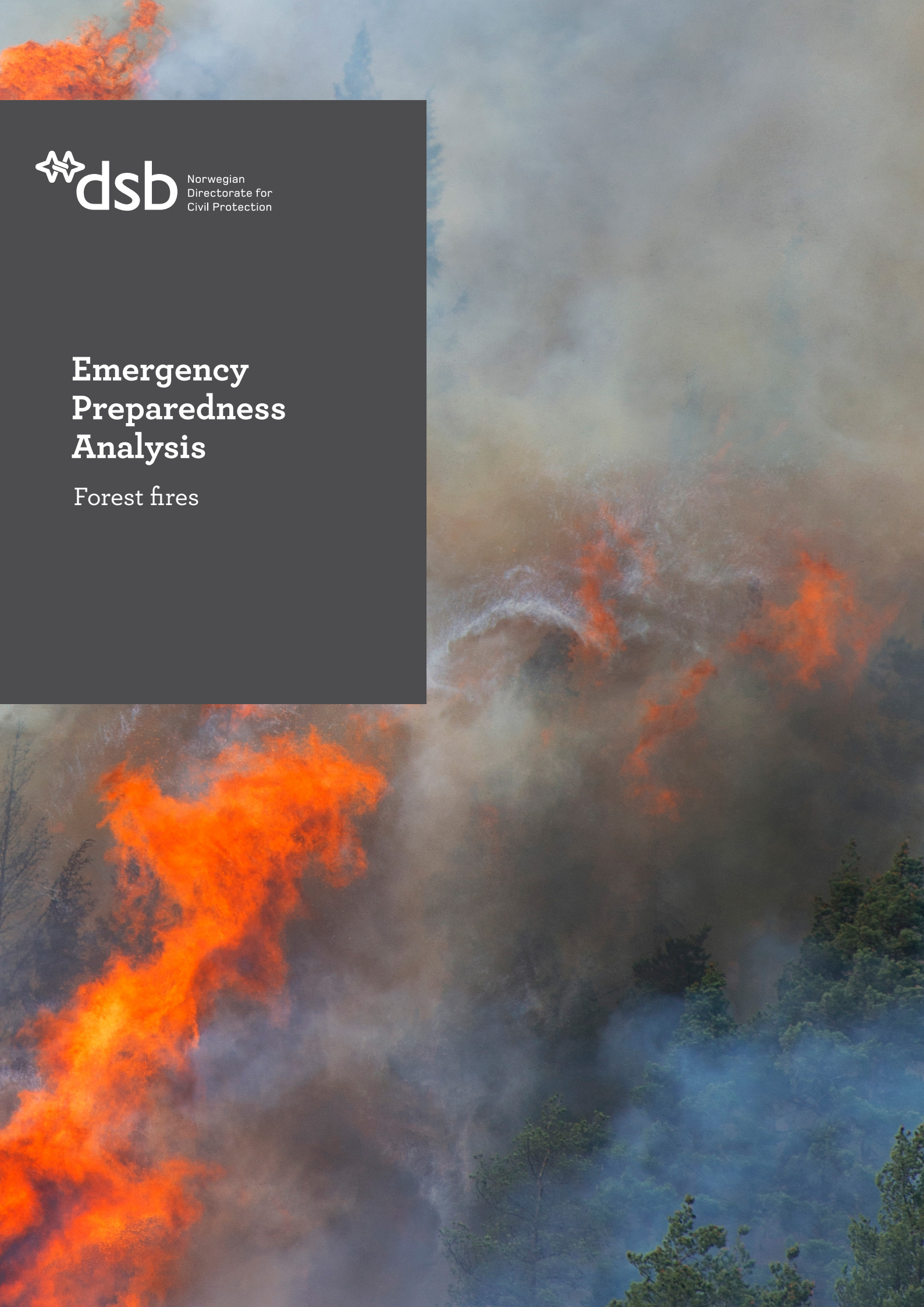

Norwegian Directorate for Civil Protection

Emergency Preparedness Analysis

Forest fires

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Emergency Preparedness Analysis

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CHAPTER

01

The purpose of this emergency preparedness analysis

THE PURPOSE OF THIS EMERGENCY PREPAREDNESS ANALYSIS

The summer of 2018 was extremely hot and dry in much of Scandinavia. There was a very high number of forest fires in both Norway and Sweden. Several of the fires in Sweden were very large. The expected consequences of climate change increase the likelihood of more long periods of drought and thus increased forest fire activity in the years to come.

The Norwegian Directorate for Civil Protection (DSB) has analysed forest fire emergency preparedness in Norway in relation to the experiences from fires in the Nordic region in recent years and expected climate change in a ten-year perspective. The primary purpose was to provide an assessment of whether current emergency preparedness can handle the forest fires we should be prepared for in the future and, if it cannot, what it will take to ensure that the emergency preparedness is good enough.

The perspective of the proposed measures is national, although the analysis also includes regional and local issues of a general nature. Changes to regulations, organisation, training, guidance and information measures, and national reinforcement measures for helicopter support and support from the Norwegian Civil Defence, Norwegian Home Guard and foreign resources were considered as part of the work.

The main focus of the analysis was on issues linked to the prioritisation and coordination of resources in the event of major forest fires that require regional or national crisis management. Important keywords are expertise, organisation, cooperation, management, responsibility and authority.

In an emergency preparedness analysis, it is the management of the event that is most important. This is a demarcation in relation to a full risk analysis, which would also assess the likelihood of the event occurring, prevention and the consequences for society. Meanwhile, an earlier risk analysis provides a backdrop for this emergency preparedness analysis.[1] The emergency preparedness analysis also takes an in-depth look at what happens once a fire is a reality, even though the most important thing will always be to prevent a fire starting and developing.

> The main question that needs to be answered by the analysis is: to what extent are we equipped to meet the forest fires of tomorrow? First, one defines a 'dimensioning forest fire' (ambition level) based on an assessment of the risk, including the expected effects of climate change in the lead up to 2030. Next, one assesses what forest fire situations can be managed with the current emergency preparedness and what it would take to be able to manage the defined dimensioning forest fire scenario. Finally, one assesses what measures would be required to manage the dimensioning forest fire in the analysis.

[1] Risk analysis of 'Three Simultaneous Forest Fires' from 2011, which is summarised in *Analyses of Crisis Scenarios 2019*.

CHAPTER

02

Background

Forests and wilderness areas represent major assets in terms of the environment, economy and quality of life. Areas of forest are very important for the climate and biodiversity, provide a livelihood for many people and are sources of adventure and recreation. Forest fires put these assets at risk. Buildings and infrastructure can also be lost in forest and wilderness fires and this can have consequences for things such as power supply, electronic communications and the usability of roads and railway lines.

Large, out-of-control forest fires can also represent a danger to human life and health. Smoke and fire damage can cause acute and chronic injuries, and, in the worst cases, claim lives. Rescue and firefighting personnel are exposed to health risks, and this can also be true for the rest of the population if they are not evacuated in time. A large number of lives have been lost in several forest fires in Southern Europe in recent years. In Norway, areas with a typical inland climate are the ones with the highest risk of forest and wilderness fires.

2.1 CLIMATE CHANGE AND FOREST FIRES

The effects of climate change in the years to come could result in both more droughts and more precipitation. The periods of drought will probably be more frequent and more intense. The increase in precipitation will, among other things, come in the form of short-lasting and local torrential downpours. There may be greater variation in weather types, both geographically and during the year.

Less snow in lowland areas in the winter, more wind, higher temperatures and more periods of drought will increase the risk of forest fires, both with respect to frequency and scope. According to a report from the Norwegian Meteorological Institute (MET), the number of days with forest fire risk could almost double from 2017 to 2100. The number of days with very high forest fire could multiply many times.[4]

The numerous fires in the winter of 2014 and summer of 2018 could indicate what we can expect in the future.

Serious events in recent years

The largest forest fire in Norway in modern times started on 9 June 2008 in Mykland, Froland Municipality, Aust-Agder County. After six days, the fire covered an area of around 30 km^2. Personnel from the local fire and rescue service were at the forefront of the firefighting efforts together with the police's operational command unit. Personnel from the Norwegian Civil Defence, Norwegian Home Guard and Norwegian Armed Forces also contributed. Efforts were stepped up as the fire developed and at its height 250–300 people and 16 helicopters were involved.

Two of the largest wilderness fires in Norway in recent times occurred in January 2014. It had been unusually dry for the season for a long time, from Western Norway to Nordland in Northern Norway, and a strong easterly wind was blowing. In Flatanger, Nord-Trøndelag, a grass fire resulted in the loss of 64 buildings, including 23 homes and holiday cottages. On the island of Frøya in Sør-Trøndelag, an area of 10 km^2 caught fire and one home was lost. Extensive evacuations were needed for both fires.

In 2018, all of Southern Norway experienced a summer with long periods of more than 25 degrees Celsius and almost no precipitation from May to August. The long dry, hot period caused drought damage to vegetation over large areas and contributed to a forest, lightning and grass fire risk far above normal. The situation was broadly the same in much of Sweden and Denmark.

On 13 July 2018, 114 forest and wilderness fires were recorded in Norway[5] and large parts of the emergency services in the affected areas were in action. Calm wind conditions helped to ensure that the situation did not get out of control. In the whole of 2018, more than two thousand grass and forest fires were recorded, almost one thousand of which were forest fires. This is the highest number of fires ever recorded in Norway.

