grow to form a new whole crown, or may be shed to provide benefit or without determent to the rest of the tree.
- Tree 2. Is the collection of these branchlet, twig, branch, limb, trunk and root systems into what we commonly call "A Tree".
- Tree 3. Is the community of trees, the forest or woodland that in nature would be defined in some way, such as within a drainage basin, soil type or Phonology.

Before the introduction of humans to the landscape, depending on climate, location, soil type etc, the picture of a natural woodland / forest would show a diversity of micro, meso and macro flora and fauna all growing and completing their life cycle in a substantial closed loop, feed back, system. Inputs being nutrient rich rainfall (Cyclic salts), Carbon Dioxide and light. In such a structure there are very little outputs, (losses) as to repeat a common statement, what happens within the community stays within the community.

The introduction of man into the landscape changed the balanced ecosystem into a net loss system. Output, in the form of nutrient loss, through the harvesting of trees, leaching, fire, hydrological changes, loss of bio diversity, has lead to the impoverishment of the soilscape. This is not only manifested through the loss of plants but through the inconspicuous loss of a habitable soil environment on which plants could grow and live out a natural life cycle. Diversity and complexity has been replaced by individuality and simplicity.

Within the urban context trees have become isolated in or on islands of inhospitable soil environments. Islands caused by segmentation by trenches and reduction or destruction of habitable soil environments through loss of the "O" soil horizon, compaction and loss of one (1) or two (2) of its root systems. Such trees are generally out competed for diminished resources by grasses and shrubs planted to beautify the area.

Given that we place trees in unnatural settings:

- Subdivide land / soil profiles, by road, housing or boundary.
- Dry or waterlog soils, due to changes to the natural soil hydration cycles. Trenches, drains, irrigation, compaction, impervious or hydrophobic surfaces,

- Impaired or destroyed soil structure, devoid of organics and / or natural micro and meso soil organisms or flora.

All these imposts diminish the ability for our trees to live out their potential life cycle, without human intervention to try to sustain the life of Trees 1, 2 and 3. As trees require such maintenance to sustain their life, this renders them in the same category as a farm animal, a crop or a domestic animal. They are all “PETS” to a greater or lesser extent.

Over resent years a phobia has developed with regards to the root system of a tree. Damage can / does occur to tree root systems but principally this is a time frame issue. We know that a tree is generally long lived. We also know that growing new roots or cutting can extend the life of the tree from decades to centuries. We also know first hand that when we take old trees from nature and impose urbanisms upon them they often die.

Why does a tree die? Shigo shows us that the only way a tree can die, even if cut down, is through starvation. Where less energy is produced by the tree each season than is utilised. The tree calls on its energy reserves and sheds unproductive organs in an effort to balance income with expenditure. Such trees are alive but committed to death, just like the cut flower in a vase, unless energy production can be increased.

Death comes “Suddenly” when after perhaps living for decades on the trees starch reserves, those starch reserves finally run out. You will all be familiar with the prolific flowering event that precedes sudden death. As previously stated, starch is like money in the bank for a human or a country, while they spend more than they earn and use their savings to balance the books all continues as normal - until the reserves run out. Then “Suddenly” you are out on the street or without food etc. Infact it is not sudden, it is the culmination of a progression to the inevitable end point.

To manage a tree’s health and life expectancy we must first understand the time frame of a tree. Lets say that the average life expectancy of a man is 100 years. We say that a dog ages 10 years for every year of a man, and on average dogs lives about 10 man years. The average life of a tree is perhaps 1000 years. We have many living trees in Australia and around the world that are much older. Thus, for every 10 man years a tree ages 1 year.

Why is it important to understand the Dogs Life Age of A Tree.
Well for example; we all know the "old wives tale" you can’t build up soil over the root plate of a tree. We have empirical evidence that shows when you tip 600 mm of high quality soil over the tree’s root system it dies, some time later the crown dies. However, if you added 10 mm of soil each year for 60 years, neither the root system nor the crown will die from this action. Why? Because it will adapt and capitalise on that new space each year. It will gain vertical space as in nature as minerals and organics are topically applied each year over the root systems.

In the urban situation we, may not / cannot, keep raising the vertical depth of the soil each year so we have to find a way of generating new space in the old position. Trees we know generate new trees in a new position with each year of growth. We know from the work of Dr Joanna Tippett and Shigo that tree roots are excellent at compartmentalising root wounds. We know the same techniques applied to crown pruning equally applies to root pruning.

We now understand time and technique, we just need to qualify “Extent”. The parameter of Extent will be largely dictated by the current condition manifested within the crowd. The poorer the condition the more intensive, targeted and measures treatment will need to be.

