



1.1 EARTHWORKS (REGULATIONS 22 – 35)

1.1.1 Overview of the plantation forestry activity

Earthworks associated with *plantation forestry* is a regulated activity under Regulation 5(1)(c) of the NES-PF. The NES-PF regulations for three ancillary activities (Part 2, subpart 9) and general provisions (Part 2, subpart 10) of the NES-PF must also be complied with as relevant when undertaking *earthworks* (Regulation 5(2)).



Earthworks are defined in the NES-PF as:

- (a) 'means disturbance of the surface of the land by the movement, deposition, or removal of earth (or any other matter constituting the land, such as soil, clay, sand, or rock) in relation to plantation forestry; and
- (b) includes the construction of forestry roads, forestry tracks, landings and river crossing approaches, cut and fill operations, maintenance and upgrade of existing earthworks, and forestry road widening and realignment; but
- (c) does not include soil disturbance by machinery passes, forestry quarrying, or mechanical land preparation'

Earthworks are undertaken to provide the physical infrastructure needed to establish, maintain and harvest a *plantation forest*. Road construction is a particularly important part of forestry operations to enable access at all stages of forestry cycle with most *forestry road* and *forestry track* construction activities occurring prior to and during *harvesting*.

1.1.2 Potential adverse environmental effects from *earthworks*

If not appropriately planned and managed, *earthworks* associated with *plantation forestry* can result in the following adverse environmental effects:

- Accelerated erosion due to slope instability and bare soil exposure (e.g. collapse of slopes around cuts).
- Excessive *sediment* discharges to waterways (e.g., through soil disturbance or slope failure), which can affect aquatic ecosystems or erode water control structures.

Other less common adverse environmental effects associated with *earthworks* include effects on indigenous fauna and flora resulting from soil disturbance and movement.

The volume of *earthworks* moved is generally much higher for first rotation *plantation forests* and therefore there is generally a greater risk of these adverse environmental effects occurring.

1.1.3 Permitted activity and conditions

Earthworks are a permitted activity in relation to **territorial authority** functions (Regulation 23) and there are no conditions. This regulation will prevail over district plan rules for *earthworks* associated with *plantation forestry* under the NES-PF. The exception is where a district plan *earthworks* rule is more stringent and meets the requirements of Regulation 6



(refer to the [NES-PF Plan Alignment Guide](#) for detailed guidance on where plan rules may be more stringent).

In relation to **regional council** functions, Regulation 24(2)-(4) of the NES-PF set out the types of *earthworks* that are permitted, provided that regulations 25 to 33 are complied with:

- Regulation 24(2) relates to general *earthworks* and all *earthworks* should first be assessed under the thresholds in this regulation.
- Regulations 24(3) and (4) provide two specific exceptions for *maintenance and upgrade of existing earthworks*¹ and *earthworks* for forestry widening or alignment when the proposed *earthworks* cannot meet the thresholds in Regulation 24(2)(c) and (d). The purpose of these two exceptions is to enable these types of *earthworks* to be carried out on steeper *orange zone* and *red zone* land, provided the relevant thresholds and standards are complied with. Where the thresholds in Regulation 24(3) and 24(4) cannot be met for these two types of *earthworks*, a restricted discretionary consent is required under Regulation 35(2)(c) or 35(2)(d).

Each type of *earthworks* is subject to different volume thresholds and standards which are outlined in Table 1.

Table 1: The thresholds and standard for the *earthworks* permitted under NES-PF.

