Response one – updated 30 April 2015

Briefing Note

28 April 2015

To: Budget Committee

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Subject: Weed Management

Introduction

This briefing paper provides background information to support Long-term Plan discussions on weed management methodologies in local parks, especially in maintaining grass edges.

LTP proposal and feedback received

One of the current draft Long-term Plan (LTP) proposals for cost savings is to reduce local parks weed management spend by "*greater use of sprays in all parks instead of mechanical means, for maintaining grass edges*".

The draft LTP proposed a level of service change to increase the chemical control of weeds, around hard surfaces and infrastructure in parks, as an alternative to mechanical edging (e.g. using weed trimmers). The extent of changes in each local board area has been communicated through recent local board workshops. Generally the changes are greatest in the northern, central and western areas of the region. This proposed change has no impact on Local Boards in the southern area where chemical sprays are already used to control weeds on edges around hard surfaces and infrastructure.

Around 80 feedback points were received on this issue with the majority (around 70) not supporting the increased use of chemical control in parks. The main reasons for concern by those opposed are:

- the increase in use of chemicals,
- the environmental impact of increased spray use on stormwater and receiving waters, and
- the impacts on public health.

The use of some chemicals for weed management generates concerns amongst some Aucklanders regarding human health and environmental risks. Particular areas of local interest include Devonport where a petition was lodged by the Devonport Toxins Action Group opposing the proposed change. Feedback from Ngāti Whātua Ōrakei Reserves Board and the Weed Management Advisory also opposed the change. Of the two pieces of written feedback received in favour of the change both supported the cost effectiveness of chemical spraying.

At the recent (21 April 2015) budget committee workshop to discuss public feedback on the LTP, councillors raised concerns regarding the alignment between the Local Parks LTP proposal and the Auckland Council Weed Management Policy (2013).

The two areas of concern are the environmental or public health implications and alignment with Weed Management Policy. This paper provides background information relevant to both these concerns plus a comparison of costs for different weed management control options.

Weed Management Policy

The Weed Management Policy has eight, non-prioritised objectives:

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- Take an integrated approach to weed management and vegetation control
- Ensure best practice in weed management and vegetation control
- Minimise agrichemical1 use
- Minimise non-target effects of agrichemical use
- Ensure public health and safety
- Protect and enhance the environment
- Empower the community to manage weeds in accordance with the policy
- Deliver weed management and vegetation control which is value for money

Weed Management Options – Environmental or Public Health Implications

The primary methods of weed control are chemical, bio-chemical, hot water, mechanical, manual and biological. Decisions on which method to use are based on a range of factors including local conditions (infestation level, physical site and asset characteristics, wider landscape characteristics and relationships), efficacy, cost, applicator safety, human health and environmental risks.

Some key features of the main options (biochemical, hot water and chemical) are listed as follows:

Bio-chemical control

- often referred to as organic weed control
- uses plant derived concentrated fatty acids; usually from coconut oil
- products include Agpro BIO-safe and Hitman
- the high acidity of these products poses environmental and operator risks and causes substantial wear and tear on the equipment
- there are some types of weeds that the organic or plant derived herbicides do not kill (i.e. nut grass, kikuyu)
- contributes to global sustainability issues from the use of coconut oil
- coconut oil acid (diethanolamide condensate) is a category 2B carcinogen
- methodology also usually requires one supplementary application of chemical control using glyphosate per year to meet control standard

Hot water steam

- control achieves a knock-down effect rather that death of the plant (burns the top of weeds with the rest of the plant still viable albeit disrupted)
- there are some types of weeds that the hot water steam does not kill (e.g. nut grass and kikuyu)
- the methodology requires easy access by specialist equipment which cannot manoeuvre into some areas
- has a high carbon footprint, energy use and carbon monoxide production through its need to heat large amounts of water.
- methodology also usually requires one supplementary control method per year to meet control standard (for example, mechanical control in Devonport and chemical control using glyphosate in other parts of the North Shore)

[1] An agrichemical is defined in the Weed Management Policy as any substance, whether inorganic or organic, man-made or natural occurring, modified or in its original state, that is used in any agriculture, horticulture or related activity, to eradicate, modify or control flora and fauna

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Chemical control

- a range of chemicals are approved for use, specific to the target species;
- glyphosate is a commonly used chemical
- glyphosate is an approved herbicide for specific weed species
- there are examples of inappropriate chemical selection and application methodology, due to incorrect technical knowledge, for example, mix ratios have been reduced to address perceived toxicity risks but has resulted in ineffective control and more frequent application.