With trees in extremely debilitated states, I have by-passed the root system and directly applied nutrients to the foliage or with stem injections, using the Mauget injection capsules, or more lately the refillable cartridge system. One thing to watch out for with nutrient injections is that if the tree has a major fungal infection, such as Phytophthora or Armillaria, the increment in nutrients can cause the “sudden” death of the tree. I have used this method to determine if a tree is saveable. I inform the client of the treatment outcomes, “sudden death” in which case any treatment or money spent over and above the cost of the injections would have been wasted or if the “tree growth responds”, we know there is a hope to rejuvenate the tree through further treatment.

As humans we eat two or three times a day, thus we have a regular and balanced nutrient intake. Unfortunately in the soil conditions for trees, which we want to become “Monuments” are often in a boom and bust cycle. For much of the growing period there are not enough nutrients available to sustain adequate growth.

When I studied at Merrist Wood College in the UK in 1973 -74 my thesis was on the nutrient levels and productivity comparison of Quercus robur (English Oak) and Chamaecyparis lawsoniana. For the Oak I took two sites, a farm paddock, and a heath woodland. For the Lawson’s Cypress Dr Binns had one site with three different soil types.
The study, a collaboration between myself and Dr. Binns of the Alice Holt Research Station Farnham Surrey.

The study involved taking samples over a 12 month period at fortnightly intervals. I took samples from the 19-12-1973 to 17-04-74. After this time Dr Binns made the collections. For my College paper I had to present the findings to samples taken on 19-04-74.

GROWTH INCREMENT ASSESSMENT QUERCUS ROBUR:
In December 1973 each of the 10 trees, 5 in the nutrient rich farm land and 5 in the poor heath land, 7 of the last growing seasons shoots were tagged and their length and lateral and terminal bud counts recorded.

At the conclusion of the subsequent growth event these 7 labelled twigs from each of the trees were harvested below the girdle scare of the preceding growth season. All lateral and terminal shoot growths, for the current season, were removed, dried and weighed for each of the sample trees.

TISSUE SAMPLES QUERCUS ROBUR:
Commencing on the 19th December 1973 the sampling method was to take approximately 100 buds, on a fortnightly cycle, from a number of twigs of the last years growth increment during the dormant season, in the growing season some 30 leaves were taken from the new growth.

The samples taken were dried and then analysed for N, P, K, Ca, Mg. Ca and Mg were not analysed during my study period up to the 19th April 1974 as the relevant equipment was not available.

RESULTS: *Slide 16 Result Graph*.
The graph shows that the nutrient status from December to March 20 1974, spring flush, was statistically identical between both groups of trees. However, once growth commenced the nutrient status of the two groups diverged significantly. This was also demonstrated, though not in this graph, that growth extension and productivity also varied widely between the two groups.

WHAT CAN WE TAKE FROM THIS RESEARCH:
Sampling timing is important but mainly that nutrient levels have a direct bearing on the productivity of the tree. So why is this important? Remember trees are users of energy first and bankers of energy second. Without going into the survivability of genetic vigour lets assume that all the trees in the sample had similar vigour. Therefore their Vitality, what they do with the available resources, was directly dictated by the nutrient status within the root plate. I didn't then, but would now, do starch tests down the branches to determine the level of starch production and how full the starch storage organs were at the end of the season.

If the starch tests return the same colour intensity down the full length of minor and major branches, down the trunk and ideally out along the root system then you can assume that growth potential was at is maximum and the tree is in a fantastic position to protect itself against stress.

Conversely should the starch levels diminish down the length of some minor and major branches you can safely assume the tree is not in good condition and is likely to be pressured, as part of the natural selection process, by any pest or pathogen that comes along.

Don't ever overlook the energy required to fight off pests and pathogens. While it is difficult to quantify, for any tree, the energy expended in such fights can be considerable. We all have had personal experiences of how this feels. When you are healthy you have a, lets call it your normal energy level. Being struck down by a good dose of a cold or flu will leave you listless, tired and possibly confined to bed. You have no less energy than when you are healthy, it is just that it is off saving your life, rather than letting you chat to your friends, texting or catching up on twitter or facebook.

So just add fertiliser and all will be well! No! Fertiliser is only part of the story. We need root space, nutrients and microflora. I would argue the item of greatest importance is that the root plate has a biologically habitable environment suitable for all the roots systems of the tree.