Regulation and <i>earthworks</i> type	Permitted Activity – Regional Council
24(2) – general earthworks	<p><i>Earthworks</i> in:</p> <ul style="list-style-type: none"> • <i>Green</i> or <i>yellow zone</i>; • <i>Orange zone</i> with slope less than 25°; • <i>Orange zone</i> with slope 25° or more and in any 3-month period that comprise: <ul style="list-style-type: none"> ○ Side cutting height of 2-3m over continuous length of no more than 100m; and ○ Deposition of less than 500m³ of <i>spoil/fill</i>. • <i>Red zone</i> and in any 3-month period comprise: <ul style="list-style-type: none"> ○ Side cutting less than 2m deep over a continuous length of no more than 50m; and ○ Deposition of less than 100m³ of <i>spoil/fill</i>.
24(3) – maintenance and upgrading of existing earthworks	Volume moved is less than 5000m ³ in any 3-month period.
24(4) – earthworks for forestry road widening or realignment	<ul style="list-style-type: none"> • Volume moved is less than 5000m³ any 3-month period; and • Where on a slope more than 25°, cut and fill road construction is used that involves: <ul style="list-style-type: none"> ○ Construction of a <i>forestry road</i> heading on same grade as road, but benched below the road formation height, to provide a bench below the road to contain and stabilise the fill slope road and create a stable base; and ○ Keying and compacting the fill to the bench; and

¹ Defined in the NES-PF as: maintenance and upgrade of existing earthworks — (a) includes —(i) activities to upgrade existing forestry infrastructure or minor reshaping of existing forestry infrastructure; and (ii) the installation and maintenance of water run-off control measures; and (iii) road metalling; but (b) does not include forestry road widening or realignment.



	<ul style="list-style-type: none"> • Spoil end-hauled to safe containment area where: <ul style="list-style-type: none"> ○ <i>Earthworks</i> on slope of more than 35°; or ○ <i>Spoil</i> cannot be benched while retaining stability; and • Records of <i>forestry road</i> widening and realignment are maintained and available for inspection.
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The permitted activity conditions that apply to all *earthworks* are summarised in Table 2. Sections 1.1.5 to 1.1.13 provide more detailed guidance on these conditions to assist with interpretation and implementation. For the exact wording of the conditions, refer to the NES-PF which can be accessed through the hyperlinks below.

Table 2: Summary of permitted activity conditions for *earthworks*.

Condition	Regional Council Function
Notice (Regulation 25)	<p>If <i>earthworks</i> involve more than 500m² of soil disturbance in any 3-month period, council must be given written notice of proposed <i>earthworks</i> location and planned start and end dates.</p> <p>Notice must be given:</p> <ul style="list-style-type: none"> • At least 20 and no more than 60 working days before the planned start date; or • A minimum of 2 days before salvage operations are planned; or • Annually for ongoing <i>earthworks</i>. <p>Council may request the management plan (if it is required, after notice is given) and it must be supplied with 5 working days of the date by which the plan must be in place.</p>
Sediment (Regulation 26)	<p><i>Sediment</i> from <i>earthworks</i> must be managed to ensure that, after reasonable mixing, it does not cause following effects in receiving waters:</p> <ul style="list-style-type: none"> • A conspicuous change in colour or clarity; or • Rendering fresh water unsuitable for consumption by farm animals; or • Significant adverse effect on aquatic life.
Forestry earthworks management plan (Regulation 27)	<p>Management plan required for all <i>earthworks</i> involving more 500m² of soil disturbance in any 3-month period.</p> <p>The plan must:</p> <ul style="list-style-type: none"> • Identify the environmental risks associated with the <i>earthworks</i> and measures to avoid, remedy or mitigate adverse environmental effects; • Contain the details required in Schedule 3; • Be in place at least 20 working days before <i>earthworks</i> begin (2 days for salvage operation) and be provided to the relevant council upon request. <p><i>Earthworks</i> must be in accordance with the plan.</p> <p>Any <i>material amendments</i> to the management plan must be documented and dated. The relevant council must be advised that an amendment has been made and this must be provided to the relevant council on request.</p>
Operation (Regulation 28)	<p><i>Earthworks</i> in any <i>orange</i> or <i>red zone</i> that are not required for <i>harvesting</i> within 12 months must be stabilised within 20 working days of completion.</p> <p>Soil disturbance in <i>ephemeral flow paths</i> must avoid accelerated erosion, obstruction, or diversion of water flow.</p>