A more detailed evaluation of the public health and environmental effects of each weed management control options is provided in the attachments attachment to this briefing paper.

Weed Management Options – Cost Comparison

The table below provides a comparison of the difference in current methods of weed control and a summary of current legacy practices.

Taking into account the frequency of applications, efficacy and resources required to achieve weed control, chemical control is the most cost effective option.

Table 1 – Weed Management Options - cost comparison

Weed control type		Km of network	$/km/yr	Annual application frequency	Comment
Chemical (glyphosate-based)	Road corridor (roadside and island gardens)	2169	$450	2-3 times	Current practice in South and West areas for the road corridor.
	Local parks		$480	3-4 times	Current practice in local and neighborhood parks
Bio-chemical		1049	$950	5-6 times	Current practice in the Central area for road corridor. Cost includes 1 supplementary chemical application to achieve level of service
Hot water steam		735	$1,200	6-8 times	Current practice in the North area for road corridor. Cost includes 1 supplementary mechanical or chemical application for hard to kill weeds.
Mechanical		Variable	Variable between $2,040 and $11,500	Variable between 12 and 50 times	Current practice in premier and high profile parks Cost variation is dependent on frequency of control
Manual		Variable		Variable	Not suited to edging as disturbed soil may exacerbate weed growth
Biological		-	-	Once-off establishment cost of a population of a suitable control agent	Not suited to edging.

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Implementation of the Weed Management Policy

The proposed use of chemical around hard surfaces and infrastructure in Local Parks is consistent some of the objectives of Auckland Council's Weed Management Policy (2013) which promotes an integrated approach to the control of weeds and vegetation for parks and open spaces, including the road corridor, and the use of methods that have the least potential for adverse effects.

The proposed approach is to apply a baseline level of service regionally (i.e. using chemical control) and provide the opportunity for Local Boards and communities to tailor practice and fund different levels of service based on local priorities.

Current weed management practices in parks and open spaces, including in the road corridor (such as roundabout gardens) still primarily reflect legacy council decisions. This has resulted in an inconsistency of approach across the region, which is to be addressed through the implementation of the Auckland Council Weed Management Policy (2013).

A cross-Council (including the Council Controlled organisations) weed management working group was established in late 2014 to implement the Weed Management Policy. This includes weed management on all council owned and managed lands but excludes methodologies to control algae and fungi. The weed management working group objectives are to:

- complete an operational review of existing weed practices;
- evaluate different options;
- identify best practice control methodologies for all weed species managed by Council (over 200 species)
- develop an implementation plan.

As at 14 April 2015 the operational review has been completed and best practice control methodologies have been identified. Next steps include a peer review of these methodologies, engagement to inform stakeholders of recommended changes and implementation planning including a political update workshop.

Other considerations

The Council Weed Management group has completed a review of all existing weed management practices. The key findings are listed as follows:

- Both cyclic- and outcome-based contracts are used by the Council family. The cyclic approach may result in over-management (i.e. work carried out based on agreed frequency requirements rather than based on agreed service levels).
- Contract specifications are demanding and can lead to increased chemical use and over application.
- For weed control on near hard surfaces, such edges and kerb and channels, chemical control costs are between 5% - 50% less than other methods (depending on the alternative methodologies and application frequency), and are more effective.
- In some situations, the method of application appears more the cause of community concern – for example, foliar spraying may not be acceptable but cut and paste is acceptable, even though the chemical involved may be the same.

To reach the current LTP levels of services for local, parks and reserves the method, frequency and costs per method are as detailed below. The primary methods used in parks and reserves are mechanical or chemical edging.

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Table 2: Cost comparison between mechanical and chemical edging in parks to achieve agreed Level of Service

Park type	Method	Control frequency per year	Average cost /m	Average annual cost / km
Premier parks and reserves	Mechanical edging	50	$0.23	$11,500.00
High profile parks	Mechanical edging	15	$0.16	$2400,00
High profile reserves	Mechanical edging	12	$0.17	$2040.00
Local and neighbourhood parks	Chemical edging	4	$0.12	$480.00

Additional information on weed management and the proposed unitary plan, glyphosate and carcinogens, human rights and some fact sheets on weed management methodologies are attached to this report.

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Attachment One – Background Information on Chemical Weed Management

Unitary Plan

The Proposed Auckland Unitary Plan (PAUP) allows agrichemical use in public places so long as it adheres to certain requirements, including the adherence to the products label requirements. It sets standards for the use of herbicides including the need to meet New Zealand standards such as those relating to signage, avoiding windy days, and certified operators etc.