With the Chamaecyparis lawsoniana the trial destructively harvested the whole tree. The tree was then cut into three sections top, middle and bottom and dried and analysed as for Quercus robur. The foliage analysis of all the trees remained remarkably constant across the year. But of particular interest was that the test showed that nutrient status of N & P were highest in the top 1/3 of the tree and graded down through the middle to the bottom of the tree. While for Potassium (K) the reverse was the case. This is important to know if you are using tissue samples as a management tool.

TWO ASIDE:
In Canada in the late 80s they were injecting Plus Seed Trees with Metasystox-r an Organophosphate insecticide-miticide (S-[2-(ethylsulfinyl)ethyl] O,O-dimethyl phosphorothioate) for Tent Moth Caterpillar. What they observed in the seeds collected in the collection period after the treatment was that seed size and germination rate improved, I think it was, two fold. Subsequent trials demonstrated it was the breakdown products of the Metasystox – the phosphorus that benefited the seeds.

In Australia in the late 90s, due to an extended drought and period of cattle food shortage, some bright spark thought of using cotton seed waste as a food supplement for cattle in feed lots. This was fine until the carcases of the cattle got to America where the FDA conducted routine chemical residue tests. These test found very high levels of pesticides in the animal meat. The same residues as the chemicals used in the Cotton Industry. Subsequent testing showed that the chemicals in this case concentrated in the seed coat. Thus you need to have some idea of what the chemical breakdown process is and where it will end up in the plant. Treating with insecticides may have a beneficial nutrient by-product effect on the plant.

MANAGING THE ROOT SYSTEM:
A program of root system space management should be commenced before or once root space becomes limited. In the nursery we take cuttings of trees with no roots and grow roots, strike the cuttings. These can be softwood, semi-ripe wood or hard wood, each is treated differently. But normally this wood is only 1 or 2 years old.

When we go to collect plants growing in their air root pruning container in our nursery, we have allowed many roots to escape into the site soil from the bottom of our special punched plastic bag, 20 – 25% open area sides and bottom. In the dormant, non growing season, for both evergreens and deciduous trees, we often cut off up to 60% of the total root mass. We observe minimal or no detrimental effects when we plant out or pot on.
What does this tell us? The younger the plant the greater the impact without detrimental effect. So as trees get older we have to be more careful. In the crown of mature trees we often say that a 20 – 25% crown thinning and reduction are acceptable. Perhaps this is an under estimate, but we are also trying to maintain a natural form and shape. Over pruning can stimulate sprout shoots from latent buds and vertical sprout shoots along and at the ends of horizontal branches, this is to be avoided.

One other topic we need now to define in "The Dogs Life of a Tree" is the phases of life of a tree at any one time. While this is contrary to my view we need to also appreciate some of the stages of life of a tree. We generally say that a tree has three phases of life - Juvenile, mature and over mature. Different species of trees have different lengths of each of these phases. Alan Mitchell, Alice Holt Research Station Farnham Surrey, concluded in the 70s that these stages were generally a ratio of 1:2:1. Thus a short life expectancy tree of say 100 years reached maturity in 25 years, was mature for 50 years and declined to decomposition over the next 25 years. For a tree with a natural life expectancy of 1000 years this would be 250 years, 500 years and 250 years.

My experience of watching trees; grow, mature and die, obviously not trees of 100 years of age, is that the construction of the tree, during its juvenile phase, up to maturity results in a net increment of tissue within the crown. At maturity, though the spread and height may increase, the total mass remains the same. In decline the mass diminishes at about the same rate as the incremental growth when the tree was a juvenile, subject to environmental pressures.

That is to say, if you kill a branch or tree, the tissue generated in the last year will be shed, fall off, in one year. In the second year the two year old wood will fall off, etc. I am perhaps spoilt by the highly visible and definable structural age of the Eucalypt. Observing a dying tree, often within the country road reserve, and watching it over time as I regularly pass the tree I see the following. Dead foliage and the current years shoot growth, normally thin and short, is shed by the next year. Observing over time it rapidly becomes clear that the tree deconstructs at the same rate as it constructs. There are always variables, such as where large wounds on branches or trunks will cause large sections to fail out of sequence. However, where such localised weaknesses are not present, the process continues in the orderly manner proposed.

The question we face is "What do we need to do to conserve old venerable trees?"

Generally ignoring the root systems and just pruning the crown will not ensure the long term survival of the Monumental tree we wish to conserve. We must manage the available root space, the root systems of Tree 2 and the biological integrity of the media, which the tree's root systems exploit to sustain the crown. Just like the way we manage the life cycle of our other PETS and food crops. A healthy plant is a happy plant. An organism that has good vigour and vitality has the resilience to resist strain. The ability of a tree to resist strain comes from the root system, so that is where good tree management should start.