Condition	Regional Council Function					
Setbacks (Regulation 29)	<p><i>Earthworks</i> must not occur within the following setbacks (subject to specific exclusions²):</p> <table border="1" data-bbox="477 367 1388 663"> <thead> <tr> <th data-bbox="477 367 1102 423">10m</th> <th data-bbox="1110 367 1388 423">30m</th> </tr> </thead> <tbody> <tr> <td data-bbox="477 434 1102 663"> <ul style="list-style-type: none"> • <i>Perennial river</i>, or • <i>Wetland</i> larger than 0.25ha; or • Lake larger than 0.25ha; or • <i>Outstanding freshwater body</i>; or • <i>Water body</i> subject to a water conservation order </td> <td data-bbox="1110 434 1388 663"> Coastal marine area </td> </tr> </tbody> </table>		10m	30m	<ul style="list-style-type: none"> • <i>Perennial river</i>, or • <i>Wetland</i> larger than 0.25ha; or • Lake larger than 0.25ha; or • <i>Outstanding freshwater body</i>; or • <i>Water body</i> subject to a water conservation order 	Coastal marine area
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Fill and spoil (Regulation 30)	<p>Fill Must contain no more than 5% (by volume) of vegetation and wood.</p> <p>Spoil <i>Spoil</i> must not be deposited:</p> <ul style="list-style-type: none"> • Where it may cause failure of the deposited material or the underlying land; or • Over <i>slash</i> or woody vegetation; or • Into a <i>water body</i>, coastal water, or a <i>significant natural area</i>; or • Onto land in circumstances that may result in the spoil or <i>sediment</i> entering water. 					
Sediment and stormwater control measures (Regulation 31)	<ul style="list-style-type: none"> • Disturbed soil must be stabilised or contained to minimise <i>sediment</i> entering water and resulting in: <ul style="list-style-type: none"> ○ The diversion or damming of any <i>water body</i>; or ○ Damage to downstream infrastructure, property or receiving environments, including coastal environments. • Stormwater, water run-off, and sediment control measures must be installed and maintained. • Batters, cuts, and side cast construction must use methods that maintain stability. • Minimum storm water culverts for <i>forestry roads and forestry tracks</i> are: <ul style="list-style-type: none"> ○ 325mm internal diameter in any <i>green, yellow, or orange zone</i> with a land slope of less than 25°; or ○ 375mm internal diameter in any <i>orange zone</i> with a land slope of 25° or more in any <i>red zone</i>. 					
Stabilisation (Regulation 32)	<ul style="list-style-type: none"> • Exposed areas of soil (except firebreaks) that may result in <i>sediment</i> entering water must be stabilised as soon as practicable after completion but no later than the last day of autumn or spring (whichever is sooner). • Suitable stabilisation measures include seeding, vegetation cover, and compacting, draining, roughening or armouring by the placement of rocks or other rigid material. 					

² *Earthworks* setbacks do not apply to: 1) The construction/maintenance of a river crossing, a sediment or water control measure, or a slash trap or debris retention structure; 2) If the *earthworks* within the setback will result in less than 100m² of soil disturbance in any 3-month period, and are not within 5 m of the water body; or 3) During the maintenance and upgrade of existing *earthworks*.



Condition	Regional Council Function
Roads, tracks, and landings (Regulation 33)	<p><i>Forestry roads, forestry tracks, and landings</i> must be managed and aligned to:</p> <ul style="list-style-type: none"> • Divert water run-off and disperse water flows to stable ground and away from constructed fill; and • Minimise disturbance to <i>earthflows</i> and gullies.

1.1.4 Determining whether a resource consent is required

The flow chart in Figure 1 illustrates the process to determine whether a resource consent is required for *earthworks* under the NES-PF and the activity status where a resource consent is required. *Earthworks* are also required to comply with the ancillary activities regulations (Part 2, subpart 9) and general provisions (Part 2, subpart 10) as relevant to be a permitted activity.