Council relies on the Environmental Protection Agency (EPA) to approve the use of specific products as per their expertise and responsibilities. They guide the use of agrichemicals to implement industry best practice to ensure storage, mixing, use, disposal and certification of contractors. These controls are for everyone using agrichemicals.

The decision to use a agrichemical such as glyphosate, steam or any other weed treatment is an operational decision for Auckland Council and not specifically referenced in the PAUP.

Human Rights

The community group Weed Management Advisory commissioned a 'Human Rights Impact Assessment of Auckland Transport's Road Corridor Vegetation Control' and has presented this report to the Auckland Transport Board (December 2014, Auckland Council's Regional Strategy and Policy Committee (April 2015) and more recently to the Mayor (April 2015).

Auckland Transport is not aware of any evidence to suggest that the use of glyphosate for the purposes of vegetation control in the road corridor poses any risk to human health and is working on a response to the issues raised.

Glyphosate is used across the Council family to control a wide range of weeds. Auckland Transport use glyphosate in the road corridor, as it is also used by most if not all other Road Controlling Authorities in New Zealand, and Council use glyphosate in parks, catchments and other open spaces

It is readily available and widely used by the general public around the home and garden and it is widely used for agriculture, horticulture, viticulture and silviculture purposes (in products such as RoundUp, Chopper, Agpro Glyphosate 360, Jolyn G 360, Nufarm Glyphosate 360, Stunn and Weedmaster Green).

Glyphosate & Carcinogenicity Claims

Recently (March 2015) the International Agency for Research on Cancer (IARC) met to assess the carcinogenicity of four organophosphate pesticides and glyphosate. Based on some studies in animals the IARC Working Group has re-classified glyphosate as 'probably carcinogenic to humans'. This new classification is being debated internationally. There is significant technical evidence to counter the IARC carcinogenic classification and their report with the technical basis for their classification is not yet available.

In NZ, glyphosate is regulated under the Hazardous Substances and New Organisms Act (HSNO) Act 1996, administered by the Environmental Protection Authority (EPA). The Agricultural Compounds & Veterinary Medicines Act (ACVM Act 1997 also has reference in relation to impacts of herbicides to agricultural and stock.

The EPA have confirmed that they are aware of IARC's change of status on glyphosate, and once they have assessed the yet to be released IARC report, they will determine whether a re-assessment of this product, and associated safety data sheet (SDS), guidelines and controls of use is required. There is currently no defined timeline for this to be completed by the EPA who have advised that they will take a "measured" approach whilst monitoring the response from other similar agencies around the world.

Glyphosate is an approved herbicide for specific weed species. Neither the EPA nor MoH have expressed any urgent direction, amendment to procedures or concern about the use of glyphosate in NZ. The NZ Ministry of Health are aware of the new IARC classification of glyphosate but have not received any updates on this matter to date.

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Unless the EPA changes its classification, the use of glyphosate by competent personnel should continue, with application strictly following label requirements and correct application procedures.

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Attachment 2 – One-pager fact sheets for control options[2]

BIOLOGICAL CONTROL

Biological control (biocontrol) is the use of a weed's natural enemy to control it, by attacking different parts of the plant, including stem, leaves and roots. Agents are usually imported from the weed's natural habitat overseas.

Impacts to human health - carcinogenicity, toxicity
Impacts to human health are minor, as the agents used do not affect humans, and there are no agrichemicals (organic or otherwise) being applied.

Removing weeds from the environment can have a positive impact on human health, for instance reducing the allergic reactions to plants like privet and woolly nightshade or removing trip hazards, etc.

Impacts to applicator
Impacts to the applicator are minor, and involve the risks applicable to all control methods, including injury on site for control or monitoring.

Impacts to asset
Impacts to an asset with this method are minor. The potential impacts involve site visits for initial biological control release, and subsequent monitoring, in terms of people entering bush areas to carry this work out. However, this will not be frequent.

Impacts to environment (including global sustainability, carbon footprint)
Impacts to the environment are low. This method is very targeted at a particularly species, with host-specific control agents that will not impact on other species or the surrounding environment, such as the water supply or soil.

A rigorous process is followed to ensure host specificity to prevent the agent from having any adverse impact on non-target species and the environment, and itself become a pest species.

In terms of the carbon footprint, many biological control agents are imported from overseas, from a weed's natural habitat, so this contributes to the carbon footprint of this control method. There is a minor impact from the use of petrol to travel to control sites for release and monitoring purposes, though this is not frequent.

Site suitability
Site suitability for this method needs to be individually assed. Where a site is suitable, there is a low risk of disturbance or impact from other control (eg chemical spray), so the biological control agents can establish and thrive, and have an adverse impact on the weed.