IMPLEMENTATION

In the simplest terms there are two main functions of a tree's root system;

- Structure, holding the tree up and stopping it blowing over, and
- Wining of resources, water and minerals to sustain the tree's life processes.

I say simplistically because the root system has many other functions for instance:

- The root system of a tree not only dehydrates a soil but it also rehydrates a soil. For example; we know the Redwoods of California capture moisture from the sea mists and hydrate themselves and the rhizosphere. Desert Plants in Australia capture moisture from the morning dew point and also rehydrate their rhizosphere.
- We know Mycorrhizal roots capture nutrients and moisture from the soil and give it up to the inside of roots in exchange for carbohydrates to sustain them,
- We know that roots die and are shed in the same way as crown tissue dies and is shed,
- We know there is a direct interconnection between leaf count and root count, they are substantially in balance. You can't have a tree with a full healthy vital root system and only a few leaves or visa versa.

What is important is to understand is the extent of work that can be carried out that will be beneficial rather than determents. Many trees have been starved to death by over pruning so getting a handle on the extent of work is essential.

Dr Kim Coder Uni. of Georgia USA that young actively growing tree use 33% of its daily Photosynthates while in older trees this percentage increases. One suggestion is that on hot summer nights the top high light foliage may use up to 75% of its daily Photosynthate production. This equates very well with what we find in our young nursery trees and observations of over pruned old trees. *Slide 17 Dr Coder Page 112 Respiration*

The all to common thought with clients is that trees are through Photosynthesis produce energy to grow new trees on the outside of old ones. They totally fail to take into account that life also respires, uses energy, just as we do. We come back to the starch production, use and storage, the money we earn, have in the bank and spend.

What we also have to come back to is that we are growing a new tree each year. The tree we see is only one year old. With understanding the trees condition, using the available tools, such as the Shigometer, Starch test IKI solution, growth increments and evaluation of the environment associated with the tree. We can construct a program to bring almost any tree back to full health and vitality. *Slide 18 Picture Shigometer set*

Babies or old people you don't feed with a large steak, three vegetables and a salad. You understand the condition and provide a program appropriate to the needs of the individual. In other words you go thoughtfully, carefully and slowly. Restoring youthful vitality to trees whose root systems have been neglected for decades or centuries will take time, but it is the only way to conserve trees of various sizes that are "Monumental"

RECOMMENDED MANAGEMENT PLAN

In combination with a trunk and crown management plan we need to develop a long term root system management plan.

The basis premise of this plan is that we will, on a predetermined frequency remove a small segment of the predefined defined root plate area and replace with a specifically blended and supplemented media.

The area removed and replaced will largely be dictated by the health and condition of the tree. Healthy vital trees can have larger sections f the root plate while stressed trees will have smaller sections removed. It should be noted that with very debilitated trees a topical root treatment over the root plate area may be required before commencing the root regeneration program.

There are various methods that can be developed to determine the root plate of a tree. Clearly, for example, where it is a specimen tree in a lawn it is quite easy to determine the extent of the root system by digging into the turf at a distance from the trunk until the extent of the root system is determined. Where there is a physical barrier to the root system such a walls, roads, drives etc. the root system my be limited by or extend beyond the barrier.

As a general rule, I take the height of a crown forming tree and take that as distance from the trunk circumference at ground line to be the nominal extent of the root system. I then come halfway out from the trunk to the drip line of the crown to be the inner limit of excavation. Then I divide the donut into the required number of segments, with the side of each segment being a radius from the centre of the tree to the outer circle.

Once the location and number of segments are decided there relative position is noted on a plan and on this plan a sequence of excavation and replacement is noted. In addition to the plan a spreadsheet or management document listing the quadrant number and specified date for treatment is constructed. Paper and electronic files are made and stored appropriately for future retrieval.

We also have the option of using Identification Chip tags (RFI) that can be set into the ground at a predetermined position. These can be electronically scanned to bring up the computer recorded file. These special RFI tags can record a large quantity of base code just like a bar code. They are waterproof and have a life expectancy of a decade or more. They are quite inexpensive being about US$ 10 each.

In the slide here we see the following:

Slide 19: The plan of subdivision for this project.
Slide 20: Aerial view of a section of the site where the E. rubida – Candlebark is located.
Slide 21: Tree survey showing E. rubida.
Slide 22: Aerial view of the E. rubida.
Slide 23: Tree Protection Zone. How it eventuated.
Slide 24: Root Treatment Zone.