

Direct Seeding Machine Operating Manual and Seed Treatment Guidelines



SOUTHCOAST
NATURAL RESOURCE MANAGEMENT



Australian Government

Acknowledgements

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This operating manual was updated in 2022 to aid with use of the machine by landholders through the Carbon + Biodiversity Round 2 trial.

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Introduction

Direct seeding is one of the tools South Coast Natural Resource Management Inc teams and project partners use to carry out revegetation projects. Direct seeding is a term used to describe a planting process that uses seed for the establishment of in this case native plant species in a prepared ground. Direct seeding can be a cost-effective way of caring out landscape rehabilitation projects through revegetation of native species. Integrated revegetation using tube stock seedlings and seed can have multiple benefits such as difficult to grow species in the nursery may lend to better success with seed improving biodiversity plantings. Tube stock species that grow easily in the nursery but are expensive can be afforded with cost savings from seed sown species. In addition an integrated planting can improve the success of a revegetation project by minimising or spreading the risk of low plant establishment.

This manual will explain how to use the direct seeder machine, how to calibrate the machine, how to treat (activate native seed) and bulk up seed in preparation for sowing.

Figure 1 Picture of seeding machine with parts labelled

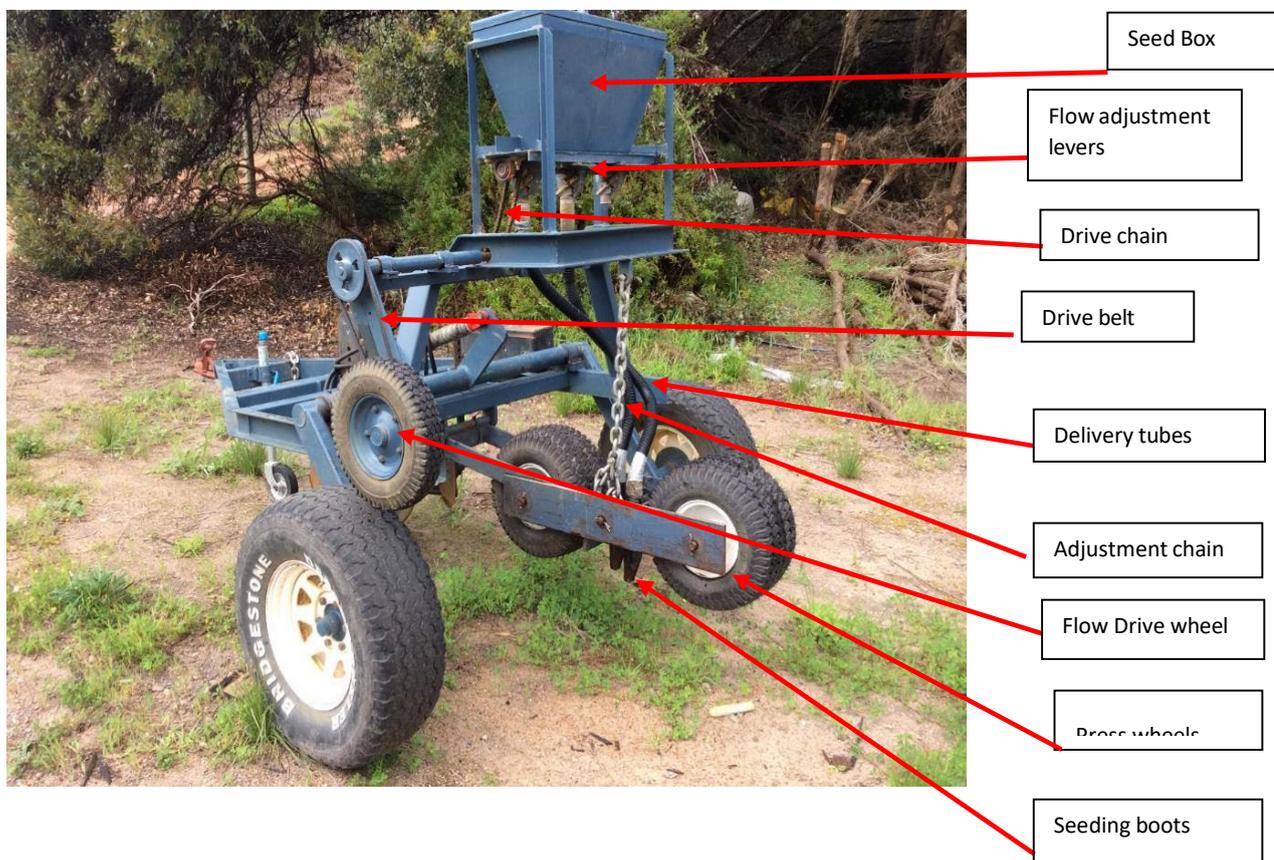
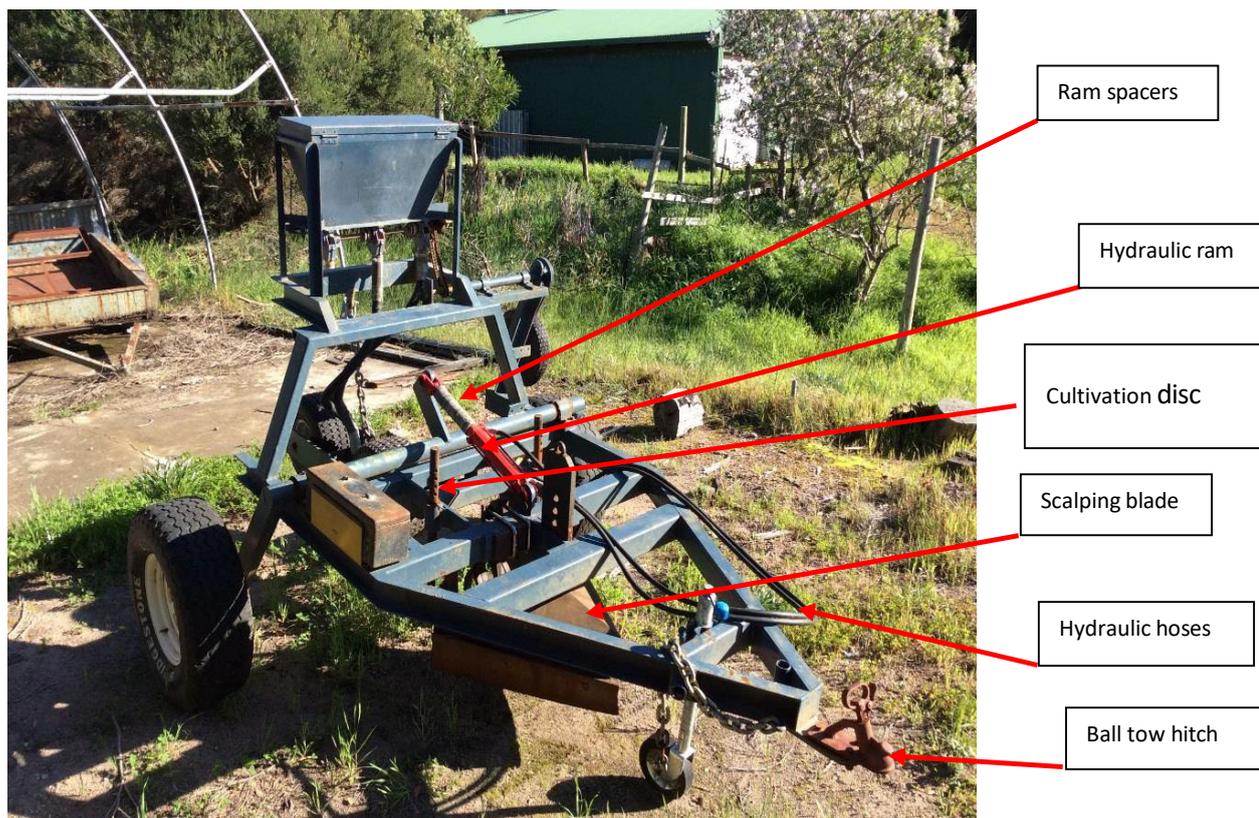


Figure 2 Forward view of the direct seeder machine



Moving machine between properties

It is permissible to tow the machine on the main road with a flashing amber light in daylight hours only. If towing the machine on the road ensure, all adjustable parts are secure and there is adequate clearance from the road. Ensure the hydraulic ram spacers are all inserted and the ram is rested on the spacers so there is no chance of downward movement in the hydraulic ram. The speed limit is 100km/hr, but 80-90km/hr is probably more suitable for this machine.