[4] O.E. Tveito: Climate Change Impact on Forestry (in Norw.), MET report no. 25/2014

[5] The figures were obtained from BRIS, DSB's reporting system for the fire and rescue services.

The forest fire in Västmanland in Sweden in July/August 2014 was the largest in the Nordic region in recent times. A total of 140 km² of forest was lost and the damage was estimated at around SEK 1 billion.[6] In the summer of 2018, there were up to 50 major fires burning at the same time in Sweden, covering a combined area of 250 km². The counties of Gävleborg, Jämtland and Dalarna were the worst hit. There were five major fires in Gävleborg at the same time, all in Ljusdal Municipality. After just over a week, the county administrative board (equivalent to the county governor's office in Norway) assumed responsibility for the efforts in Gävleborg County. In the counties of Jämtland and Dalarna, the efforts were organised in a close cooperation between the county administrative board and the local fire and rescue services, without the county administrative board assuming responsibility.[7]

Several of the largest fires in Sweden in 2018 occurred in areas that are within 50–100 km of the national border with Norway and where the vegetation and topography are quite similar to what is found on the Norwegian side of the border.

Forest fires as a phenomenon

Forest fires can be triggered by human activity, they can be started deliberately, or they can be caused by lightning strikes. Lightning strikes can start a large number of forest fires more or less at the same time. Fires triggered by lightning strikes can occur anywhere, while fires triggered by human activity often start in areas with some traffic and thus also more infrastructure. A large proportion of the major forest fires in Sweden in 2018 were triggered by lightning strikes.[8]

Forest fires spread quickly if the conditions are right. The most important factors in this context are the dominant tree species in the forest, the density of the forest, the amount of moisture in the ground and vegetation, air humidity, topography and, not least, wind conditions.

Forest fires can be grouped into several categories. A forest fire will normally start as a running ground fire in brush and can develop to ignite tree branches and trunks. The higher up the trees the fire reaches, the faster it will spread. The most serious are so-called treetop fires where the spread is from treetop to treetop. The terrain, wind conditions and distance between the trees determine the rate of spread, which will normally be 30–40 metres per minute, although in some conditions this can reach 100–150 metres per minute, or six to nine kilometres per hour.[9]

In major forest fires, the heat that develops can become so intense it can cause strong winds in the area of the fire, which often blow in a direction other than they would in a normal weather situation. This can result in the fire spreading in unexpected directions and over greater distances.

As a phenomenon, *firestorms* have been recorded in several countries in the last few years such as, for example, Portugal, Greece and Canada. These are forest fires that develop an extremely high energy level. Local meteorological conditions created by the fire result in the hot smoke being pressed down towards the ground and quickly igniting new areas. Such fires can spread at speeds of up to 90 kmph and expand by 80–140 km² an hour. Explosive fires like this require extreme droughts and highly combustible forests, but experts cannot rule out Scandinavian countries also experiencing such fires in the future.[10] Fires like this are very difficult or impossible for firefighters to put out.

2.2 ROLES AND RESPONSIBILITIES IN FOREST FIRE MANAGEMENT

Forest and wilderness fire prevention and management in Norway is based on cooperation between municipalities and central government. Fighting fires is the responsibility of municipalities via local

[6] See: www.brannvernforeningen.no
[7] Forest Fires in the Summer of 2018 (in Swedish), Swedish Government Official Report SOU 2019:7
[8] Ibid
[9] Assessment of the Civil Defence's forest fire operations in 2018 (DSB 2019, in Norw.)
[10] Presentation by Marc Castellnou at the conference The Role of Bioeconomy in Controlling Forest Fires. Stockholm 29 May 2018 https://www. youtube.com/watch?v=5O49cusFm6w&feature=youtu.be

fire and rescue services. The police play an role, especially if fires threaten life and health. County governors contribute to the regional coordination of the efforts of various stakeholders and the government provides national assistance as required. Such assistance can consist of forest fire helicopters, personnel from the Norwegian Civil Defence and Norwegian Home Guard, management support, organising assistance from neighbouring countries or the EU, and other assistance.

At a local level

Municipal and intermunicipal fire and rescue services constitute the cornerstone of fire preparedness. There were 240 fire and rescue services in Norway in the first half of 2019. The fire and rescue services of many smaller municipalities are largely based on part-time positions. More than 60 per cent of chief fire officers are in part-time positions[11] and other fire service officers are also part-time employees. A number of firefighting cooperation arrangements have been established between municipalities. Many municipalities with a lot of forest have established extra forest fire reserves in line with regulations.[12] The Fire and Explosion Prevention Act require municipalities to cooperate on the best possible utilisation of resources, although it is up to each municipality to decide how extensive such cooperation should be.

According to section 27, paragraph one, of the Police Act, it is up to the police to initiate and organise rescue efforts where people's lives and health are threatened. This can also be the case with major forest fires. Paragraph three gives the police the authority to initiate the measures necessary to prevent danger and limit injuries even if lives and health are not threatened. Section 2-2 of the Police Instructions includes the following provision: "Upon request provide other public authorities with protection and assistance during the performance of their duties when this follows from law or custom, and otherwise intervene on their own initiative in other authorities' areas in cases where this is deemed necessary to protect life, health or important societal assets."[13]

The forestry industry can contribute personnel and machinery to both the firefighting efforts and the subsequent mopping up operations. The industry offers it members short forest fire courses organised by local fire and rescue services, primarily so they can quickly extinguish fires that occur in connection with forestry.

Local farmers often contribute equipment. For example, fertiliser spreaders can transport and spread firefighting water. Other volunteers can also contribute to the efforts, although there can be significant restrictions on their use in firefighting work.

Regional coordination

Emergencies are reported to the fire and rescue services via the regional 110 operations centre. As of June 2019, there were 14 such operations centres, although this number is being reduced to 12, one for each police district. Operations centres play an important role in requests for assistance from one fire service to another. Such assistance will generally be based on agreements made between neighbouring fire and rescue services. Fire and rescue services have a duty to provide assistance to other fire and rescue services to the extent that they can spare the resources given their own emergency preparedness situation.[14]

The 110 operations centres have their own personnel with fire and rescue service training and experience, as well as additional training in operating the operations centres. However, the operators do not have the same duties and authority as police operations centres (112). They do not coordinate efforts within their district. They only alert the responsible chief fire officer or commanding officer on call who will manage the resources from then onwards. 110 operations centres are in the process of being moved to the same premises as police operations centres (112 operations centres). This will facilitate efficient information exchange and improve the coordination between the efforts of the police and the fire and rescue services in a regional perspective.

[11] Regulation on the organisation and dimensioning of fire services, section 2-5. If a municipality has 20,000 inhabitants, it must have a full-time chief fire officer. In practice, full-time equivalence is calculated proportionately based on the number of inhabitants. For example: Rødøy Municipality in Nordland had 1,305 residents in 2014, and the minimum requirement for the chief fire officer position was at that time a 6.5 per cent position.

[12] Regulation of 26 June 2002 No. 729 on the organisation and dimensioning of fire services, section 4-12.

[13] Regulation of 26 June 1990 No. 3963 General service instructions for the police

[14] Act of 14 June 2002 relating to the prevention of fire, explosion and accidents involving hazardous substances and the fire service (Fire and Explosion Prevention Act)

The police can organise the rescue work in rescue sub centres (RSCs), which will normally be located in the police district's operations centre. Regular members of a rescue management unit, if one is established, include representatives of the Norwegian Directorate of Health (normally seconded from the specialist health service), the Norwegian Armed Forces (normally the Norwegian Home Guard), the Norwegian Civil Defence, the fire and rescue service and voluntary organisations. Joint rescue coordination centres (JRCCs) can instruct RSCs to assume responsibilities outside their own police district.[15]

County governors are mandated by instructions to assume responsibility for coordination at a regional level before, during and after a serious event.[16] The higher the number of municipalities, agencies and levels involved, the greater the need for coordination. One important tool in the coordination role is the county emergency preparedness council, which is composed of representatives of important public agencies, the emergency services, the Norwegian Armed Forces and voluntary organisations. Through sharing information and discussions, the county governor shall help to ensure agreement is reached on the measures that should be implemented.

When adverse events are reported or have occurred, the county governor and chief constables involved must immediately establish contact to assess the situation.[17]

County governors have different practices when it comes to how active they are in the acute phase of an event. For example, they can ask municipalities that are not affected by the fires to look positively on requests for assistance from the operational command unit. The main roles of the county governor and the county emergency preparedness council are to protect society as a whole, especially critical infrastructure such as power and electronic communications, and to coordinate the efforts that do not require professional firefighting expertise. County governors do not themselves have professional firefighting expertise, but fire and rescue services are represented on county emergency preparedness councils.

