TABLE OF CONTENTS

TABLE OF CONTENTS **1**

LEARNING OBJECTIVES - KNOWLEDGE **3**

TYPES AND USES **4**

Dozers **5**
Features 5
Limitations 5
Excavators **5**
Features 6
Limitations 6
Skidders **6**
Features 7
Limitations 7
Feller Bunchers **7**
Features 8
Limitations 8

BUILDING LINE **8**

The Finished Product **9**
Organization - Personnel **9**
Supervisor 9
Line Locator 9
Machine(s) and Operator 10
Heavy Equipment Units **10**
The Single Resource 11
The Strike Team 11
The Task Force 12

CHALLENGES AND SOLUTIONS **13**

Steep And/Or Difficult Terrain 12
Uphill Line Construction 13
Large Amounts Of Fireline To Construct 13
Wet Ground 13
Accessibility 13
Large Diameter Timber 14

OTHER FIRELINE TASKS 11

Water Delivery 15
Access 15
Digging Sump Holes 15
Leveling Ground 15
Danger Tree Removal 16
Mop-Up Assistance 16
Helipad Construction 16
Moving Gear 16
Rehabilitation 16

SAFETY OF EQUIPMENT AND OPERATORS 17

FIREFIGHTER SAFETY AROUND HEAVY EQUIPMENT 18

LEARNING OBJECTIVES - KNOWLEDGE

At the end of this module students will be able to:

- Identify the main types and uses of heavy equipment used on fires in BC;
- Explain how personnel and equipment are organized to build line to standard in a variety of situations;
- List some of the challenges faced when constructing line, and give possible solutions to overcome them;
- Describe other fireline tasks that employ heavy equipment, and tell how they are completed;
- Explain why a safe work attitude is paramount when working around heavy equipment and give examples of safe practices.

THERE IS NO FIELD PORTION TO THIS MODULE

Unfortunately there will not be any opportunity to try your hand at operating the heavy machinery.

However, you will be working alongside heavy equipment at some point in your fire fighting career.

It is very important to know the different types, uses and capabilities in order to work safely and successfully.

CHAPTER 5 HEAVY EQUIPMENT

Heavy equipment is a valuable resource to consider when fighting fires. There are many reasons why we make the decision to use machinery which will be discussed in greater detail later in the chapter. It is first necessary to learn about the different types and uses of each piece of equipment.

TYPES AND USES

There are several types of heavy equipment available for use on the fireline and all are effective tools. The main four machines we work with are dozers, excavators, skidders and feller bunchers.

These pieces of equipment come in varying sizes, but the overall job they do remains the same. Size choice will depend on the specific fire situation, but in general terms, bigger means more power; however, bigger does not mean better! Each machine will have a size specification that will best suit a certain need. The smaller machines can often be much better suited for the job. Additional size information is included with each description.

BULLDOZERS

This machine is the most widely used piece of equipment on the fireline. They are also referred to as cats. Dozers do the bulk of line construction on large project fires if the terrain and the sensitivity of the area permit. They can move a lot of earth in a short amount of time. A single dozer is much faster than an entire 20 person unit crew and the end product is much more effective in containing a fire. They can also build access roads, helipads, safety zones, flatten areas for portable water sources and push over most Danger Trees.

Features

The primary feature on the dozer is the wide blade on its front that is used to quickly move large amounts of earth. Some cats will also come equipped with rippers on the back which can be used to break up hard ground in rough terrain. Dozers come in a variety of sizes, specified with the letter 'D' followed by a number. For example, a D-3 is smaller than the D-11 based on the number. For our applications machines which fall in the D-4 to D-8 range are most suitable (between 8 and 40 tons).

Limitations

Operator experience is a major limitation to the capabilities of all machines; steep ground might not be so steep for an operator with a lifetime of experience. However, the primary limitation on dozers is terrain. If the ground becomes particularly rocky the dozer will generally struggle to move through the area. If the ground becomes too steep (>40% slope/23 degrees) it becomes dangerous to the operator and other ground personnel. If the ground is too soft the machine could sink, timber can also become too big. For all these situations the solutions are the same: you either need to find a bigger cat or involve other machines.

EXCAVATORS

Excavators are also very common on the fireline. These machines are the most versatile, multi-functional pieces of heavy equipment that we use. One of their main roles is to build line alongside dozers. An excavator excels at being able to access tougher ground. It has the ability to build pads for it to sit upon as it goes thus making steeper

or rockier ground less challenging. An excavator can also be much more functional when moving fuels off of the guard. It can grip onto trees and slash and direct them deliberately if the bucket has a thumb attachment (these are almost mandatory for guard construction). Other fireline tasks for excavators include being able to push over trees, build helipads, build roads, dig sump holes and rehabilitate areas after fire suppression activities have ended.