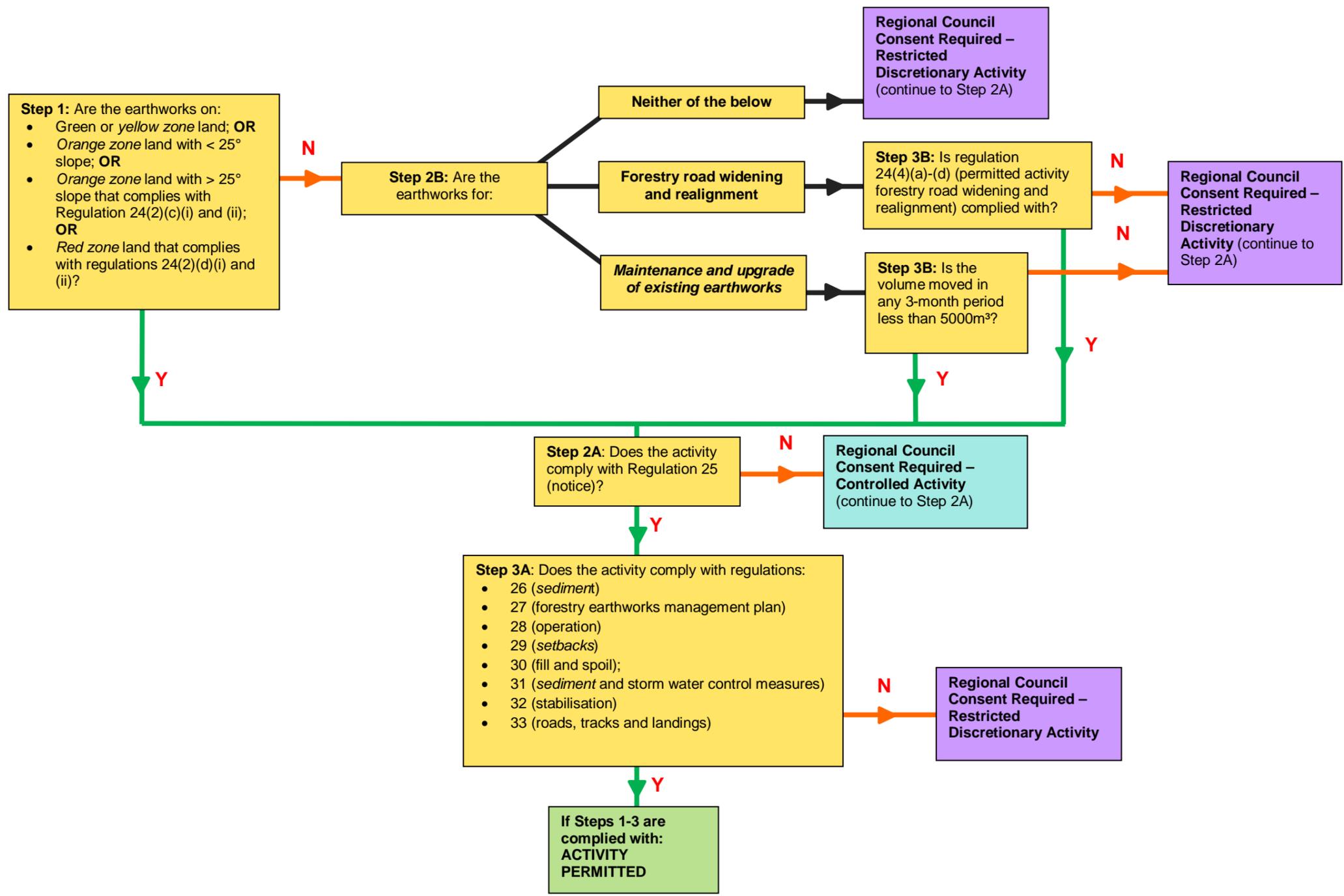


Figure 1: Flow chart to determine whether resource consent is required for earthworks.