National coordination

DSB is the national fire authority, a role that means that the directorate has subject, administrative and supervisory responsibilities, but does not have the authority to issue instructions to the municipalities' fire and rescue services. The directorate develops legislation, regulations and guidance and administers, among others, the Fire and Explosion Prevention Act, the Civil Protection Act and Nødnett (the Norwegian Public Safety Network). DSB is the municipalities' supervisory authority with respect to fulfilment of their obligations under the Fire and Explosion Prevention Act and associated regulations. In the area of civil protection and emergency preparedness, DSB manages county governors on behalf of the Ministry of Justice and Public Security. In the event of crisis management, municipalities report to county governors who in turn report to DSB. DSB reports the overall situational picture to the Ministry of Justice and Public Security ('coordination channel'). Given DSB's coordination role[18] DSB will also initiate cooperation conferences in which county governors and involved stakeholders at a directorate level participate.

Police districts will report on the situation to the National Police Directorate, and in the event of rescue efforts to a joint rescue coordination centre (JRCC) as well. The National Police Directorate can, if necessary, manage and coordinate the police's resources across police districts. The JRCC and the National Police Directorate will also report to the Ministry of Justice and Public Security ('discipline channel').

JRCCs lead and coordinate all types of rescue actions (land, sea and air rescue services). This is done either directly by Joint Rescue Coordination Centre North Norway or Joint Rescue Coordination Centre South Norway, or by issuing missions to rescue sub centres (RSCs). Land rescues are normally addressed by an RSC. If necessary, a JRCC can assume management and coordination responsibility from an RSC during a rescue action. The chief constable of the South West Police District heads Joint Rescue Coordination Centre South Norway, while the chief constable

[15] Regulation of 19 June 2015 No. 677 Organisation plan for the rescue service

[16] Regulation of 19 June 2015 No. 703 Instructions for the county governors' and Governor of Svalbard's work relating to civil protection, emergency preparedness and crisis management

[17] Ibid

[18] 18 Regulation of 24 June 2005 No. 688 Instructions for the Norwegian Directorate for Civil Protection's coordinating roles

of Nordland Police District heads Joint Rescue Coordination Centre North Norway. The rest of the rescue management unit is made of representatives of a number of agencies, including DSB.[19]

2.3 NATIONAL REINFORCEMENT RESOURCES

Forest fire helicopters and management support
Forest fire helicopters and management support are national reinforcement resources. Thanks to an agreement between DSB and Helitrans AS, a forest fire helicopter is on permanent standby between 15 April and 15 August, mainly at Sandefjord Airport Torp. If necessary, Helitrans AS can make more helicopters available. DSB determines the number of helicopters and deploys them based on the risk picture. In 2018, 22 helicopters were made available and all were in action at the same time on 12–13 July.

There is good access to light helicopters in Norway, but since 2018 access to larger helicopters that can lift more than three metric tons of water has been very limited (the same is true for Sweden). Europe has forest fire helicopters and planes with heavy lift capacity, primarily in the south.

Joint Rescue Coordination Centre South Norway issues mission orders to forest fire helicopters based on requests for assistance from local chief fire officers relayed through 110 operations centres. Mandatory management support is triggered when forest fire helicopters are tasked with assisting a chief fire officer. Management support has been established as a permanent, nationwide on-call mechanism with experienced fire service officers, which means that leading, highly-experienced fire service officers can assist chief fire officers with complicated forest fires. DSB administers the management support mechanism via Rogaland Fire and Rescue IKS. The current management support mechanism is not large enough to deal with a large number of fires at the same time. The mechanism involves a total of 16 fire service officers, but only one person is on standby at any one time.

The Norwegian Civil Defence
The Norwegian Civil Defence is organised into 20 districts, mainly based on county boundaries (as per November 2019). In the event of a forest fire, the Norwegian Civil Defence is an important government reinforcement resource for the emergency and preparedness agencies because it can supply personnel and equipment resources for ground efforts. The Norwegian Civil Defence has a force of 8,000 male and female conscripts and is organised as part of DSB. Within each district, the personnel are divided into peace time action groups (FIGs) consisting of six officers and 16 personnel and relief and reinforcement groups for the FIGs (FIGPs). The personnel have equipment for, and some training in, fighting forest fires. Six new mobile reinforcement resources (MFEs) are important capacities with more equipment for off-road transport and pumps.

If necessary, the fire and rescue service's operational commander can request assistance from the Norwegian Civil Defence district. The civil defence staff in DSB can deploy personnel and equipment across district boundaries to where the need is greatest.

The Norwegian Armed Forces
The Norwegian Armed Forces can assist civil society in the case of various types of event, including natural disasters and accidents, "to protect human life and health and property and to maintain peace and order." Requests for assistance must be submitted as prescribed in the assistance instructions by a chief constable or the National Police Directorate to the Norwegian Armed Forces' National Joint Headquarters (FOH).[20] The Norwegian Armed Forces can also assist public authorities other than the police. Work on regulating this through specific instructions is ongoing.[21]

The Norwegian Armed Forces' most important contribution in the event of forest fires will be personnel from the Norwegian Home Guard.

[19] Regulation of 19 June 2015 No. 677 Organisation plan for the rescue service

[20] Regulation of 16 June 2017 No. 789 Instructions concerning the Norwegian Armed Forces' assistance to the police

[21] Support and Cooperation. A description of the total defence in Norway. Ministry of Defence/Ministry of Justice and Public Security 2018

HEDMARK COUNTY

Municipality	Town	Rainfall past 24 hrs.		19 June 2019	20 June 2019	21 June 2019
		Date measured	Rainfall			
Trysil	Mosanden	19 June	17,6 mm	11	0	0
Engerdal	Småbekken	19 June	0 mm	9	0	0
Nord-Odal	Sand	19 June	0 mm	9	0	0
Kongsvinger	Kongsvinger	19 June	0,2 mm	14	0	0
Kongsvinger	Prestegardstjennet	19 June	0,6 mm	0	0	0
Åsnes	Flisa	–	–	10	0	0
Åmot	Ørnhaugen	19 June	0,6 mm	2	0	0
Åmot	Landsørkje	19 June	1,7 mm	14	0	0
Alvdal	Steia	19 June	0 mm	35	29	18
Folldal	Fredheim	19 June	0 mm	3	0	0
Tynset	Hansmoen	19 June	0,1 mm	4	0	0
Hamar	Bjørke	19 June	28 mm	7	0	0
Hamar	Disen	19 June	13,6 mm	9	0	0
Hamar	Stavsberg	19 June	8 mm	8	0	0
Ringsaker	Kise	19 June	2,7 mm	6	0	0

FIGURE 1. Forest fire risk warning for Hedmark County on yr.no.

In total the Norwegian Home Guard comprises approximately 38,000 personnel. The Norwegian Home Guard has units throughout the country and is organised into four regions that in turn are divided into 11 districts and 241 areas.[22] The Norwegian Home Guard's local presence means that resources can be deployed quickly in the event of a request for assistance. However, the personnel do not have their own firefighting equipment for forest fires and nor do they train for them.

The Norwegian Armed Forces also has helicopters that, unless they are deployed in some other manner, can be tasked to join in the firefighting efforts or to transport personnel and equipment. The Norwegian Armed Forces will also be able to contribute to monitoring and situational reporting at a regional level from aircraft, organising air traffic control when a large number of helicopters are in action above a relatively confined area and host country support upon the receipt of international reinforcement resources. In the case of prolonged serious events, the Norwegian Armed Forces will also be able to contribute other equipment and materiel.

[22] See www.forsvaret.no

2.4 WARNINGS AND MONITORING

From April to August, the Norwegian Meteorological Institute (MET) performs daily calculations and updates of the forest fire weather index and provides 2-day forecasts of forest fire risk. The forest fire index is compiled for just over 100 points for which MET has precipitation, temperature and humidity observations. The index is not necessarily representative for a larger surrounding area. The calculations are published on www.yr.no.

Summer precipitation often shows considerable spatial variation. Local topography and vegetation can also significantly affect the risk of forest fires. Thus, it is challenging to provide precise local forest fire warnings. In 2018, we experienced that the effect of local downpours on forest fire risk was overestimated.

Previously, there were numerous staffed fire lookout towers in forested areas. These towers helped to ensure early warning of forest fires. As of 2018, there was only one such tower left at Linnekleppen in eastern Norway.

Some municipalities have forest fire watch agreements with local flying clubs. The aircraft monitor large areas of forest, report observed fires and provide specific information about their location and scope in order to help firefighting efforts.

Lightning strikes can be monitored via various digital reporting services such as https://www.lightningmaps.org. These services provide a good indication of where forest fires will occur after thunderstorms.

DSB is the national contact point for the EU's Emergency Response Coordination Centre, NATO and the UN. Receiving international assistance also requires preparation, nationally, and entails obligations that must be fulfilled. In the case of the forest fire in Froland, the Norwegian authorities reported a potential need for support (a 'pre-alert'), although they were able to get control of the fire without outside assistance. Sweden received significant support via the EU mechanism in connection with the forest fires in 2014 and 2018.

2.5 INTERNATIONAL ASSISTANCE

If there is a risk of national resources being exhausted, Norway can request assistance bilaterally from the Nordic countries or through the EU's Emergency Response Coordination Centre. The EU mechanism gives Norway access to capacities from other European countries, and the most common assistance in such contexts comes in the form of forest fire planes from countries in Southern Europe. The option to source helicopters from other countries is also included in the emergency preparedness agreement with Helitrans AS.