This method can be suitable at sites where other methods are not, for instance less accessible locations, and sites alongside native bush, or commercial crops, which may be impacted by chemical control for instance.

Frequency of application per annum
This is species, and agent specific, and will depend on whether an agent establishes successfully. Ideally, there will only need to be one release, followed by monitoring.
In some instances, where an initial agent release does not establish and have the desired effect quickly enough, a supplementary release occurs.

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[2] These fact sheets are summaries only and do not represent all available information on each methodology.

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Cost
There is an initial cost to research, purchase and import a biocontrol agent, though biocontrol is cost effective in the long-term as ideally an agent will establish and breed at a control site, meaning you do not need to keep purchasing, or releasing them at that site, or using other control methods.

There are associated costs with monitoring, including labour and petrol to reach sites etc but these are minor costs as this method reduces the need for re-applications, or re-releases, and thus reduces the need for human control work.

This weed control method is usually cost efficient but is longer term. For example, biocontrol is the preferred control method for ragwort. The saving to New Zealand's 12,000 dairy farmers in not having to use herbicides to control ragwort is estimated to be approximately $12m per year nationally (Landcare Research paper, 2014[3]), and since the introduction of the smilax leaf rust in 2008, the smilax weed population has been decimated and therefore has not incurred cost to the Auckland Council.

Effectiveness
Biocontrol can be very effective when an agent establishes itself at a site. It is not an eradication tool, but is a viable alternative tool to control weeds, and is particularly good for widespread weeds, which are difficult and expensive to control by other methods.

It can also be used in conjunction with other methods at some sites, such as manual control.

Once established, a biocontrol agent follows the weed as it spreads and can return repeatedly to kill off new weed growth—all without adverse human input.

As well as success with ragwort, smilax and mistflower, recent releases in Auckland include a woolly nightshade lace bug and three agents for Tradescantia (wandering Jew), with a Tradescantia stem borer showing visible impact at a site in Patumahoe.

[3] Figure used is a national figure as no regional data or data on a per ha basis appears available

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CHEMICAL WEED CONTROL

Chemical weed control refers to the control of weeds by the application of agrichemicals (herbicides) with methods including foliar spray, stem injection and cut and paste.

Impacts to human health - carcinogenicity, toxicity
There are potential impacts on human health from chemical use, and particularly the application by spray, which can drift from the treatment site. These include producing skin and respiratory reactions in some people. There are also potential impacts on animals that come into contact with agrichemicals, producing skin or respiratory symptoms and insects like bees can also be affected by some products.

Indirectly, human and animal health can be impacted by any chemical impact on a water supply.

Recent assessment of existing research by the International Agency for Research on Cancer (IARC) has linked the commonly used herbicide glyphosate to cancer, particularly Non-Hodgkin lymphoma, and classified it as a category 2A carcinogen (please note that this classification is being challenged by numerous parties and NZ's EPA have not changed its position).

Diesel and petrol engine exhaust from machinery used in some control types are category1 and 2B carcinogens respectively.

Removing weeds from the environment can also have a positive impact on human health, for instance reducing the allergic reactions to plants like privet and woolly nightshade or removing trip hazards, etc.

Impacts to applicator
Like the wider public and surrounding properties, applicators are susceptible to chemical spray and potential respiratory or skin reactions if they come into contact with the product, or accidentally ingest any.

Unlike spray drift, other chemical application methods like cut and paste and stem injection do not have an impact on the wider population, but applicators are at risk from these methods. They have direct contact with the herbicides being applied by cut and paste or injection, either at concentrated or diluted levels, which could have impacts on the respiratory systems, skin or eyes.

Correct use of PPE mitigates impacts to the applicator.

Impacts to asset
Agrichemical use can have a negative short-term impact on aesthetics, with spray leaving areas looking brown and dead before the weeds decompose and are replaced with vegetation.

There can also be non-target species death (eg native species, grass), leaving areas unattractive and needing to be replanted.

Long-term, weed removal improves an asset environmentally by allowing native species to regenerate and biodiversity to improve, and aesthetically, through control of overgrown, weedy areas. This improves both the look, and safety of a site.

Like all other methods, agrichemical control impacts on an asset due to the 'wear and tear' of an operator and equipment (eg vehicles) being on site.

Impacts to environment (including global sustainability, carbon footprint)
The impact in terms of a carbon footprint is low, as agrichemical control is a more efficient use of labour and equipment than some other methods, including hot water and manual control.

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There can be an impact on the environment from people accessing bush areas to do weed control, and doing so multiple times for follow up checks or treatment, with the potential for habitat disturbance, or plant trampling.