1.1.5 Regulation 24 – Permitted activity: regional council

Regulation 24 includes limits on the volume of *earthworks* that can be undertaken as a permitted activity, depending on where the *earthworks* are located and the type of *earthworks*. In complying with these regulations, it is not necessary to know the exact volume of *earthworks* that will be deposited or moved – only whether the limits specified in the regulations will be exceeded. The permitted limits are:

General earthworks:

- *Orange zone* with slope of 25 degrees or more – deposition of less than 500m³ of *spoil* or fill in any 3-month period (Regulation 24(2)(c)(ii)) and a side cut of 2-3m over a continuous length for no more than 100m. This limits side cuts to 3m and there are no limits if the side cut is less than 2m. If the cut is greater than 2m high but less than 3m, then the length of the cut should be measured to ensure it is no longer than 100m.
- *Red zone* – deposition of less than 100m³ of *spoil* or fill in any 3-month period (Regulation 24(2)(d)(ii)) and a side cut of less than 2m over a continuous length for no more than 50m.

Maintenance and upgrading of existing earthworks and earthworks for forestry road widening or realignment:

- Volume of *earthworks* moved is less than 5000m³ in any 3-month period (Regulation 24(3) and 24(4)(a)).

As a general guide:

- 100m³ is about the size of a truck and trailer unit (or 10m x 10m x 1m high).
- 500m³ is about the size of a single storey three-bedroom house (10m x 20m x 2.4m high).
- 5000m³ are larger-scale *earthworks* but likely to be less than what is needed to create a *landing*.

These thresholds should be calculated for a continuous area of *earthworks* within a *plantation forest* (not per land parcel) over a 3-month period. *Earthwork* activities that are physically separate and distinct do not create overlapping or cumulative environmental effects that are more than minor. Therefore, these should be treated separately for the purposes of the thresholds in Regulation 24. For example, in a large *plantation forest* there may be multiple maintenance *earthworks* activities being carried out that are in distinct separate areas which cumulatively exceed 5000m³, but the actual volume of each area of *earthworks* is small with limited potential for adverse effects.

The thresholds in Regulation 24(c) and (d) for *earthworks* volume and side cutting need to be read together – both must be exceeded for *earthworks* to require a restricted discretionary consent under Regulations 35(2)(a) and (b).

1.1.6 Regulation 25 – notice

Notice is required for *earthworks* when the soil disturbance will exceed 500m² in any 3-month period. This threshold is to avoid the notice requirement applying to really small-scale *earthworks* with minimal environmental effects, such as grading maintenance.

Notice of *earthworks* must be provided in writing to the relevant regional council and must include:

- **Details on the place of the earthworks** – this should provide an accurate description of the location of the *earthworks* with supporting maps where appropriate.



- **Details on the planned start and end date for earthworks** – this needs to be as accurate as possible while recognising that there are inevitably external factors that may impact on the start/finish dates of the *earthworks*.

Section 5.2. of the [NES-PF Consenting and Compliance Guide](#) provides more detailed guidance on the notice provisions in the NES-PF, including timeframes and formally receiving and acknowledging notice.

1.1.7 Regulation 26 – sediment

Regulation 26 relates to the effects of *sediment* discharges from *earthworks* in receiving waters after ‘reasonable mixing’. The water quality standards are based on section 70 of the RMA and Section 4.9 of the [NES-PF User Guide](#) provides general guidance on the conditions in the NES-PF relating to the effects of *sediment* discharges on receiving waters.

When undertaking *earthworks*, foresters should be attempting to minimise the quantity and flow rate of any water on exposed soil by diverting it away from bare soil sites. The key trigger for soil detachment, transport, and deposition (sedimentation) is moving water, so reducing the degree that water and soil interact and the speed that it happens should be the focus of any *earthworks sediment* management regime. As water and soil contact is inevitable (e.g. rainfall on exposed areas of *earthworks*), *sediment* management practices should focus on slowing down the movement of water to reduce the amount of *sediment* that is entrained in run-off and deposited in receiving waters.

Implementing good sediment management practices and complying with permitted activity conditions for *earthworks* (e.g. conditions relating to the forestry *earthworks* management plan, setbacks, and *sediment* and storm water control measures) will enable foresters to comply with Regulation 26. Foresters may draw on a range of sources to identify appropriate management practices to ensure compliance with Regulation 26, including existing council guidance and/or industry guidance as appropriate.