Ensure the bolt on ball hitch attachment is securely bolted on to the tongue of the hitch when towing with a standard vehicle tow ball. (Remove this to hitch to tractor with pin).

General Maintenance and Pre Start Checks

1. Grease all grease points (5 in total)

Figure 3 Grease points



2. Check the seed flow adjustment levers and the little round washers that hold bit around the shaft together. (The rivets keep failing and are probably loose)

Figure 4 Check washers



Washer needs checking and re-fixing if separated

3. Check bearings on cultivation discs for movement, they wear out, particularly on heavy dirt and check the disc arms for bends.
4. Clean seed boxes and the entire route the seed follows to the seeding boot.
5. Apply chain lube to drive chain
6. Check pulley belt for wear

Job Safety Assessment (JSA)

Ensure you have read the JSA associated with the operation of this machine. (Appendix 3)

Seed Treatment

Hot Water Treatment:

Equipment required – Fine mesh colander/strainer, Large pot (10L), newspaper, smooth cotton sheets, gas burner/stove.

1. Bring water to the boil.
2. Put seed into a wire mesh strainer and dunk into boiling water for 10 seconds. Agitate seed with a spoon so water penetrates the entire batch

Figure 5 Boil method



3. Remove from hot water and run under cool water for 10 seconds

Figure 6 Cool seed down



4. For tough seeds, where recommended, repeat steps 2 & 3 – otherwise go straight to step 5
5. Strain well then tip seed onto the sheet and spread out for drying, ensuring each species is labelled. Put newspaper under sheets before loading up with seed to absorb water. Best in a sunny spot out of the wind to dry. (Make sure seed batches are labelled)

Figure 7 Dry seed



6. Turn seed every hour or so to assist drying process.
7. When dry, put into calico bags making sure each bag is labelled. Do not use plastic bags as the seed may sweat and go mouldy.
- 8.

Smoke Treatment:

Equipment required – An enclosed vessel that can hold smoke and has capacity to hold a few trays of seed, flexible ducting, fire grate, non-flammable hood to go over fire (the flexible ducting is attached to the top of the hood to transfer the smoke to the smoking vessel), trays for laying seed out on (preferably with a bottom that smoke can permeate, eg cloth or wire mesh), green pruning's off native vegetation for making smoke, water on hand, work bench of some description, storage bins if batching the seed with spongelite and vermiculite for storage.

1. Light fire and generate a good reserve of coals. Allow to cool somewhat so when green material is added, it generates a lot of smoke, but does not burst into flames.

Figure 8 Set up smoking



2. Lay seed out on trays and then stack in the smoking vessel.

Figure 9 Stack trays with seed



3. Add native green material to the coals and put hood over the fire to funnel smoke into the smoking vessel via the flexible ducting. Make sure the fire can still breathe or it will smother.

Figure 10 Stack trays in smoking drum



4. Smoke each batch for at least 10 minutes

Figure 11 Smoke seed for 10 minutes



5. Remove and either re-bag into calico bags or mix in bins with vermiculite or vermiculite/spongelite at about 10kg seed to 40-50L of vermiculite/spongelite mix.

Figure 12 Seed storage for transport



Storage:

Mix treated seed with vermiculite and spongelite, approx. 10kg seed to 30-50L vermiculite/spongelite mix. Store in plastic bins during the project. Make up final batches with other ingredients a day or two before seeding it. The seed should keep in good condition mixed for at least 6-8 weeks. (Do not completely seal lids if in bins with rubber seals. Plastic bins with clip on lids are ok as they are not air tight.)

Figure 13 Bulking up seed



Machine Calibration

The rate the seed mix feeds out at is set by adjusting the feed regulator levers below the seed boxes. Moving the lever to the right exposes more of the cog and draws more mix through resulting in a higher feed rate.