Chemical products are synthetic. The only natural resource used is water for the dilution of chemicals for application, and this is a lower amount than what is needed for hot water/steam treatment of weeds.

There can be an impact on the environment in terms of non-target species affected, and an impact on water quality if some agrichemical products get into the water supply. Some chemicals are toxic to aquatic organisms and contamination of waterways should be avoided. Some herbicides also have more of a lifespan in the soil than others.

As with all other methods of weed control, there is also the environmental cost of petrol and vehicles on the road travelling to sites.

If the product is being sprayed, the effects of wind drift may cause serious damage to non-target species.

Weed control has many benefits to the environment, including regeneration of native species and enhanced biodiversity including in waterways cleared of aquatic weeds.

Site suitability
A site must be safely accessible by foot or vehicle or if not, must be safely accessible, and suitable for another method of control (eg aerial spray).

For sites to be suitable for spray applications, the surrounding environment must be taken into account, including households and water supplies, with care taken to spray in optimum conditions to reduce the impact on surrounding areas and communication made with affected people, including those on the No-Spray Register.

If a site is only accessible by abseilers for instance (eg a cliff face), this needs to be done by highly trained, professional contractors. Some sites have erosion potential if a weed is removed roots and all which needs to be taken into account when planning weed control.

Frequency of application per annum
This is site and species specific, though if chemical control is done properly, it requires less follow up control that other methods. For instance, roadside weed control using the agrichemical glyphosate requires two to three applications a year, compared to eight for hot water treatment, and six for organic or plant based herbicide.

Cost
Agrichemical control has costs in terms of labour, training, certification for the operators (eg Growsafe, handling certificates), equipment, (including petrol for vehicles) the agrichemical product itself and water for dilution. However, this method is less labour intensive and fewer follow up visits are required for control.

In Auckland, 2169km of roadsides are treated with this method (west and south) and to achieve the required level of service, it costs $975 per kilometre per year in total. This cost includes agrichemical product, equipment and operator cost and inspection costs, even if no weed control is done. In an urban environment, glyphosate is applied two-three times per year at an average cost of $450/km/annum.

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Any non-target species death due to chemical control, eg grass can lead to other weeds emerging that were being supressed, so there can be an added cost needed to control these weeds and/or to replant grass.

High or increased use of herbicide also has a non-monetary cost in terms of the perception of Auckland Council.

Effectiveness
Agrichemical control can be very effective, if done correctly, and site and species are chosen appropriately. Agrichemical control is more likely to kill the weed completely, rather than just defoliate the plant like other methods and effective control reduces the need for follow up treatment.

Some plants however suffer only a 'knock down' effect from herbicides like glyphosate, eg nutgrass.

Successful control and re-vegetation of a site can also reduce herbicide use over time.

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HOT WATER

The 'hot water' method is the treatment of weeds by the application of high pressure steam. Equipment involved is a truck with a hot water unit on the back, with a driver and an applicator on foot.

Impacts to human health (carcinogenicity, toxicity).
The risk to human health from the product is low with this method. There is the potential impact from any fumes from fuel used to power the truck and equipment.

Diesel and petrol engine exhaust from machinery used in many control types are category1 and 2B carcinogens respectively.

Removing weeds from the environment can also have a positive impact on human health, for instance reducing the allergic reactions to plants like privet and woolly nightshade or removing trip hazards, etc.

Impacts to applicator
The potential impacts on the applicator from this method include steam burn, or other injury caused by the equipment. There are also associated risks with working on roadsides with nearby traffic, and the operators are exposed to any fuel fumes from the truck and equipment and other vehicles in the area.

Impacts to asset
There is no harm to the asset from the product itself, however there can be a temporary negative aesthetic impact, with weeds treated by steam defoliating and browning off before they decompose.

Like all other methods, hot water control impacts on an asset due to the 'wear and tear' of an operator and equipment (eg vehicles) being on site multiple times a year.

Long-term, there is improvement to the asset aesthetically once weeds decompose and disappear and this method can reach and treat weeds growing in areas that other methods cannot (eg pavement cracks), thus improving the look of an asset.

Weed removal also avoids the risk of stormwater drains and kerbside drains becoming blocked and flooding, or pavements becoming cracked, or uneven.

Weed removal can also improve an asset environmentally, as re-vegetation with more desired species can occur, enhancing biodiversity.

Impacts to environment (including global sustainability, carbon footprint)
The risks to the surrounding environment are very low as the product is natural and the control is targeted.

Control achieves a knock-down effect rather that death of the plant (burns the top of weeds with the rest of the plant still viable albeit disrupted).