1.1.8 Regulation 27 – forestry *earthworks* management plan

A forestry *earthworks* management plan is required for *earthworks* that involve more than 500m² of soil disturbance in any 3-month period. The purpose of the forestry *earthworks* management plan is to ensure site specific risks from *earthworks* are identified and managed up-front.

The forestry *earthworks* management plan must be prepared in accordance with the information requirements in Schedule 3. The Schedule requires a clear description of the management practices that will be used to avoid, remedy or mitigate risks from *earthworks*, including proposed erosion and sediment control measures. Clause 4(d) of Schedule 3 states that the description of proposed management practices must be of ‘**sufficient detail to enable a site audit of the management practices to be carried out**’. The forestry *earthworks* management plan must also be provided to the relevant regional council on written request and must be in place 20 working days before *earthworks* begin (except in the case of a salvage operation).

Section 5.3 of the [NES-PF Consenting and Compliance Guide](#) provides more detailed information on the NES-PF management plan preparation and review process, and *material amendments* to management plans.

1.1.9 Regulation 28 – Operation

Stabilisation of earthworks in ESC orange and red zone

Regulation 28(1) states that:

‘earthworks in any orange or red zone that are not required for harvesting within 12 months must be stabilised within 20 working days of their completion’.



Regulation 28(1) is focused on managing *earthworks* on steep or unstable slopes (i.e. ESC *orange* or *red zone* land). It makes a distinction between *earthworks* required for *harvesting* within the next 12 months and all other *earthworks*. *Earthworks* for *harvesting* often occur over longer time periods to create *harvesting* infrastructure – *forestry roads* and *landings*. The surface of these *earthworks* will often have a metal running surface. The parts that need stabilising are the cut faces and fill slopes. It can take longer to stabilise exposed earth during *harvesting* for operational reasons. For all other *earthworks* in *orange* or *red zones*, these must be stabilised within 20 working days of their completion. Regardless of the purpose of the *earthworks*, foresters should seek to *stabilise earthworks* as soon as practicable.

The most appropriate method to stabilise *earthworks* will need to be determined on a case-by-case basis. Potential methods that may be appropriate to stabilise *earthworks* include:

- Conventional planting of vegetation – this may include planting grass or legume seed where soil and topography conditions support germination and growth.
- Hydroseeding – spraying a mixture of water, seed, fertilisers, organic binders and mulch onto soil can produce dense grass cover quickly and may be more suitable for steeper, more infertile soils or during the growing off-season.
- Spreading mulch – may consist of bark, woody material or hay where an instant barrier of protection is required and may also be used in conjunction with sowing grass.
- Spreading of *slash* – similar effect to the spreading of mulch but it can also be used as a *sediment* filter to reduce water velocity and to reduce the impact of logging machinery on tracks during wet weather.

The most common method for stabilising temporary harvest tracks is construction of cutoffs to disperse and divert stormwater to stable ground.

Soil disturbance in ephemeral flow paths

Regulation 28(2) states that ‘*soil disturbance in ephemeral flow paths must avoid accelerated erosion, obstruction, or diversion of water flow*’. *Ephemeral flow paths* are defined in Regulation 28(3) as:

- ’ the route that water from intermittent rainfall events follows, if -*
- (a) the flow path is an entrenched dry gully greater than 1 m deep; or*
 - (b) there is evidence of a channel within the valley system where overland flow occurs from time to time; or*
 - (c) there is evidence of erosion (such as gullying or headward gully erosion) associated with short-term water flow from time to time within the valley system; or*
 - (d) there is evidence of an active bed activated by rain events.’*

The photos below in Figure 2 provide examples of ephemeral flow paths (source: Bay of Plenty Regional Land and Water Plan (Operative 2008).



Example 1

The flow path is an entrenched dry gully greater than 1 metre deep. This site would qualify as an ephemeral flowpath.



Example 2

There is clear evidence of a channel within the valley system where overland flow occurs from time to time.

This site would qualify as an ephemeral flowpath.



Example 3

There is clear evidence of erosion (such as gulying or headward gully erosion) associated with short term water flow from time to time within the valley system.