2.6 COMMUNICATION

Communication is essential for ensuring that the firefighting is effective and safe. Communications infrastructure is vulnerable in the event of a forest fire. Fires can damage base stations and the transmission network for mobile phone communications, or they can cause power outages. Nødnett's base stations have a minimum eight hours' backup power, which makes the system somewhat more resilient to power outages than commercial networks, which usually have two to four hours' battery capacity.

FIGURE 2. Storage locations for transportable base stations for Nødnett. Sources: Map: DSB, Photo: SiteService.

Norwegian Public Safety Network
DSB is responsible for the Norwegian Public Safety Network (Norweg. Nødnett), which will be the most important communication resource in the event of a major forest fire. Nødnett has a high degree of coverage, although it still does not cover everywhere where there may be a need for communication. The system is used by many of the most important stakeholders and includes functionality that facilitates efficient management even when a high number of users are involved. Nødnett also has air coverage. Forest fire helicopters do not have permanently installed Nødnett terminals and crews have to use handheld radio terminals that they bring with them to communicate via Nødnett. This is not an optimal solution and can cause communication problems between ground personnel and helicopters.

Nødnett's base stations depend on both the transmission network and power. Forest fires can cause local infrastructure to fail. In such situations, Nødnett terminals can be used locally in direct mode, albeit with limited range. Some radio terminals can be configured to function as links between radio terminals in direct mode and the rest of the network.

DSB can order the use of transportable base stations (TBSs) in the event of inadequate Nødnett coverage during, for example, forest fires. These base stations can be transported by vehicle or helicopter. The stations have their own power generators, meaning they are self-sufficient, and can also be connected to external power sources. TBSs can be connected to Nødnett via satellite and are therefore not reliant on local infrastructure.

TBSs are packed and ready for transport at any time and are stored in many locations around the country. In the case of the forest fire in Sokndal in Rogaland in April 2019, it took just over three hours to deploy the two TBSs used.

Foreign planes and helicopters that are deployed to Norway as reinforcement resources will normally be unable to connect to Nødnett.

Commercial networks
Stakeholders that are not connected to Nødnett have to use commercial networks or other forms of communication. The commercial networks generally have the same coverage as Nødnett, although there are areas that are only covered by Nødnett and some that are only covered by the commercial networks. The commercial networks do not have the same functionality as Nødnett with respect to, for example, setting up voice groups, direct mode and options for expanded coverage.

Mobile phone networks can become overloaded during major events. Users who perform particularly important tasks in society can sign priority subscriptions with operators. A priority subscription will have greater chance of getting through than other subscribers in the event of high loads or problems in mobile phone networks.

Satellite phones and the safety radio service
If ordinary electronic communications fail, it will be possible to communicate with the aid of satellite phones. Ordinary phones can usually call and receive from satellite phones and satellite telephony can therefore be a good backup solution. Satellite telephony capacity is however limited. Its theoretical capacity is around 240 simultaneous calls in an area about the size of Southern Norway.[23]

In some areas, the Sikringsradioen (safety radio) service – a VHF based system used by the forestry industry, hunters and others – might be a backup solution.

[23] Løkken, K. H., Grunnan, T. and Birkemo, G. A. (2016). Robust electronic communication in a crisis situation – An introduction to electronic communication for local and regional responders (in Norwegian). External memo 2016/01473.

2.7 LOCAL ORGANISATION OF THE FIRE AND RESCUE SERVICES' EFFORTS

DSB recommends organising municipalities' fire and rescue efforts based on a Unified Management System (UMS). This is designed to ensure efficient and nearly the same management of events such as forest fires across municipalities and counties.[24]

The management system's guide provides a general description of the functions, responsibilities, authorities and tasks that must be resolved in the management of all types of event. The designations assigned to the functions and associated tasks are used in emergency preparedness action plans, training and exercises. In the case of events of a certain scope, such as a major forest fire, tasks need to be delegated so that the operational command unit does not lose track and to ensure that all tasks can be performed in an appropriate manner. As an event and the operational force grow in size, the organisation will be able to grow accordingly. In general, it is important that no leader is assigned greater control responsibilities than what is manageable. Five people, functions or tasks is regarded as an ideal level, although in the event of major forest fires the range of control responsibilities in operational positions are often far greater.

According to UMS, good forest fire management requires:

- An up-to-date and shared picture of the situation's potential development.
- Knowing the stakeholders' responsibilities, authority, authorisations and division of responsibilities.
- An overview of stakeholders that can provide assistance.
- An assessment of the need for personnel
  - With what expertise
  - The number who should be called out or warned in advance
  - Call out system
- A quick overview of how many people are available and when
  - Ensuring safety
  - System for rotating personnel to ensure endurance over time
  - Boarding and accommodation of emergency personnel
- Assessment of the need for equipment – type, availability, transport, resupply.
- Addressing information needs, internally and externally.

Forest fires can potentially last many days and weeks and can therefore become a test of endurance. Personnel and equipment will need to be supplied continuously over time, which places great demands on management, expertise and teamwork. A forest fire requires situational judgement and an understanding of the fire's development to ensure that one can dimension and prioritise the use of resources correctly.

> Serious forest fires are characterised by rapid and unexpected growth, a lack of control, prolonged duration, a risk to life and health, uncertainty about the fire's potential, a lack of information, great media interest and considerable time pressure.

2.8 THE FIRE AND EXPLOSION PREVENTION ACT

The Fire and Explosion Prevention Act[25] and associated regulations give municipalities a duty to deal with fires, including forest fires. Municipalities have to conduct risk and vulnerability assessments so that fire and rescue services can be adapted as best as possible for the tasks they may face. The fire and rescue service in each municipality has a duty to provide assistance to other municipalities and must do so to the extent that they can spare the resources given their own emergency preparedness situation.

[24] User Guidelines for the Norwegian Incident Command System (in Norwegian). (DSB, Norwegian Environment Agency, Norwegian Coastal Administration, 2011)

[25] Act of 14 June 2002 relating to the prevention of fire, explosion and accidents involving hazardous substances and the fire service (Fire and Explosion Prevention Act)

According to the Fire and Explosion Prevention Act, authority in the area of prevention is normally delegated to the chief fire officer in the municipality. As far as authority in connection with fires and other accidents is concerned, a chief fire officer's authority stems directly from the law, ref. section 12 of the Fire and Explosion Prevention Act. All of the authority necessary to lead and coordinate a fire and rescue service's efforts therefore lies with the chief fire officer. This authority also includes managing forest and natural fires, irrespective of size.

In the Regulation on the organisation and dimensioning of fire services[26] the following provisions are relevant with respect to forest fire emergency preparedness:

- If after assessing risk and vulnerability, the municipality identifies situations that cannot be addressed through the Regulation's minimum requirements, special preventive measures and cooperation agreements, etc., the fire service shall be provided with further resources (section 2-4)
- When satisfactory emergency preparedness cannot be achieved in some other manner, the municipality has a duty to sign up personnel for service in the fire service (...). Such signing up shall be done for a limited period (section 4-4)
- The chief fire officer, or the person in command on the chief fire officer's behalf, can request assistance as soon as a fire or accident threatens to grow beyond what the established emergency preparedness can manage (section 4-10)
- In situations where the fire risk is significantly higher than normal, the municipality shall introduce a higher level of emergency preparedness, increase watches, pre-deploy equipment and take other similar measures
- (section 4-11)
- In areas where there is a significant risk of forest fires, the chief fire officer shall, in consultation with the local forestry authorities, organise a special reserve force for action in the event of such fires. Such a reserve force shall undergo training in relevant duties. (section 4-12)
- The total operational force shall number at least 16 people, at least four of whom must be qualified as operational commanders (section 5-1)

The regulations for preventing fires establish a general ban on campfires in forests and other wilderness areas in the period 15 April to 15 September. A municipality can deviate from this if local conditions indicate that it is justifiable. However, campfires are permitted in locations where it is obvious that they will not cause a fire.[27]

[26] Regulation of 26 June 2002 No. 729 on the organisation and dimensioning of fire services

[27] Regulation of 17 December 2015 No. 1710 on fire prevention

CHAPTER

03

Procedure for the emergency preparedness analysis of forest fires

An emergency preparedness analysis is more limited and detailed than a risk analysis, which is intended to outline the entire risk picture from causes to the consequences for society.[28] An emergency preparedness analysis assumes that the event has occurred, and its causes and likelihood are therefore not assessed. The focus is on management of the event, and this influences the consequences of the event.

3.1 ANALYSIS QUESTIONS

An emergency preparedness analysis starts with defining what the dimensioning event ought to be, in this case the sort of fire the emergency preparedness should be dimensioned to manage. This will indicate the level of ambition for the forest fire emergency preparedness in Norway. What is a 'dimensioning forest fire' is determined in the analysis on the basis of risk assessments. In this analysis, we have based our determination of what a dimensioning fire is on a risk analysis of 'Three Simultaneous Forest Fires' conducted by DSB in 2011[29], the experiences from 2018 and the expected effects of climate change.

The next step in the analysis is to assess which forest fire situations we could manage with the current emergency preparedness. This is done based on our experience of managing different forest fires at a local and national level. What could we manage in a controlled manner and what situations would be challenging? By 'manage' we mean gain control of the fire before it has further unacceptable consequences.

Finally comes an assessment of whether we could manage the dimensioning forest fire in the analysis with the current emergency preparedness or whether it would be inadequate. If the dimensioning forest fire could not be managed today, one will need to either strengthen the emergency preparedness with new measures or reduce the level of ambition.