I have found that the shallow seed mix (mostly fine seed) flowed nicely at around 8L/2.86km travelled (which in my case equated to 1Ha, 3.5m row spacing). (Around the first notch or a bit before)

The seed mix in the course seed box flowed well at about 11L/2.86km. This box needed to be open more to prevent blockages from the large *Banksia* and *Hakea* seeds. If these very large seeds are not in the mix, lower the feed rate. This is not an exact science so don't be too hung up about feed rates. The important thing is that it flows well and you know how much is going out. (Just a bit past the first notch will put the feed rate in the range of 11L/2.86km)

To calibrate the machine you will need about 5L of each of the mixes you have prepared, a clear plastic bag (so you can observe flow) for each seed box you will be calibrating and something to tie the bag onto the outlet spouts under the seed boxes, then follow the instructions below:

- Disconnect the hoses from the seed box outlets and cable tie out of the way or remove altogether.
- Tie bags capable of collecting 2-5L of material to the seed box outlets making sure the material can flow through into the bottom of the bag without obstruction
- Decide which box you will be using for each seeding depth and put the nominated mix into the allocated seed boxes.
- Set the feed regulator levers a bit before the first notch for shallow and a bit after for deeper for starters
- Use a GPS or vehicle odometer to measure 500m and mark the start and finish.
- Engage the drive wheel of the seeding machine at the start of the 500m run and travel to the end point.
- Have someone follow the machine to ensure there is an even flow from the outlets. This can be observed through the clear plastic bags. If there are hang ups or difficulty with flow, increase the flow rate before starting the next run.
- Empty the contents of each bag into a measuring jug and record the volume of mix put out from each seed box.
- Open or close feed regulator levers to increase or decrease flow rates.
- Repeat the exercise a few times to fine tune the calibration and obtain settings that suit the mix you have.
- When you are happy with the flow rate you can plug this number into the calculations below when batching the seed mix to get the desired kg/ha of seed.

Note** Check flow rate from machine every 1km or so to ground truth the flow rate. You may need to adjust the lever a little bit up or down to keep the kg/ha on track. Ground truth every Ha to ensure your rate of seed/Ha matches what you have stipulated all the way through the seeding program. This is easy if you put 1Ha worth of seed in the box each time you load up, then run out the equivalent km's to seed 1Ha before re-loading. This way every Ha is seeded with the correct amount of seed.

Seed Batching

- To calculate the actual feed rate of pure seed in kg/ha, you will need to calculate the weight of seed /litre of mix in all of your seed bins. $\text{Kg/L} = \text{weight of seed (kg)}/\text{Total volume (L)}$

Eg. Bin 1 = 10kg seed in a total volume of 50L of vermiculite/spongelite mix, ie 0.2kg/L.

- To ascertain how much mix from each bin needs to go into the final batch, decide on a batch size, say half a days seeding = 4ha. Work out what percentage this is of the total program. Eg. If the total program is 40ha, then $4/40 = 10\%$ of the seed.
- Calculate the volume of mix from each bin that needs to go into the 4ha batch, eg from the Bin 1 example above, it will be 10% of 50L = 5L. Repeat for all bins
- Next calculate the total volume of seed mix from all bins in the 4ha batch. At a seed rate of 1kg/ha, the total seed present in the mix should add up to 4kg. Now split the shallow seeded mixes from the deep and work out the total volumes each so you know how much goes in each of the seed boxes.
- Use the row spacing table in **Appendix 1** to work out how many km the machine needs to travel to seed 1ha, eg, row spacing of 3m = 3.33km. From previous experience we know that about 9L/2.86km flows well for shallow and 11L/2.86km flows well for deep. Therefore, we are chasing a total of $3.33/2.86 \times 9 \times 4 = 41.6\text{L}$ for the shallow mix and 51.2L for the deep mix. These mixes are determined by adding the chosen ingredients of bentonite clay, wetting agent, fertiliser, etc. in the recommended amounts (see **Appendix 2**) and then bulking the mix up with vermiculite and spongelite to bring it up to the desired volumes.

Setting Up the Machine for Seeding

Before commencing seeding the machine needs to be set up for each individual job as the set-up will change with different soil types and different tractors (mainly adjustment to draw bar height). There are two things that need to be adjusted, the depth of the scalping blade and the depth and alignment of the ripping tyne.

Tractor

The machine is light weight and can be easily pulled by a small 50hp tractor. A small tractor (under 100hp) is recommended for both manoeuvrability and to prevent damaging the machine, although, a tractors up to 140hp have been used with no issues. The height of the hitch may be an issue on some tractors. Usually it can be lowered if turned upside down. There is a spacer in the tool box to place between the two tongues on the tractor draw bar (sleaved over the pin) to stop the machine hitch moving up and down

Setting Scalp/Ripper Profile and Depth

On sand there are benefits to having a slightly “V” shaped scalp profile for concentrating water in the centre of the scalp where the seed is placed. To achieve this:

1. Hitch the machine to the tractor and plug in hydraulics
2. Adjust angle of machine to sit so the leading edge of the scalper is approximately 10-20mm lower than the back. This will produce a slightly “V” shaped scalp profile. This adjustment is made by lowering or raising the draw bar height or using spacers to set the height of the front of the machine.