Features

Excavators come in a variety of sizes just like the dozers. The primary feature on an excavator is its long reaching boom, arm and the bucket attachment. A bucket and thumb combination can be used for grabbing, digging and pushing applications.

Limitations

Excavators are primarily limited by their speed to push in guard. They are much slower than dozers as they do not have a front blade to quickly establish clear and clean line. They can also get stuck in soft ground, but this is unlikely as the long reach of the boom can push or pull it free. There is also the possibility of throwing a track like any other tracked machine. A good operator can get it back on quickly with assistance.

SKIDDERS

Skidders are associated with delivery and have two applications on the fireline. A skidder can come equipped with water tanks and deliver water to precise locations as terrain and operator skill permit. Such equipment can also drop the tank and work as they were built to by skidding and decking wood away from the fire and line. This is done in conjunction with a feller buncher.

Features

There are two types of skidders: grapple skidders and line skidders. A grapple skidder has a hydraulic grapple on the back which is operated from within the cab to pick up a load. A line skidder uses a cable winch to move a load. This type requires the operator to release the winch, get out of the cab and manually choke the cable to the logs to skid them away.

Limitations

As a water delivery system skidders are limited by the down time needed to refill and turnaround times. Water must be close by and a good volume pump must be available, otherwise fire fighters will be waiting a long time between tanks. Tanks are generally not very large either (300 - 500 gallons).

The skidder is obviously the ideal tool for skidding logs and works well with the feller buncher. These machines are fast and maneuverable, because they run with large tires. However, having no tracks limits them in other ways, they can get bogged down easily in soft ground, they can create ruts in the road or guard and they are more prone to roll over.

FELLER BUNCHERS

The Feller Buncher is essentially a modified excavator with a specialized cutting head. They are becoming more and more common on the fireline. The sole purpose of the feller buncher is to fall and bunch wood for skidding in advance of a dozer pushing in the guard. This machine minimizes wood waste and allows the timber to be salvaged as control lines are being constructed. It also cuts down on the mess and difficulty of rehabilitating the area once the fire is out.

Features

Feller bunchers come in a variety of sizes. The bigger ones can manage bigger timber. One feature specific to each machine is the type of cutting head it has. Some are equipped with what is called a blow-down head, which allows the operator to tilt the head in a variety of directions to harvest trees lying on the ground. The standard head is only set up to cut standing timber. Cab features vary as well, some

machines are equipped with a self-leveling cab (shown in the picture), which allows the operator to access steeper ground and cut stumps level. Cab swing is another consideration. Some bunchers have the cab swing within the area of its tracks (zero swing) while others have large tail swing where the counter weight extends beyond the width of the tracks. The length of swing between the cutting head and counter weight will determine how small a work location the feller buncher will be able to work in.

Limitations

As with excavators, feller bunchers are primarily limited by the speed in which a control line can be cleared of standing timber. It just takes that much more time to harvest, skid and deck the wood. Very steep terrain, soft ground and timber size can also render this machine ineffective. Again, in many cases the quality of the operator is the greatest limitation.

BUILDING LINE

Substituting heavy machinery for crews when building fireline is common practice. Using fire fighters has less impact on the environment; however, using hand tools to construct guard is a slow and arduous process compared to using heavy equipment. If terrain, fire size and fire behavior are favourable, dozers and other equipment are preferred. Machines can work 24 hours a day, give you a wide control line, increase overall accessibility and, most importantly, cover way more

THE FINISHED PRODUCT

Lines are constructed with each fire attack method (direct, parallel and indirect). In each case the finished product should be the same and follow the same principle as hand guard. All excess materials must be pushed to the outside edge of the guard. This is mandatory even when it means debris has to be pushed uphill, which is difficult in steeper terrain. There can be no compromise, any buildup of fuel along the inside edge of the guard can reek havoc as the fire approaches. If fire gets into these piles of fuel during the mop-up stage they will all need to be broken up, most likely by a machine, to ensure that they are completely extinguished. The guard itself must be completely 'bladed' down to mineral soil and free of all roots and woody debris. It should be level and at the very least offer All-Terrain Vehicle (ATV) access. Any trees damaged by the passing of the dozers must be felled and all danger trees within two tree lengths of the line must also be felled. This can be done with machines or by fallers after the equipment has passed through.