The effects of the various measures intended to strengthen the emergency preparedness must be assessed.

The analysis questions that must be answered are:

1. Level of ambition: What is a dimensioning fire in a ten-year perspective? What sort of a forest fire should we be able to manage?
2. Current emergency preparedness: What sort of forest fire could we manage today?
3. Required emergency preparedness: What would it take to be able to manage the dimensioning forest fire in the analysis? What are the weaknesses in the current emergency preparedness?
4. Initiative: What are effective measures for strengthening the forest fire emergency preparedness?

3.2 EMERGENCY PREPAREDNESS ANALYSIS MODELS

DSB has based its procedure for the emergency preparedness analysis on two models: NORSOK Standard Z-013N Risk and Emergency Preparedness Analysis[30] and a bow tie model for the analysis of adverse events. The first model specifies the steps in an emergency preparedness analysis and the relationship between risk analyses and emergency preparedness analyses. The second shows what part of the sequence of events is being analysed.

The NORSOK standard for emergency preparedness analyses

The NORSOK standard defines an emergency preparedness analysis as follows: *Establishment of defined situations of hazard and accident (DSHA), including major dimensioning accidental events (DAEs), establishment of performance requirements for emergency preparedness and their fulfilment and identification of emergency preparedness measures*.

[28] For example, the national risk analyses in Analyses of Crisis Scenarios 2019, DSB

[29] Published for the first time in the National Risk Assessment 2011 updated in Analyses of Crisis Scenarios 2019

[30] Norwegian edition from 2001 and English edition from 2010

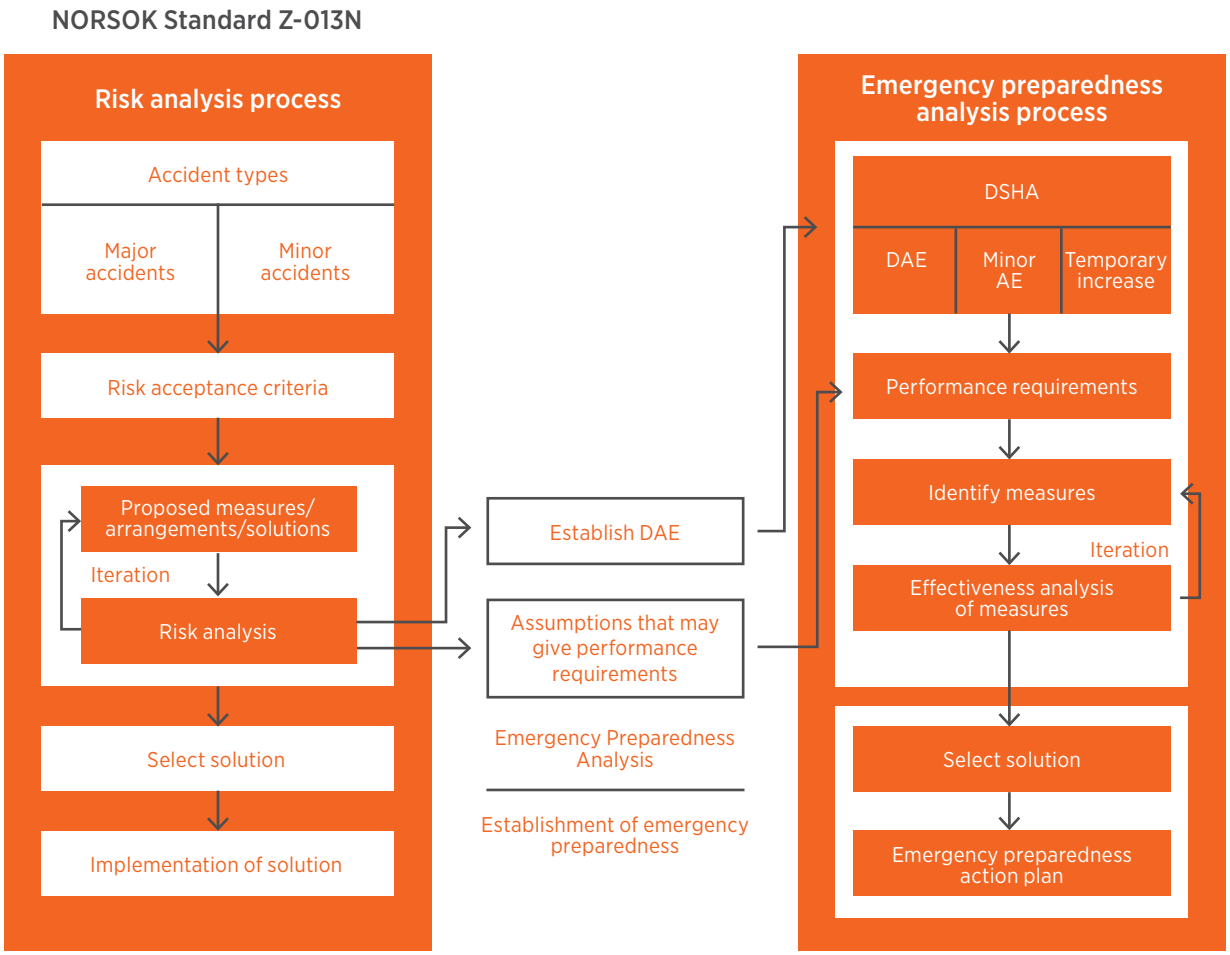


FIGURE 3. Figure taken from NORSOK Standard Z-013N Risk and Emergency Preparedness Analysis. DAE is short for dimensioning accidental event, while DSHA is short for defined situations of hazard and accident.

Figure 3 shows the relationship between risk and emergency preparedness analyses. A risk analysis that provides a basis for establishing the dimensioning accident event must be available prior to an emergency preparedness analysis. Both the likelihood and consequences must have been assessed in order to identify what sort of event should be dimensioning for the emergency preparedness.

Managing the dimensioning event requires a certain level of emergency preparedness. The sort of events that the current emergency preparedness could manage must be analysed in order to assess whether it is adequate for the dimensioning event as well. If there is a gap between the existing and an adequate level of emergency preparedness, new emergency preparedness measures must be considered. The effects of these measures must be examined in order to dimension them correctly. If it is not possible to achieve an adequate level of emergency preparedness, the dimensioning event (level of ambition) must be reduced.

The figure on the next page illustrates the steps in the emergency preparedness analysis for forest fires.

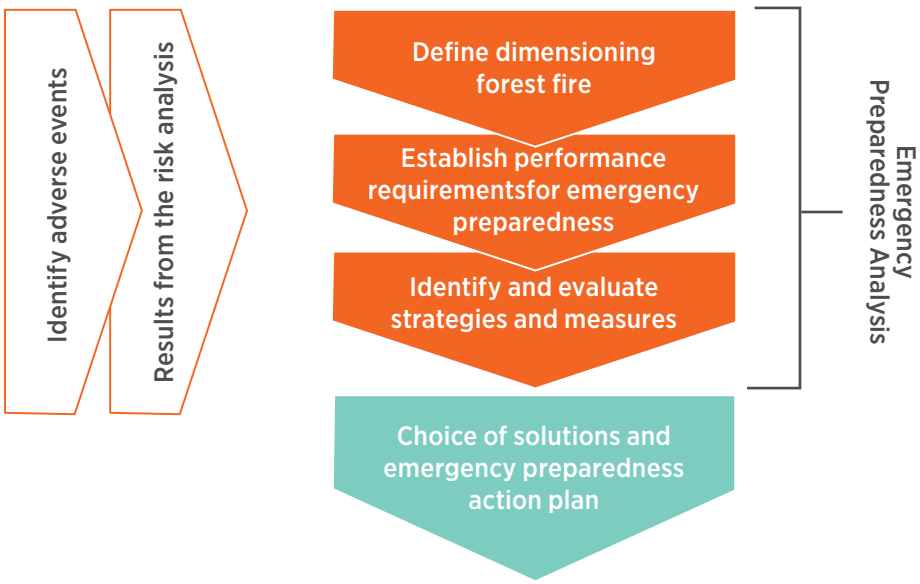


FIGURE 4. Simplified figure based on NORSOK Standard Z-13 showing the relationship between risk and emergency preparedness analyses and the three steps in the emergency preparedness analysis.