Figure 14 Spacers



Spacers can be used for final height adjustment. Fine adjustment can be made by playing around with different width spacers to get the working height of the machine exactly where you want it.

3. Adjust the depth of the scalp by raising or lowering the scalping blade. The height should be set so the blade just skims a few cm off without leaving big amounts of spoil. This adjustment can be made using the hydraulics to take the weight off the pin that sets the scalping blade height, remove pin and re-set to desired height.

Figure 15 Adjust depth of scalp



4. Depth in the middle of the scalp will be about 30mm below natural ground level and about 10mm below at the edge. Further adjustment can be made by inserting the spacers around the hydraulic ram on the machine.

5. Adjust ripper position and depth. A good depth for the ripper in sand is about 150- 200mm below the depth of the scalp. The ripper should be positioned in the middle of the scalp. Check the ripper boot is firmly attached. If on clay or tight soils, the ripper may lift the machine off the ground. If this happens you may need to do one of the following

Figure 16 U Bolt and plate setup



U Bolt and plate set up to attach ripper. Use the flat plate with no holes at the back. The flat plate with channel against the square tube and the flat plate with holes outside on the same side as the plate with channel.

1. Set ripper to shallower depth so it is not lifting too much and make one pass with no seed. On the second pass remove the ripper and run the seed through the machine on the same line still using the scalping blade and mounding/cultivation discs.
2. Seed without ripping, just utilising the scalp and cultivation discs. (not as good as option (6))

The ripper is attached to the square tube in behind the scalper and next to the hydraulic ram attachment point with U bolts. The spacing plates need to be inserted to fix it in position.

Setting Mounding/Cultivation Discs

Set the discs so they are about 3-5cm below the bottom of the scalping blade. Run the machine for about twenty metres and see if they are pulling up too much soil to flow evenly through the gap between the discs. If it is blocking up, raise one hole. In soil with a higher clay component, it may be difficult to get the soil to flow between the discs with the ripper in place. It may keep binding up which is no good. If, after adjusting a few times, it will not flow without blocking up, it may be easier to do two passes. The first with the scalp and ripper (no discs), the second with scalp, discs and seeder operating, (no ripper).

You will still have to play around with the best disc height to get a nice amount of cultivation, but no blockages.

Figure 17 Transport position cultivating discs



The discs are pictured in the transport position (Fully raised). Simply remove the bolts and set to desired cultivation depth

Setting Depth of Seeding Outlets

Generally two seeding depths will suffice. Seek advice as to the depths each species should be seeded at. Either deep or shallow and what depths these should be. In general terms, the bigger banksia and hakea seeds can be sown at about 8-12mm and the small shallow seeded species at about 6mm. Follow directions below to set the depths on the outlet boots:

1. Sit the press wheels on a straight edge so the depth of the seeding boots can be gauged. Make sure the straight edge is straight so the reading is not compromised by the curve of the tyres.
2. Measure the distance the seeding boot sits below the edge of the straight edge. This will be the seeding depth. Ensure both seeding boots are set to the desired depth for the seed you are sowing. If it needs adjusting, loosen adjustment bolt and adjust by lowering or raising. Tighten everything up.

Floating Seeding Boots and Press Wheels

Adjust the chain so the press wheels float freely on top of the mound produced by the cultivation discs. You want a bit of slack, but not so much that the wheels can't lift free when the machine is raised. Adjust by repositioning