This site would qualify as an ephemeral flowpath.



Example 4

The presence of the actively eroding gully head associated with stormwater flow indicates that this valley would be classified as an ephemeral watercourse. Without the presence of the eroding gully system, the valley would not be considered an ephemeral flowpath.



Example 5

The valley does not show any evidence of overland flow channels, or erosion as a result of overland flow.

This site would not qualify as an ephemeral flowpath.



Figure 2: Examples of ephemeral flow paths (Source: Bay of Plenty Land and Water Plan).

Ephemeral flow paths only carry water in intermittent rainfall. They are only likely to erode if the vegetation cover in the channel is interfered with, and/or the water flow in them is fast flowing and a high volume. To avoid erosion in *ephemeral flow paths*, the first step is to recognise whether a depression in the ground is likely to turn into an *Ephemeral flow path* during heavy rainfall. For depressions that are likely to become *ephemeral flow paths*, the best course of action when planning and undertaking *earthworks* is to avoid disturbing the ground at the base of the channel.

Erosion risk increases the longer the ground is exposed. When the base of the channel of an *ephemeral flow path* needs to be disturbed for a *harvesting* track or similar, it is important to rehabilitate immediately after the works. Keeping the channel clear is also important to minimise potential erosion.

1.1.10 Regulation 30 – Fill and spoil

Fill

Fill is defined in Regulation 3 as 'soil or aggregate, placed to raise the land surface'. Regulation 30(1) requires that *fill* contains no more than 5% (by volume) of vegetation and wood. The purpose of this requirement is to ensure *fill* is stable. Fill that contains a lot of woody material becomes unstable as the woody material rots and the void space changes. The weight of soil on sloping wet rotting wood used as *fill* can result in slope failures. Further, wood can also introduce water flow pathways into the *fill*, and these routes can result in slope failure.

Obvious causes for concern are where there is evidence of fill being loaded onto *slash*, or *fill* containing high levels of *slash* during *earthworks* or post-harvest. Generally, a visual assessment will provide a good guide as to whether this is likely to be a problem and a pragmatic approach to assess the amount of vegetation and wood material within the *fill* is expected.



Corduroy roads

The purpose of Regulation 30(1) is to avoid unstable *fill* being created. Wood material can also be used to construct a road corduroy, which is a structured load-bearing surface where the logs are laid horizontally and parallel, and there are no void areas³. Corduroy roads are an engineered road construction technique used in places where the substrate is very weak and where the load must be spread if the road is to be trafficable. The use of logs to create a road corduroy does not meet the definition of “*fill*”.

Spoil

Spoil is defined in the NES-PF as ‘*the by-product of excavations and earthworks*’. Regulation 30(2) requires that spoil must not be deposited in areas where it may cause failure of the deposited material or the underlying land, or for *spoil* to be deposited over *slash* or woody vegetation, into a water body, coastal water or a *significant natural area*, or onto land in circumstances that may result in *sediment* or *spoil* entering water. This will need to be determined on a case by case basis, with consideration given to the volume of material deposited, the land covered by *AEP* events (refer to Section 4.10 of the [NES-PF User Guide](#)), and the stability of deposited material.

1.1.11 Regulation 31 – Sediment and stormwater control measures

All sediment, water runoff and stormwater control measures aim to disperse and slow water to reduce its potential to entrain, transport and deposit sediment. *Sediment, water runoff and stormwater control measures* (including some examples) are discussed in Section 4.8 of the [NES-PF User Guide](#).

In addition to the requirement to install and maintain these measures, Regulation 31(1) includes a performance-based condition for disturbed soil to be stabilised or contained to minimise sediment entering water, resulting in:

- The diversion or damming of any *water body*.
- Damage to downstream infrastructure, property, or receiving environments, including the coastal environment.

This condition requires proactive steps to be taken to ensure these adverse effects do not occur. Common practices to stabilise and contain disturbed soil are techniques that stop flow (e.g. *sediment* traps) and techniques that redirect and disperse flow (e.g. with cut-outs, water table drainage *culverts*, berms).