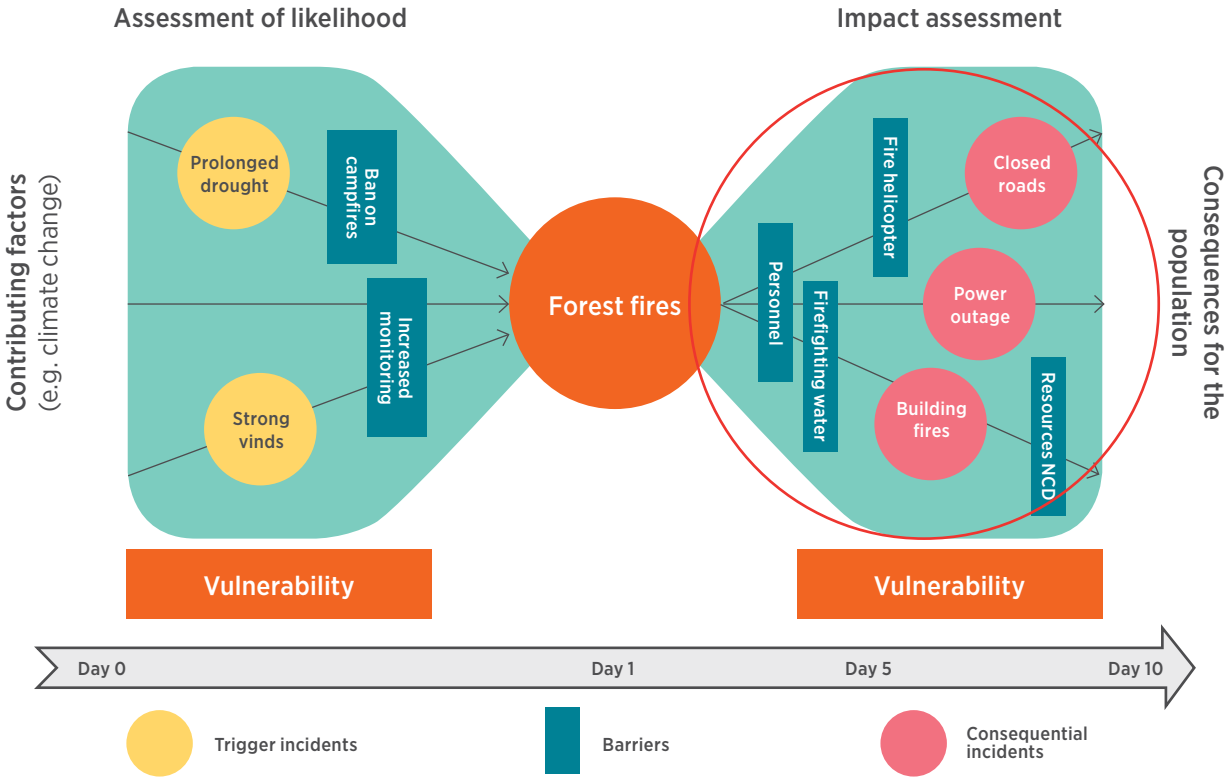


FIGURE 5. Bow tie model showing the entire sequence of events in an adverse event from contributing factors to the consequences for the population. While a risk analysis focuses on the entire sequence, the focus in an emergency preparedness analysis is on barriers and management assuming that the adverse event has occurred (red circle).

Bow tie model for adverse events
A bow tie model can be used to illustrate the sequence of events that are going to be analysed, ref. Figure 5. The whole figure shows what is included in a risk analysis, while the red circle on the right shows the contents of an emergency preparedness analysis.

An emergency preparedness analysis does not assess the triggering events, contributing factors or likelihood mitigation barriers on the left-hand side of the bow tie diagram.

An emergency preparedness analysis assumes that the event has already occurred and assesses how it will be managed (illustrated by the red circle in the figure above). Measures will be consequence mitigation barriers, often aimed at strengthening management capacity. These are shown on the right-hand side of the model.

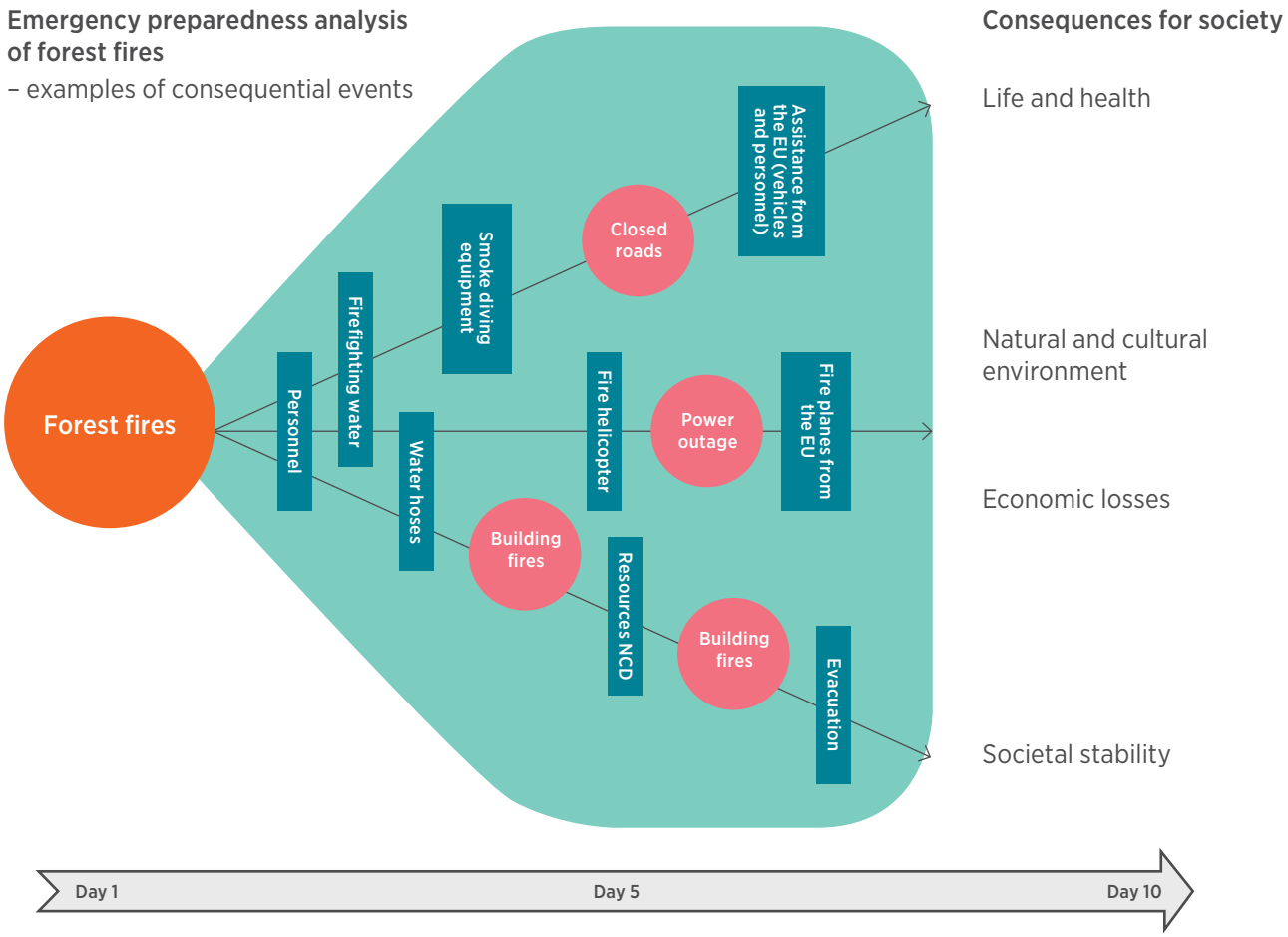


FIGURE 6. Emergency preparedness analyses study the sequence of events after the adverse event has occurred and focus on any consequential events and established or proposed consequence mitigation barriers (the consequential events and barriers in the figure are examples only).

3.3
ANALYSIS PROCESS

The analysis process is divided into three phases: information collection, a full-day seminar with experts in the subject, processing the information and quality assurance of the report.

DSB took the initiative concerning the analysis as the competent authority for the area of fires. The work commenced in February 2019. An analysis seminar was held on 29 April with around 30 participants from various fire services and a number of other stakeholders. See the participant list in Appendix 1. A preliminary analysis was presented at a meeting of the national fire science board in June.

FIGURE 7. The phases in the emergency preparedness analysis.

CHAPTER

04

Description of the forest fire scenarios

This emergency preparedness analysis is based on a scenario approach. The analysis is conducted against the backdrop of the big forest fire in Västmanland in Sweden in 2014, the summer drought and wildfires in 2018 in Sweden and Norway and the expected impact of climate change on the risk of forest fires in the years to come.

The situation in mid-July 2018 was considered extreme in both Sweden and Norway. In both countries, there were many fires. In Sweden, some of them increased considerably in size, whereas Norway managed to get the fires under control at an earlier stage. However, given more unfavourable wind conditions, the situation could have become much worse in Norway as well.

In light of climate change, we have to be prepared for conditions that one day can lead to similar events in Norway as those experienced in Sweden in 2018.

4.1 BACKGROUND FOR THE CHOICE OF SCENARIOS

Norway generally bases its work on generic emergency preparedness action plans. In a small country, it would be inappropriate and disproportionately expensive to maintain national emergency preparedness arrangements designed for special types of event. To the degree that special arrangements exist, they are designed for events with a relatively high likelihood of occurring. At a national level, relatively specific plans exist for pandemic/epidemic emergency preparedness, oil spill emergency preparedness and nuclear emergency preparedness. These are risk areas where the annual likelihood of serious events occurring in ACS 2019 is estimated to be of the magnitude of 1 per cent or higher, although no such threshold has been set as a principle. The plans are largely based on dimensioning scenarios.[31]

In connection with the work on the National Risk Assessment (now called Analyses of Crisis Scenarios (ACS)) in 2011, an analysis was conducted of a situation involving three simultaneous major forest fires in Southern and Eastern Norway. Each of the fires was of a scale similar to the fire in Froland in Aust-Agder in 2008, the largest forest fire in Norway after 1945. The analysis was reviewed and updated most recently in connection with the publication of ACS 2019, although the likelihood of the scenario was not reassessed.