Things to Watch Out For When Operating the Machine

- Occasionally the delivery hoses may pull off the seeding boots when raising and lowering during turning at the end of rows.
- Hang ups at the bottom of the seed box above the cog are quite common, especially with bigger hakea and banksia seeds and the fluffy seeds, so watch the flow through the little window at the base of the seed box and check regularly.
- Sometimes the delivery tube may block up, particularly if you are using large flat seeds that can lodge across the rectangular hole at the top of the metal seed boot, check regularly.
- The washer holding the bit around the shaft where you adjust the flow rate comes loose. Can make a quick fix with a cable tie, but not ideal and makes it difficult to adjust thereafter.
- Guard against getting moisture in the seed boxes, delivery hoses and seeding boots as this will clog things up and mess up the flow rate. (Particularly if using bentonite clay as it sticks like s*** to a blanket). Cover seed boxes with a tarp at night to prevent moisture getting in.
- *Hakea pandanica* will cause blockages!! Either break the wings off the seed or don't use it.
- Roots get caught around the ripper and build up causing a cavity or trench which means the seeding depth will be poor. To get it off, raise the machine and reverse up, then lower and resume. If this doesn't work, you will have to get out and remove by hand..... Bugger! (Especially if it's raining)

Figure 18 V shape profile



This is the sort of result to aim for. Clean scalp of deep enough to push aside weed seeds, but not so deep as to move too much soil. On sand aim for a slightly v shaped profile to focus water around the seedlings.

Row Spacing

Figure 19 Even line spacing



You can use a length of conduit or anything similar to help keep your row spacing even. This will affect your seeding rates if your row spacing is too far out. If the row spacing is closer, it may be just as easy to follow a wheel mark or some other method.

Appendix 1

Figure 20 Table showing km/ha for different row spacing (machine calibration)

Row spacing (m)	km/ha
2	5
2.5	4
3	3.33
3.5	2.86
4	2.5
4.5	2.22
5	2

Appendix 2

Recommended ingredients for seed batch per hectare:

0.8 to 2kg seed depending on project (No less than 0.7kg)

4kg Bentonite clay (Optional and only recommended for very poor non wetting sands)

1.25kg Wetting agent (Optional, but recommended, particularly on sandy soils)

3kg fertiliser (Baileys Apex lowP)

Add vermiculite and spongelite to bulk the seed batches up to the desired volumes desired volumes

Appendix 3

Seeding Machine Job Safety Assessment (JSA)

Activity: Seeding Machine

Staff member/Contractors name: Sean Hazelden

Date developed: 11/04/2014

Other staff members involved: Sean Hazelden, Coastal Corridor Project Officer

Job Location: 912 Springdale Road, Hopetoun and other locations as required

List the tasks/steps involved:

- 1) Hygiene
- 2) Towing machine to property
- 3) Machine maintenance
- 4) Attaching machine to tractor
- 5) Machine set up
- 6) Operating the machine

Risk assessment *(add more lines as required):*

Potential hazards (identify the hazard associated with each of the above steps):	Initial risk (Using the risk assessment matrix to assign a risk rating on the back page)	What measures will you use to control the hazards? (Refer to the hierarchy of controls on back page):	Risk after intended control action(s) (Using the risk assessment matrix to assign a risk rating on the back page)
1) Spread of dieback, weed seeds or other undesirable entities	Moderate	a) Ensure the machine is well washed down with a high pressure sprayer before introducing it to a new property.	Low

2) Vehicle accident, Damage to road surface or towing vehicle	High	<ul style="list-style-type: none"> a) Ensure all adjustable parts are raised to a level where they will not contact the road surface under any circumstances. b) Ensure adjustable parts are secured adequately in the raised position. c) Ensure the hydraulic ram is raised fully, the collars are in place and the ram lowered to rest on the collars. d) Ensure the flashing light is activated and travel speed matches road conditions, (must be under 100km/hr by law) 	Low
3) Grease or lubricant on hands or in eyes	Moderate	<ul style="list-style-type: none"> a) Care when greasing grease points. Use a well maintained grease gun. Dispose of excess grease and cartridges appropriately b) Takes care when spraying lubricants to protect your eyes. c) Wash hands thoroughly after the job is completed. 	Low
4) Crushing injury, oil contact	High	<ul style="list-style-type: none"> a) Keep hands away from pinch points when backing the tractor to the tow hitch and fitting the draw pin b) Keep hydraulic fittings clean and clean up any spilt hydraulic oil after attaching hydraulic hoses. c) Wash hands if covered with hydraulic oil 	Low
5) Crushing injury, cuts, bruises and abrasions, strains	Moderate	<ul style="list-style-type: none"> a) Use tractor hydraulics where possible as an aid to reduce heavy lifting when adjusting the scalping blade. b) Use correct lifting techniques when lifting discs and ripper into position. c) Take care when tightening nuts to avoid slips causing bruises and abrasions d) Avoid climbing on machine as slipping could cause injury. 	Low