The impacts are more significant around carbon footprints and global sustainability, with a significant volume of water required for each operation, and multiple visits needed over a year. There is also the fuel needed to operate the truck and steam machine.

Weed control has many benefits to the environment, including regeneration of native species and enhanced biodiversity including in waterways cleared of aquatic weeds.

Site suitability

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A site needs to be accessible and safe for the equipment, driver, and applicator. Many sites are not suitable for this method, which is most often used on roadsides.

Frequency of application per annum
Multiple visits are needed to control regrowth, with up to eight visits a year needed to meet the current level of service required on roadsides.

Cost
This method is labour intensive, as it requires a lot of resources and is time consuming. A longer, more intensive application is required on the weeds to achieve sufficient die back than there would be with agrichemical treatment. The machine also needs to be refilled multiple times during an operation and multiple visits per year are required to control weeds. There is also the cost of water and the fuel needed to run the truck and steam machine.

In Auckland, 735km of roadsides (north) are treated with this method, and to achieve the required level of service, it costs an average $1,200 per kilometre per year. This cost includes water, equipment and operator cost and inspection costs, even if no weed control is done. It also includes additional mechanical or glyphosate control for hard to kills weeds following steam treatment.

Effectiveness
This method can be less effective than some others, as it does not kill or remove a weed's root structure as an agrichemical or manual control can do. Steam treatment defoliates the weed, which will then decompose and it requires follow up treatments to control regrowth.

There are also some species of weed that this method does not successfully control (eg nutgrass and kikuyu), which need mechanical or agrichemical follow up.

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MECHANICAL WEED CONTROL

Mechanical weed control is weed control done by mechanical methods such as mowing, weed eating, edge trimming, slashing, felling and frequent grading of unsealed roads. It is often done for amenity purposes in parks such as trimming grass or garden edges or keeping drainage ditches clear.

Impacts to human health - carcinogenicity, toxicity
The impacts on human health from this method are low when mechanical control is done well, and weed material is properly disposed of.

Diesel and engine exhaust from machinery used in many control types are category1 and 2B carcinogens respectively.

Removing weeds from the environment can also have a positive impact on human health, for instance reducing the allergic reactions to plants like privet and woolly nightshade or removing trip hazards, etc.

Impacts to applicator
Risks to the applicator of mechanical control include injury from equipment, injury due to an unsafe, unsuitable site being chosen for this method, felling large trees or plants in an unsafe way, injury from tripping over weeds, being injured by a plant spike or branch, respiratory reactions to plant pollens or seeds, or skin reactions from species like moth plant, which produces a sticky sap that can irritate skin.

Impacts to asset
Like all other methods, mechanical control impacts on an asset due to the 'wear and tear' of an operator and equipment being on site, and this is slightly higher with mechanical control as more visits are required. Some methods of mechanical control present risks to other assets from projectiles arising from the control method (e.g. stones being flicked by weed-eaters).

Mechanical control is often done for amenity purposes, to tidy edges of pathways or gardens, or keep drains clear, improving an asset both aesthetically and increasing its lifespan, by reducing the chance of damage from overgrown weeds.

Long-term, weed removal also improves an asset (eg a park or reserve) environmentally by allowing native species to regenerate and biodiversity to improve,

Impacts to environment (including global sustainability, carbon footprint)
With mechanical control there is an impact in the sustainability and carbon footprint space with the use of fuel to power the mechanical tools needed for this work, as well as petrol to transport staff and equipment to sites. This fuel use also happens multiple times a year, with the minimum number of visits for park edging work being 12 times per year for "local and neighbourhood" parks, with "premier parks and reserves" being maintained 50 times per year.

Site suitability
The site needs to be accessible and safe for mechanical control to be carried out and for this control to be effective.

Frequency of application per annum
The frequency of follow ups is site specific, but to meet the required levels of service mechanical edging must be undertaken a minimum of 12 times annually for "local and neighbourhood parks", and more for "premier parks and reserves," where control is done 50 times per year. Chemical edging is done only four times a year as it is a longer lasting treatment.

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Flail mowing of swale drains four times per year reduces weed densities and keeps open drains looking tidier than exposed. However, flail mowing twice per year is not an effective or efficient option.

Cost
Costs include hiring skilled contractors or staff, cost of any equipment, cost of petrol, and the costs of multiple visits which are needed with this method, to deal with resprouting weed.

This is a cost both in staff time, and a shorter equipment lifespan, with high usage.

Mechanical edging is more expensive than chemical control, and needs to be done more frequently.