The 'Three Simultaneous Forest Fires' scenario was estimated to have a likelihood of 1 per cent in 2011. According to a report from the Norwegian Meteorological Institute (MET) for Skogbrand Forsikring from 2014, the number of days with forest fire risk in Eastern Norway may have doubled by the end of this century, and the number of days with a very high forest fire risk may have multiplied many times over in this period.[32] Therefore, there is much to indicate that the annual likelihood of the ACS scenario is already higher than 1 per cent and that even more serious scenarios should be assessed.

This analysis is based on the situation in 2030 and we have assumed that by then the number of days with a very high forest fire risk may be double what it was in 2011. A forest fire event with a 1 per cent annual likelihood in 2030 may therefore be equivalent to an event with a 0.5 per cent annual likelihood in 2011. Based on this, the 'Three Simultaneous Forest Fires' scenario, which is summarised in ACS 2019, would thus have an annual likelihood of 2 per cent.

Given this, a new scenario has been developed that it is estimated would have an annual likelihood of 1 per cent in 2030. This is a scenario involving three simultaneous major forest fires (as well as some smaller ones), where the largest is of a scope that is roughly equivalent to the largest fires in Sweden in 2014 and 2018. This scenario is regarded as a relevant starting point for an assessment of what the future forest fire emergency preparedness should be capable of managing, in other words, a possible dimensioning scenario.

Two other scenarios are also included in the analysis. The first is a scenario of similar seriousness to the

[31] For more specific events linked to local conditions, for example accidents at specific industrial facilities, rockslides, etc., emergency preparedness analyses are conducted, and emergency preparedness action plans established even though their likelihood is far lower than this.

[32] O.E. Tveito: Climate Change Impact on Forestry (in Norw.), MET report no. 25/2014

one in the analysis from 2011 (annual likelihood of 2 per cent in 2030), the second is an even more serious scenario than the dimensioning scenario, with an annual likelihood of around 0.5 per cent in 2030.

The indication of likelihood is a rough one and based on a projection of earlier analyses in which the effects of climate change have been taken into account. Fires of the magnitude experienced in Sweden in 2018 are undoubtedly also possible in Norway and the likelihood of very large forest fires will increase during this century.

The scenarios are referred to in the text as 'Level 1', 'Level 2' and 'Level 3', where the first is the least serious and 'Level 2' is tentatively dimensioning. The locations of the three fires were determined based on input from, among others, the Norwegian Institute of Bioeconomy Research (NIBIO). The assumed weather situation is described by the Norwegian Meteorological Institute.

4.2 THE SITUATION AT THE START OF JUNE, END OF JULY

At the beginning of June, a high-pressure system builds up over Southern Norway and remains stationary for several weeks. It is hot and the risk of forest fires increases to a very high level. The wind conditions are generally calm, albeit with some land and sea breezes from the southwest on the coast.

A series of small and medium-sized forest fires occur during June. These require significant resources from the local fire and rescue services and the Norwegian Civil Defence. DSB has 22 light and medium-heavy forest fire helicopters at its disposal and all of them are in action. However, four of them are on loan to Sweden and Finland, where the fires are larger and several are out of control.

After four weeks, i.e. 1 July, the high-pressure system moves eastwards and there is an increasingly southerly wind field. In the daytime, the wind along the coast reaches a strong southwesterly breeze. There is less wind further inland, although there is still a fresh breeze (10 m/s) in many places. At night, the wind is weaker: a gentle southwesterly breeze (3–5 m/s).

On 2 July, around 50 forest and wilderness fires are reported in Southern Norway, most of them along the south coast and in Eastern Norway, although there are also some fires in Western Norway and Trøndelag. All of the forest fire helicopters are in action. Sweden and other countries in Northern Europe have also been hit hard.

A number of fires along the south coast and in Eastern Norway are now getting out of control, and within a short space of time three of them become significant in scope.

4.3 LOCATIONS OF THE FIRES

The locations of the three largest forest fires were:

A. The Neslandsvatn fire
The fire started in the area to the northeast of the centre of Gjerstad in Aust-Agder and is gradually spreading northwards in the direction of the village of Neslandsvatn (300 inhabitants) in Drangedal Municipality, Telemark County.

B. The Darbu fire
The fire started in the area to the northeast of the centre of Kongsberg in Buskerud and is gradually spreading northwards on both sides of the E134 highway in the direction of Darbu (600 inhabitants) and Ormåsen (1,500 inhabitants) in Øvre Eiker Municipality. Several important power lines run through the northernmost part of the area.

C. The Trysil fire
The fire started in the area to the west of Nybergsund in Trysil (Hedmark County) and is spreading northwards along the west bank of the River Trysil towards Innbygda (2,400 inhabitants), the holiday cottage areas to the north and south of the Trysilfjell mountain area and further northwards. The Trysilfjell mountain area contains many thousands of holiday cottages.

4.4 LEVEL 1: THE SITUATION ON 4 JULY

The forest fire risk is now extremely high throughout all of Southern Norway. Around 50 small and medium-sized fires are burning. Many fire services have all of their available personnel in action. A number of fires are out of control in Sweden, Finland and the Baltic States.

A total of 1,000 firefighters are fighting the fires i Southern Norway. The Norwegian Civil Defence also has 1,000 conscripts in action. All of the forest fire helicopters have been deployed in the management of fires (although four are still out of the country). It is the holidays, and both the fire and rescue services and the Norwegian Civil Defence are struggling to get hold of operational personnel. The forestry industry has suspended felling and has put its resources at the disposal of the fire services. The Norwegian Civil Defence's leadership is assessing and prioritising the efforts of the Norwegian Civil Defence's resources. Firefighting continues around the clock.

A request for assistance has been sent to the Norwegian Armed Forces. Both helicopters and personnel are needed. Norway notifies the EU that it may make a request for assistance via the Civil Protection Mechanism. However, limited resources are available because of the many ongoing forest fires in our neighbouring countries. Norway still has four helicopters in Sweden and Finland.

The three major fires, A, B and C, are out of control and as per 4 July each of them covers 15–29 km^2. (The largest is about the same size as the Froland fire in 2008).

Fire A is threatening buildings in Haugland, Brødsjøvatnet and Rød in Drangedal Municipality. The Sørland Line (railway) is closed. The local fire service in Østre Agder and Drangedal has called out all of its available personnel and is receiving some help from the fire services in Skien, Porsgrunn and other places, which meanwhile also have other fires they must use their resources on. A total of 75 personnel from the fire and rescue service, including the forest fire reserve and organised volunteers, are involved. The Norwegian Civil Defence has 30 FIG and FIGP units from multiple Norwegian Civil Defence districts involved. The Mobile Reinforcement Unit (MFE) from Kristiansand is also involved (ref. section 2.3). A total of 400 Norwegian Civil Defence personnel are involved. Two helicopters are in action, but the chief fire officer in Drangedal has requested more to prevent the fire reaching built-up areas.

Fire B is threatening buildings in Darbu in Øvre Eiker Municipality. A good number of homes have burned down on both sides of the E134 highway. The E134 highway and county road Fv72 (Gamle Kongsbergvei) are closed. The Kongsberg and Drammen region's fire service have mobilised all of their available resources (100 firefighters, including the forest fire reserve, and volunteers). The Norwegian Civil Defence has 12 FIG and FIGP units and around 230 personnel involved. Four helicopters are in action.

Fire C has ignited a number of holiday cottages on the southern side of the Trysilfjell mountain area. Most of the cottages have turf roofs that are very dry and the vegetation surrounding the cottages is also bone dry. The fire is also threatening a campsite with 250 caravans. Buildings in Innbygda, the municipal centre of Trysil, are also in the danger zone. Midt-Hedmark fire and rescue service is trying to gain control of the fire, but several other locations in the district are also on fire and this is limiting the available resources. A total of 50 firefighters are involved in the firefighting, together with 100 from the forest fire reserve. Other fire services in Hedmark have been asked to help, but many are fully mobilised and in action fighting other and smaller forest fires.

> The personnel resources indicated for each fire are those present at the fire site. However, in such large and extensive fires as these, personnel will have to be rotated. Some will have to be resting at any given time. This means that the resources that are available for active firefighting at any given time are a good deal fewer than the quantity specified in the text.

The Norwegian Civil Defence has 15 FIG and FIGP units from Hedmark and Oslo og Akershus Norwegian Civil Defence district involved, and the MFE from Oppland Norwegian Civil Defence district is assisting Hedmark Norwegian Civil Defence district with the mission. A total of around 270 operational Norwegian Civil Defence personnel are involved. Five helicopters are participating in the firefighting.

FIGURE 8. The situation along the south coast and in Eastern Norway on 7 July.

4.5
LEVEL 2: THE SITUATION ON 7 JULY

The three fires are still out of control and now cover 50–87 km². (The largest fire is about the same size as the largest fire in Sweden in 2018). Other fires are also out of control, including in Setesdal, Seljord, Siljan, Flesberg, Ringerike, Elverum, Gausdal and near Rena. Some fire services have recalled personnel from holiday. The situation in other parts of the country and in our neighbouring countries otherwise remains unchanged.