6) Crushing from tractor or machine	High	a) Ensure the tractor is out of gear and brake engaged before getting out. b) Do not ever place any part of your body under a part of the machine that is only supported by the hydraulics. c) Ensure 3 points of contact when getting in and out of the tractor to avoid slips and falls.	Low
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Reassessment (is the job now safe to do? Circle assessment below):

<p style="text-align: center;">Yes</p> <p style="text-align: center;">Proceed with caution using control measures. Do the job safely.</p>	<p style="text-align: center;">No</p> <p style="text-align: center;">Do full safety assessment. Contact line manager.</p>
--	--

Check if personal protective equipment (PPE) is appropriate and serviceable:

- Respirator Gloves Safety Shoes Hard Hat Sun protection (inc broad brimmed hat)
- Overalls
- Safety goggles Chemical protection suit High visibility clothing Other (describe)_Long pants and shirt buttoned at wrist required for Water Corp property

Staff/contractors signatures:

Check if personal protective equipment (PPE) is appropriate and serviceable:

- Respirator Gloves Safety Shoes Hard Hat Sun protection (inc broad brimmed hat)
- Overalls
- Safety goggles Chemical protection suit High visibility clothing Other (describe)_Long pants and shirt buttoned at wrist required for Water Corp property

Staff/contractors signatures:

Rick Management Matrix

Risk assessment matrix

What you need to do

- 1) Consider what can go wrong
- 2) Determine how bad the outcome would be (CONSEQUENCE)
- 3) Determine how likely it is to happen (PROBABILITY)
- 4) Calculate the risk level

		CONSEQUENCE			
		Catastrophic	Critical	Marginal	Negligible
PROBABILITY	Frequent	Extreme	Extreme	Extreme	Moderate
	Probable	Extreme	Extreme	High	Moderate
	Occasional	Extreme	High	Moderate	Low
	Remote	High	High	Moderate	Low
	Improbable	Moderate	Moderate	Moderate	Low
RISK		Extreme	High	Moderate	Low
		Senior management attention needed	Full safety assessment needed	Specific monitoring or procedures required, management responsibility must be specified	Manage through routine procedures

CONSEQUENCE

Catastrophic Death, loss of infrastructure/system, release causing irreversible high impact, wide scale, detrimental alteration of the environment, such that significant public interest or regulatory intervention occurs or reasonably could occur.

Critical Severe injury, major infrastructure/system damage, release causing reversible, localised, high impact, decrease in environmental value, such that minor public interest or regulatory intervention occurs or reasonably could occur.

Marginal Major injury, minor system damage, non-damaging environmental exposure.

Negligible Less than above.

PROBABILITY

Frequent Likely to occur often during the life of an individual item or system or very often in operation of a large number of similar items.

Probable Likely to occur several times in the life of an individual item or system or often in operation of a large number of similar items.

Occasional Likely to occur sometimes in the life of an individual item, or will occur several times in the life of a large number of similar components.

Remote Unlikely, but possible to occur sometime in the life of an individual item or system or can reasonably be expected to occur in the life of a large number of similar components.

Improbable So unlikely to occur in the life of an individual item or system that it may be not assumed to be experienced, or it may be possible, but unlikely to occur in the life of a large number of similar components.

Hierarchy of controls

Elimination Removing the hazard or hazardous work practice from the workplace. This is the most effective control measure.

Substitution Substituting or replacing the hazard or hazardous work practice with a less hazardous one.

Isolation Isolating or separating the hazard or hazardous work practice from people not involved in the work or the general work areas, for example, by marking off hazardous areas, installing screens or barriers.

Engineering This may include modifications to tools or equipment, or adding guards to machinery or equipment.

Administration Includes introducing documented work practices that reduce the risk, e.g. limiting the amount of time a person is exposed to a particular hazard or erecting signs to restrict access to particular areas.

PPE (personal protective equipment) The last resort. This is the least preferred option and should be considered only when other control measures are not practicable, or to increase protection.

Most preferred safety control

Elimination

Substitution

Isolation

Engineering

Administration

PPE

Least preferred safety control



Department of Environment and Conservation

Our environment, our future



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