1.1.12 Regulation 32 – Stabilisation

Regulation 32 applies to all areas of exposed soil from *earthworks* that may result in *sediment* entering water (whereas Regulation 28 applies to *earthwork* in *orange* and *red zones*). Regulation 32(1) requires that:

Exposed areas of soil, except firebreaks, that may result in sediment entering water must be stabilised as soon as practicable after completion of the activity, but no later than the last day of the autumn or the spring, whichever is sooner, after completion of the activity.

The reference to ‘the last day of autumn or spring’ ensures that *earthworks* are stabilised no later than six months after completion of the activity. Six months is the absolute maximum timeframe before exposed soil must be stabilised and generally the end of autumn or spring

³ For more information on corduroy roads, refer to the New Zealand Forest Owners Association Forest Road Engineering manual: <http://www.nzfoa.org.nz/resources/file-libraries-resources/transport-and-roading/484-nz-forest-road-engineering-manual-2012/file>



will be sooner. However, the key requirement in Regulation 32(1) is that *earthworks* ‘**must be stabilised as soon as practicable**’. This should generally be achieved well within the required timeframe to avoid potential adverse effects of exposed soil on receiving waterbodies (i.e. *sediment* transport and deposition). Regulation 32(2) lists a number of suitable stabilisation measures, including seeding, vegetation cover and compacting, which are all proven methods to stabilise soil. However, this list should not be seen as exhaustive and the most appropriate stabilisation methods will need to be determined on a case by case basis. Section 5.3.10 of the [NES-PF User Guide](#) provides some examples of vegetation and mulch/slash stabilisation measures.

1.1.13 Regulation 33 – Roads, tracks and landings

The purpose of Regulation 33 is to reduce the likelihood of erosion resulting from *earthworks*. Regulation 33 specifically requires that *forestry roads*, *forestry tracks* and *landings* are managed and aligned to divert water run-off to stable ground and away from constructed *fill* and minimise disturbance to earthflows and gullies.

Constructed fill

Constructed *fill* is more vulnerable to erosion caused by water flows. Regulation 33 therefore requires *forestry roads*, *tracks* and *landings* to be managed and aligned to divert flows away from areas of constructed *fill*. Techniques to achieve this include (but are not limited to):

- Water table drains (channels to direct water from cut banks or berms along the road to *culverts* or cut-outs).
- Cut outs (channels to direct water away from a road, track or landing and divert it into sediment control structures).
- Berms (small banks on the outside edge of a road or landing constructed to channel water to cut-outs and additional *sediment control measures*).
- Water table drainage culverts (structures to drain water across a road, often made of corrugated PVC).

Gullies

Gullies created by gully erosion are generally not an issue for *plantation forestry*. However, gully erosion can be an issue on soils and substrate with even-sized moderate to coarse particle size, such as the Central North Island pumice, loess, and marine sands. On these soils, good water control is crucial to help avoid gullies forming and/or minimising disturbance of existing gullies. If gullies do develop they can rapidly undermine *forestry infrastructure*.

Earthflow

Earthflow is a type of erosion defined in Regulation 33(3) as:

‘rapid flowing of soil and underlying weathered material on slopes of between 10 and 20 degrees that is characterised by -

- (a) an overthrust bulging dome at the toe, a depressed, fissured, and disrupted centre upslope, and slipping or slumping at the head; and*
- (b) prominent transverse cracks, particularly in the upper region of the movement.’*

Earthflow is a relatively deep-seated erosion type found on crushed mudstone geologies. Often the toe of the slope is being continually eaten out by the stream. *Earthflows* are inherently unstable, so removing its toe stability means that it continues to flow downhill, very slowly. This can undermine *forestry infrastructure* on an *earthflow* as it will likely move downhill with the *earthflow*. Increases in the weight loading, or water within an *earthflow* will increase its flow rate. The gentle slope of an *earthflow* may look like a suitable site for roads



or other infrastructure, but anything built on it will rapidly deform, and it will be in constant need of repair and maintenance. As such, it is important to minimise disturbance to *earthflows*.