ORGANIZATION - PERSONNEL

Heavy equipment is not just sent off unsupervised to charge through the forest. There must be a plan and a chain of command in place. The following personnel are organized together under the Operations Section to meet specific objectives:

Supervisor

- Can have a number of different titles depending on the fire situation. Such as: Operations Section Chief, Division Supervisor and Equipment Branch Director (large fire) or the Incident Commander of an IA crew (small fire).
- Responsible for the safety of personnel and good quality job completion.

Line Locator

- Sometimes a contractor, but usually an experienced crew member.
- Responsible for setting out flagged path for equipment to follow.
- These individuals must have an understanding of fire behavior and machine limitations.
- They must be able to correctly choose the most efficient and effective route for the guard to ensure line quality.

Machine(s) and Operator

- Always contracted out - BCWS does not own any machines (some agencies do such as California State, The State of Victoria, Greece and others).
- Responsible for following direction of BCWS supervisor to complete the job to our standard.
- The amount of supervision needed will depend on the operator's fire experience.

HEAVY EQUIPMENT WORK UNITS - Exercise

A heavy equipment work unit can consist of one machine or several. On small, slow moving fires one machine of appropriate size for the terrain and fuel type can be employed to quickly encircle the fire and allow suppression and mop-up to begin. On larger and more complex fires more 'iron' is needed. Some fires may require ten pieces of equipment while others might require 50.

Every fire situation is different. For that reason heavy equipment must be organized into work units according to the specific fire objectives. There are tried and tested core unit configurations that work well in certain general situations and these can be adjusted to meet specific requirements. We will use situational examples to discuss how heavy equipment can be configured as a single resource, a strike team and a task force. These are ICS terms and are used readily with heavy equipment.

The Single Resource

Note: please write out what actions you would take to establish guard and different considerations for the heavy equipment being used in each of the following scenarios. Use point form.

Scenario #1: **The Lone Soldier**

> You are on a 3 person Initial Attack crew and have arrived on scene of a slow moving, one hectare fire. Fire behaviour is expected to increase and hand guard will take too long. The terrain is relatively flat with few obstacles**.**

The Strike Team

Scenario #2: More Iron Required

Fire behaviour has increased and the fire has grown to 50 ha in size. Your single dozer will no longer suffice. The terrain is still flat and free of large obstacles. The goal is to create a perimeter as fast as possible.

The Task Force

Scenario #3: Combining Forces

A sudden change in wind direction has pushed the fire up a steep, rocky hill. Your guard is almost complete. However, the dozers need some help pushing through the steep and rough terrain.

Scenario #4: Waste Not Want Not - A Specialized Force

The fire has continued to grow and has moved into an area with high quality, merchantable timber. The ground is moderately steep.

CHALLENGES AND SOLUTIONS

Utilizing heavy equipment is not without its difficulties. It is not usually as simple as getting some iron to the fire, putting it to work and voila! The fire is contained! Every situation is unique and there are often challenges to overcome. These may include the following:

1. Steep and/or difficult terrain
2. Uphill line construction
3. Large amounts of fireline to construct
4. Wet ground
5. Accessibility
6. Large diameter timber

1. STEEP AND/OR DIFFICULT TERRAIN

This is quite common with the topography of British Columbia. In some cases it is fruitless to even try using machinery. Some possible solutions include:

- **Use an excavator**: This machine has a greater capacity to work in steep, rocky and rough terrain conditions. It will slow down production, but will still be safer and faster than a dozer.
- **Use hand line**: Excavators still have terrain limitations. If it is just too steep or rocky fire fighters will need to construct handline to tie sections together, this will be the objective of BCWS crews.

2. UPHILL LINE CONSTRUCTION

Pushing fuel and debris uphill is a difficult task and at times it would seem fine to push debris downhill into the fire. It certainly is faster, but in the long run it will be a colossal problem. This is a situation where clear directions from the supervisor are a must. Some possible solutions include:

- **Dozer blade angle**: Many dozers can adjust this by the movement of a pin. Others do not even need the operator to leave the cab.
- **Use an excavator**: In situations where pushing debris upslope becomes too difficult for dozers then an excavator can be used. It has the ability to direct timber and debris into openings well in advance of the dozer pushing through with a guard.
- **Use hand line**: A viable option if these sections are not too long.

3. LARGE AMOUNTS OF FIRELINE TO CONSTRUCT

If the fire is extremely large there will consequently be a lot of line to construct. There are two simple answers to this problem:

- **More equipment**: More iron will get the job done that much faster.
- **Longer shifts**: It is not unheard of to run machines 24 hours a day by replacing the operator after her shift and double-shifting the machine. This must be considered when time is of the essence.