Effectiveness
Mechanical control is effective in an amenity weed control sense in particular, but does not kill the weed to its root as herbicides aim to do, or remove it completely, as manual methods aim to do.

Mechanical methods such as mowing or weed eating cut or shred the above ground part of the weed and can prevent and reduce seed populations as well as restrict the growth of weeds by reducing biomass thus reducing a weed's vigour.

Mechanical control is most effective when it is timed well, eg before a plant can set seed. However, weeds can resprout from stem and root fragments, so this method is one that needs to be undertaken repeatedly.

An advantage of mechanical control is that soil is not left exposed or disturbed which in turn assists in preventing soil erosion.

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BIOCHEMICAL WEED CONTROL

Biochemical weed control refers to the control of weeds by the application of plant derived herbicides (commercial products include Agpro Biosafe, Organic Weedkiller Rapid or Hitman). The active ingredients are plant derived fatty acids like palm and coconut oil, or acetic acid. This method of control is also called organic or natural control.

Impacts to human health - carcinogenicity, toxicity
These products have high fatty acidic levels and can impact on human health if it comes into contact with skin and eyes.

Coconut oil acid (diethanolamide condensate) is a category 2B carcinogen.

Diesel and petrol engine exhaust from machinery used are category1 and 2B carcinogens respectively.

Removing weeds from the environment can also have a positive impact on human health, for instance reducing the allergic reactions to plants like privet and woolly nightshade or removing trip hazards, etc.

Impacts to applicator
Impacts to the applicator include potential respiratory, and eye or skin burns and reactions if they come into contact with the product, or accidentally ingest any.

As with all methods there is also the risk of injury from equipment or working on an unsuitable site.

Impacts to asset
The high acidity levels of some of these products can be corrosive, and there is potential impact on an asset due to this corrosion, including corrosion of surfaces, or equipment.

These products can be non-selective, which makes them useful on a range of plants, but also brings the risk of non-target species control.

Long-term, weed removal improves an asset environmentally by allowing native species to regenerate and biodiversity to improve, and aesthetically, through control of overgrown, weedy areas. This improves both the look, and safety of a site.

Like all other methods, agrichemical control impacts on an asset due to the 'wear and tear' of an operator and equipment (eg vehicles) being on site.

Impacts to environment (including global sustainability, carbon footprint)
There can be an impact on the environment from people accessing bush areas to do weed control, and doing so multiple times for follow up checks or treatment, with the potential for habitat disturbance, or plant trampling.

These products can be non-selective, which makes them useful on a range of plants, but also brings the risk of non-target species death. While this method can control a range of species, it is not fully effective on some common species and as a result, often requires one supplementary application of glyphosate per year. On harder to kill species, a second application after 3-4 days will assist control.

There is low soil residual activity. Many products are toxic to aquatic organisms and contamination of waterways should be avoided.

As with other chemical control, is the product is being sprayed, the effects of wind drift may cause serious damage to non-target species.

Response one

In terms of sustainability, palm and coconut oil is not considered a sustainable product due to the deforestation of tropical areas and destruction of ecosystems that occurs to produce the product.

Some of these products are acidic and can be corrosive, and more investigation is needed into the impact of any run-off from these natural herbicide products.

Weed control has many benefits to the environment, including regeneration of native species and enhanced biodiversity including in waterways cleared of aquatic weeds

Site suitability
A site needs to be safely accessible for this method of control for operator and equipment. If a site is only accessible by abseilers for instance (eg a cliff face), this needs to be done by highly trained, professional contractors. Some sites have erosion potential if a weed is removed roots and all which needs to be taken into account when planning weed control.

Frequency of application per annum
Treatment is carried out quickly, with the applicator able to stay in the vehicle for much of the work; however multiple visits are needed to control regrowth. Up to six visits a year are needed to meet the current level of service required on roadsides.

Cost
Costs include labour, equipment and product. The costs can be quite high with this method as it requires multiple visits and the treatment is not long-lasting.

There is an added cost to replacing equipment more frequently as some natural herbicides can be acidic and corrosive and cause substantial wear and tear to equipment.

In Auckland, 1049km of roadsides (central) are treated with this method and to achieve the required level of service, it costs an average of $950 per kilometre per year. This cost includes natural agrichemical product, equipment and operator cost and inspection costs, even if no weed control is done. It also includes any supplementary chemical follow up that is needed to achieve the level of service required.

While these products might be looked on as a good alternative to agrichemicals like glyphosate, there is the potential non-monetary cost in terms of reputation damage, if council began to use palm-oil based products on a large scale, particularly due to the council-owned Auckland Zoo's campaign to buy palm-oil free products.

Effectiveness
Weeds usually break down quickly after application of a biochemical in the right conditions but because these products kill only the green parts of the plant they contact (defoliation) rather than root systems, tubers or bulbs, they are not as effective as some other methods of control. Many treated weeds regrow and need multiple follow up treatments.

Like hot water treatment, Biosafe for instance is not effective on nutgrass or kikuyu, and another follow up method is needed for this weed.

Response one

NO CONTROL

This method is the decision to undertake no weed control (either for a period of time, or indefinitely) in a particular area, for various reasons including effectiveness, the site being inaccessible, removal of the weed being dangerous (eg increasing erosion risk) or the weed being assessed as having low impact on a site, with control potentially being more harmful or disruptive to the area.

However, for some species, in some confined environments, no control can be recommended best practice as the presence of the weed species provides a habitat for indigenous species to establish, and in time, these eventually dominate and suffocate the weed species. For example, in some confined rural environments, no control of blackberry may be recommended over mechanical, chemical or other control methods.

Impacts to human health - carcinogenicity, toxicity
The impact to human health is low in terms of product impact, as there is no product being applied.

However, the impact from the weeds themselves may be higher if they are weeds that have impacts on human health, eg privet perfume or moth plant sap. Lack of control also increases the physical hazards a weed presents, including sharp branches, trip hazards, etc

The 'no control' method also brings with it the risk of volunteers, community groups or park neighbours carrying out the work themselves if they feel it needs doing. While many of these people have some knowledge of weed control, they will likely lack the required knowledge around different products and safety guidelines and regulations, and may not have the correct equipment or product. This increases the risk to them, and to others.

If lack of weed control reduces the recreational appeal of a site, this can have an impact on human physical and mental health, for instance if people are unable to use a space for normal recreational or fitness activities due to weeds.

Impacts to applicator
The impact is nil on an applicator (eg a council staff member of contractor) where no control work is being carried out.

There is also the potential impact on an untrained volunteer, community group member or park neighbour who undertakes work they feel needs doing, without permission or guidance. This includes injury from equipment, injury on site, or reactions to agrichemical products (organic or otherwise) they are using on their respiratory system, skin and eyes. In extreme cases, these people can also face trespass.

Impacts to asset
The impacts of no control on an asset can be great, including reduced aesthetic appeal, damage, eg to footpaths, bridges, drains (including blockages causing flooding) and other infrastructure and there is also a recreational impact, with reduced enjoyment from park visitors due to weeds.

Impacts to environment (including global sustainability, carbon footprint)
The impact of no control can be great but hard to quantify. If a weed gets out of control due to lack of control work it can outcompete other plant species, cause illness/injury (eg through privet perfume, moth plant sap, being a trip hazard, blocking sight lines), destroy habitat for native birds, animals and insects, destroy cultural sites, invade waterbodies and block drains, causing flooding.

It may also increase the need for one-off control operations on a complaint basis for instance, meaning inefficient and unsustainable use of vehicles, equipment, product and manpower, which increases the carbon footprint.

Response one

Site suitability
Sites for 'no control' should be chosen carefully, and assessed in terms of potential costs to asset or environmental damage resulting from no control and costs for any future control, if needed.

Frequency of application per annum
This varies with this method, as any control would be on an ad hoc basis, on complaints or request for service, for instance.

Where no-control is the preferred option (e.g. blackberry in some settings), the control timeframe is likely to be 8 years or more.

Cost
There is no cost for weed control itself (eg product, labour), if there is no control being carried out.

There are potential costs but any potential costs are hard to quantify. No weed control brings the potential costs of repairs or replacement of assets due to weed damage, potential costs in terms of lost recreation opportunities (so cost to mental and physical health, and potentially dollars as people/clubs use different areas for their events).

There is a potential cost to relationships that council has with volunteers and community groups that feel council has given up on a site, or left it for others to do, particularly if a group has been doing work there and is invested in it.

There is also a potential cost to in terms of the perception of Auckland Council from the general public. For instance, if the council are not controlling their weeds, why are they asking me to control mine?

Any decision to not control weeds at a particular site also risks future costs for one-off inspections or control operations, due to complaints or request for service, which is less efficient, and a potentially higher cost for weed control if it eventually is needed somewhere, due to the site being bigger.

Effectiveness
This method is hard to measure or predict in terms of effectiveness, or lack thereof as this would depend on why no control was undertaken.

If no control is being undertaken for a defined period of time, while the area is being planted with native species for instance, this may be an effective use of 'no control', as it can make future control easier as the weed habitat has been reduced.