4. WET GROUND

Machines have a tendency to get stuck when the ground gets soft. This is difficult to overcome because the fire will still burn through these areas.

- **Use smaller machines**: Less ground pressure will be created.
- **Use specialized machines**: Some are equipped with wider tracks to further decrease the pressure and increase the surface area. There are also machines specifically built to work in extremely soft areas such as muskeg.
- **Use hand line**: An efficient and viable option if these sections are not too long.

5. ACCESSIBILITY

Not all fires do burn right next to roads. Low beds are used to transport machines to fires and unload them at the closest possible access point. If the distance to 'walk' the machines is too far and lacking navigational aid there can be issues. Tracked machines move between 5 and 15 km/hr on good terrain.

- **Build road**: If operations are long-term use machines to build the access.
- **Be patient**: If roads cannot be built and machines are necessary, walk the machines in. Helicopters must be used to ensure the iron is on the right track.
- **Use hand line**: Helicopters can hold the line until crews can get there to support.

6. LARGE DIAMETER TIMBER

Large wood is difficult for any machine to move through safely. This creates a real problem when coupled with the fact that most big trees grow on slopes.

- **Use big machines**: Use the biggest available.
- **Use fallers**: If the big machines struggle the alternative is to go through with a faller first. If there is a lot of timber production fallers are often contracted to speed up the process and free up fire fighters for suppression tasks.
- **Use hand line:** An efficient and viable option if these sections are not too long.

OTHER FIRELINE TASKS

Heavy equipment does not just build fireline**, t**hey are used to complete other various fireline tasks, such as:

1. Delivering water
2. Creating access
3. Digging sump holes
4. Leveling ground
5. Removing danger trees
6. Assisting with mop-up
7. Building helipads
8. Moving gear
9. Rehabilitation

1. WATER DELIVERY

This task is done almost solely by the use of skidders with tanks. None of the other machines are used for this purpose. Skidders have the ability to carry water to locations on the line where a hose lay may be too complex. They are usually equipped with a pump, but it is often substituted with a high pressure BCWS model.

2. ACCESS

All machines can work to provide greater access to the fireline. The process is essentially just like building a control line. Dozers and excavators are the usual choices as they are primarily employed to build roads when they are not working on fires. All operators should be experienced. Building access is often done in conjunction with guard construction. Meaning machines may be dedicated to this task, but not to the detriment of building line. The quality of the access will vary based on what type of traffic will be using the access and the duration that it will be needed. There is no point in building a two lane road if you are only going to be using quads on it for one day. Skidders can also provide moderate access to isolated areas with the use of the blade attachment.

3. DIGGING SUMP HOLES

This task is limited to the excavator. When there are no relay tanks this machine can quickly dig a large hole for water tenders to off load into. They can also create a sump where a slow moving water source can drain into and become a sustainable source once it is filled up.

4. LEVELING GROUND

It is quite common to see fire fighters working hard trying to develop an elaborate site to set up relay tanks while a dozer is sitting right there. Operators will be glad to drop their blade for you and push out a level spot of a desired size. Much time will be saved to free up fire fighters for other tasks. Excavators and skidders also have this capability, but dozers are definitely best suited.

5. DANGER TREE REMOVAL

The removal of danger trees is a high risk operation. Only the most skilled fallers within the organization are qualified to perform this task. Even so, the less we expose our personnel the better. Danger trees can often be removed by heavy equipment during line construction; the ideal machine for this is the excavator. It can maneuver through standing timber to reach more of these trees without creating a big mess. It can also walk into the fire to knock down dangerous,

burning trees. Feller bunchers can also be of use here, but are generally less available and are more important to cutting in the control line. Dozers can push almost anything over, but it is best if they stay on the guard. Skidders can be used to handle smaller trees.

6. MOP-UP ASSISTANCE

Sometimes fire will get into areas which make mop-up very difficult. Old logging landings, landing piles, guard berms and other deep burning areas will often require help from machinery. You could spray water forever and it may never go out; it is not uncommon for these areas to continue burning deeply throughout the winter. An excavator is the choice machine to dig the fire out of the ground and facilitate thorough mop-up.

7. HELIPAD CONSTRUCTION

Many machines are capable of this task if the ground is flat. A dozer is the quickest choice. An area can be cleared out to the size specifications for any helicopter quite quickly and with little personnel power required. One concern is exposing too much dirt because this will create dust and make it difficult for helicopters to have adequate visibility upon landing. These areas often require a wet down by crews.

8. MOVING GEAR

Heavy equipment should never be dedicated to this task. However, there is no harm in loading up a machine with gear if it is going in your intended direction.

9. REHABILITATION

Once the firefighting is done there is still much work is still left to be completed. Rehabilitation is the process by which the landscape is restored to as close to its original state as possible. This may be as simple as filling in hand guard or as complex as reclaiming kilometers of guard. For the latter, dozers, excavators and skidders are used. The excavator is the best overall machine for the application of filling in guard and restoring proper drainage. Skidders are used to remove any wood with value.

SAFETY OF HEAVY EQUIPMENT & OPERATORS

The safety of the equipment and the operator is a shared responsibility. The operator will be ultimately responsible for his or her individual safety. However, some operators have had little fireline experience and the experienced ones sometimes forget the fact they are in a volatile work environment. Fire fighters need to be aware of the hazards and follow a strict set of rules when working with heavy machinery.

- All machinery must begin work from a solid **anchor point**. This is an area they can quickly return to if fire activity increases. As equipment stretches farther away from this anchor point then new ones must be located and **safety zones** need be constructed in conjunction with building control line.

- Operators must have a constant line of **communication** with BCWS personnel and the line locators. The operators need to be immediately informed if the fire is threatening or if there is a change in objective.

- All bulldozers, skidders, bunchers and excavators must be equipped with Rollover Protection Structures (ROPS) and Falling Object Protection Structures (FOPS).

- All machines should be equipped with a winch, especially if working alone. On larger fires avoid working dozers alone in case of breakdown, becoming trapped in soft ground, working on excessively steep slopes or sudden wind shifts.

- Heavy equipment should not operate on slopes so steep they cannot back up.

- Machinery operated in the dark must be equipped with appropriate lighting equipment.

- Extra caution should be exercised when the machinery is used to push down snags. The snag top can snap and fall back over the machine.

- The blade/bucket/cutting head must be lowered to the ground any time a machine is parked. When an operator must leave their machine with the engine running, it is also essential that the brake is set.

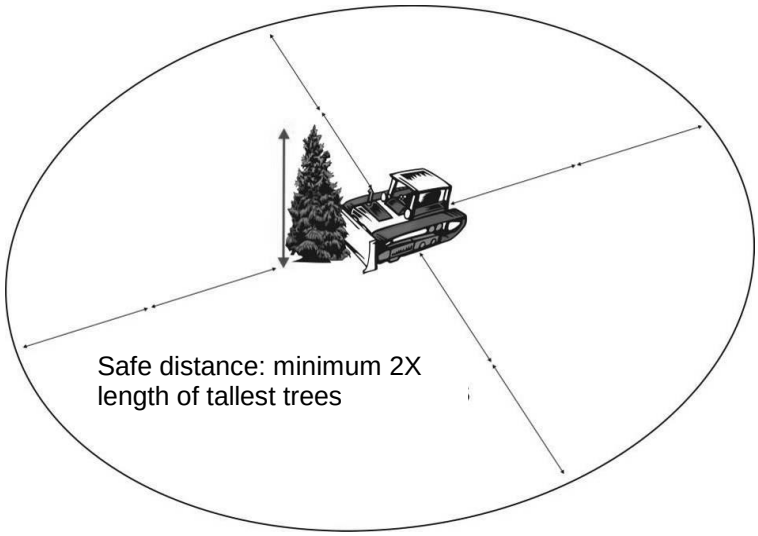
- Machines parking overnight should do so in a safe and open area, preferably on bare ground. Operators will need to leave time to grease their machines.

- Operators should be limited to a 12 hour shift.

FIREFIGHTERSAFETY AROUND HEAVY EQUIPMENT

Operating heavy machinery is out of the question for BCWS fire fighters. However, it is guaranteed you will be called to work around them. There is a strict set of rules the organization follows to ensure ground crew safety.

- Fire fighters must keep clear of machinery in operation. You must be at least **two tree lengths** away and never directly downhill. Machines can send trees, rocks and other debris in your direction.



- Proper **PPE** must always be worn. Use gloves when handling winch cables or chokers.

- Fire fighters are not permitted on the machines. Never ride on equipment.

- Persons wishing to approach an operating machine must first get the operator's attention. Excavators swing around quickly and may not see you especially on the boom side. If trying to get an operator's attention, try to find your way into the line of sight from a distance and on the uphill side of where the machine is working.

- Establish radio communications whenever possible. This may require issuing each operator a BCWS radio. Machines are rarely equipped with a radio compatible to the BCWS handhelds.

- Machinery always has the right of way**.**