Two fire planes arrive from France, and three extra helicopters have been sourced from Germany and Austria through Helitrans AS. The helicopters on loan to Sweden and Finland are brought home.

The Norwegian Armed Forces have made six helicopters available. In total, 31 helicopters are now available for firefighting and transporting personnel and equipment. The Norwegian Home Guard has called up 800 personnel who are nearly ready action, although due to the lack of equipment it is difficult to make full use of these reserve personnel.

The Civil Defence brings in crews from central, western and northern Norway, largely to relieve crews who have been in action for quite a while. Many volunteers sign up, and some start fighting the fires without being organized and more or less on their own.

Fire A is now threatening the village of Neslandsvatn. The buildings in Haugland, Rød, Brødsjøvatnet and Sørter have partly burned down and others are still in the danger zone. The Sørland Line and county road Fv256 between Sannidal and Neslandsvatn are closed. All mobile phone and Nødnett base stations have been lost and there are major problems with communications between the ground personnel, helicopters and operational command unit. All available firefighting resources in Agder and Telemark have been mobilised. 200 firefighters and 150 personnel from the forest fire reserve are now involved in fighting this fire. The Norwegian Civil Defence has ten extra units and around 200 extra personnel from several Norwegian Civil Defence districts involved, meaning it now has a total of 600 personnel in action.

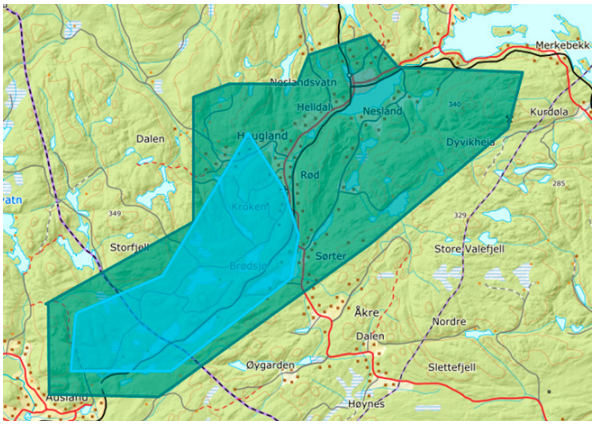


FIGURE 9. Fire A – the Neslandsvatn fire. Level 2, 7 July: Circumference 35 km, area: 50 km²

Fire B has ignited buildings in Darbu and has reached the large residential area at Ormåsen to the west of Hokksund. The electricity has been switched in the power lines running through the area. Sparks are falling over Vestfossen, raising fears that the protected wooden house environment at Fossesholm Manor will be ignited. The E134 highway, county road Fv72 and the Sørland Line are closed. All available firefighting resources in Nedre Buskerud (150 firefighters and 50 personnel from the forest fire reserve) are involved in the firefighting. The Norwegian Civil Defence has received extra support from unaffected districts, six units and 100 personnel, meaning that a total of around 330 personnel are now in action.

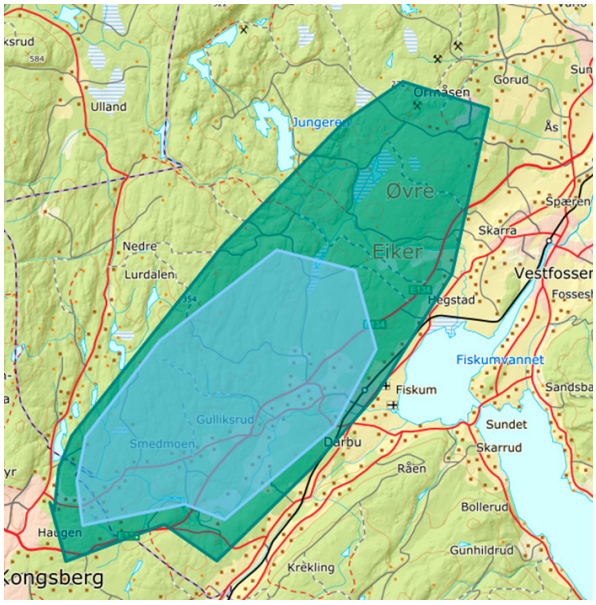


FIGURE 10. Fire B – the Darbu fire. Level 2, 7 July: Circumference 32 km, scope 50 km²

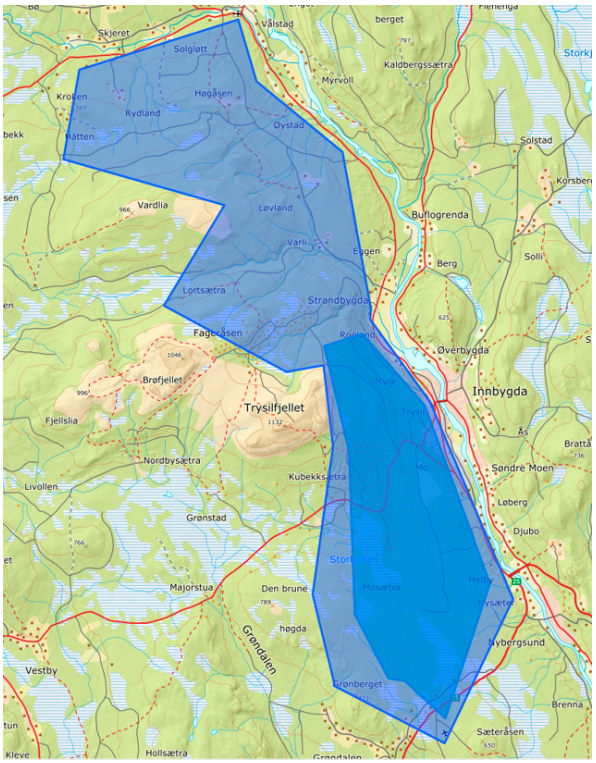


FIGURE 11. Fire C – The Trysil fire. Level 2, 7 July: Circumference 56 km, area 87 km²

Fire C continues to threaten Innbygda. Several hundred holiday cottages to the south of the Trysilfjell mountain area have been lost and many are still in danger. The fire is now threatening the large holiday cottages areas on the north side of the mountain. Caravans in Trysilelva Camping and buildings in Innbygda on the west bank of the River Trysil are on fire. 80 firefighters and 200 personnel from the region's forest fire reserve are in action. The Norwegian Civil Defence's forces have been strengthened with 100 new personnel from six units, such that around 370 personnel are now in action.

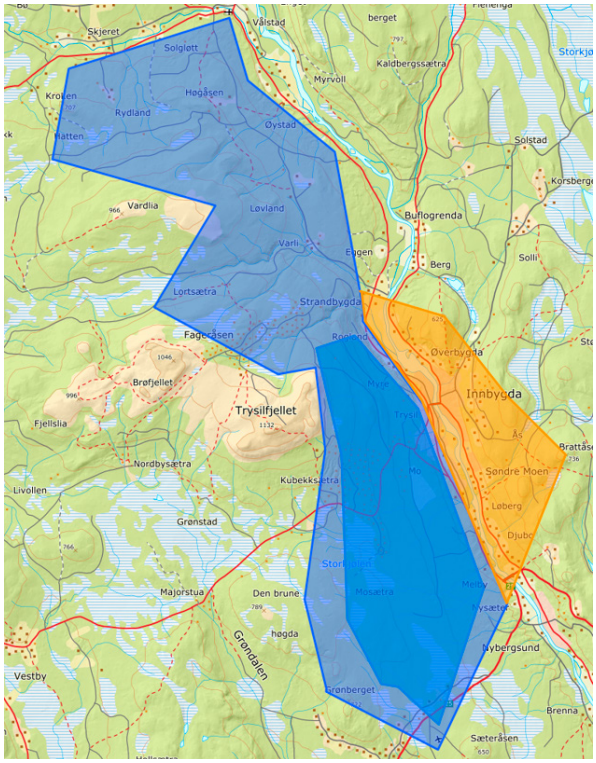


FIGURE 12. Fire C – The Trysil fire. Level 3, 9 July: Area: 112 km²

4.6
LEVEL 3: THE SITUATION ON 9 JULY

The fires are still not under control and the forest fire risk remains extremely high throughout Southern Norway with many smaller and medium-sized fires. Many fire services and the Norwegian Civil Defence report that resources are becoming exhausted. All of the personnel need rest. A lot of equipment has been lost in the fires and other equipment needs maintenance. The situation in our neighbouring countries remains serious.

Fire A: Village buildings in Neslandsvatn are burning.

Fire B: The fire has ignited a large proportion of the buildings in Darbu and some houses in Ormåsen. Flying sparks continue to threaten Vestfossen, where small fires continue to occur. The electricity in the power lines running through the area is still turned off.

Fire C: In the afternoon, the fire suddenly spreads, unexpectedly and at great speed, southwards. Within the space of half an hour, buildings in Innbygda on both sides of the River Trysil catch fire, and the same happens to large areas of forest to the east of the river.

The forest fires will burn for several weeks after 9 July and the subsequent mopping up operations and clean-up will carry on for several months. Given the scale of the forest fires here, the weather conditions will have a major impact on their duration. Precipitation will especially have an impact, although changes in wind direction may also be important.

CHAPTER

05

Consequential events and consequences of the forest fires

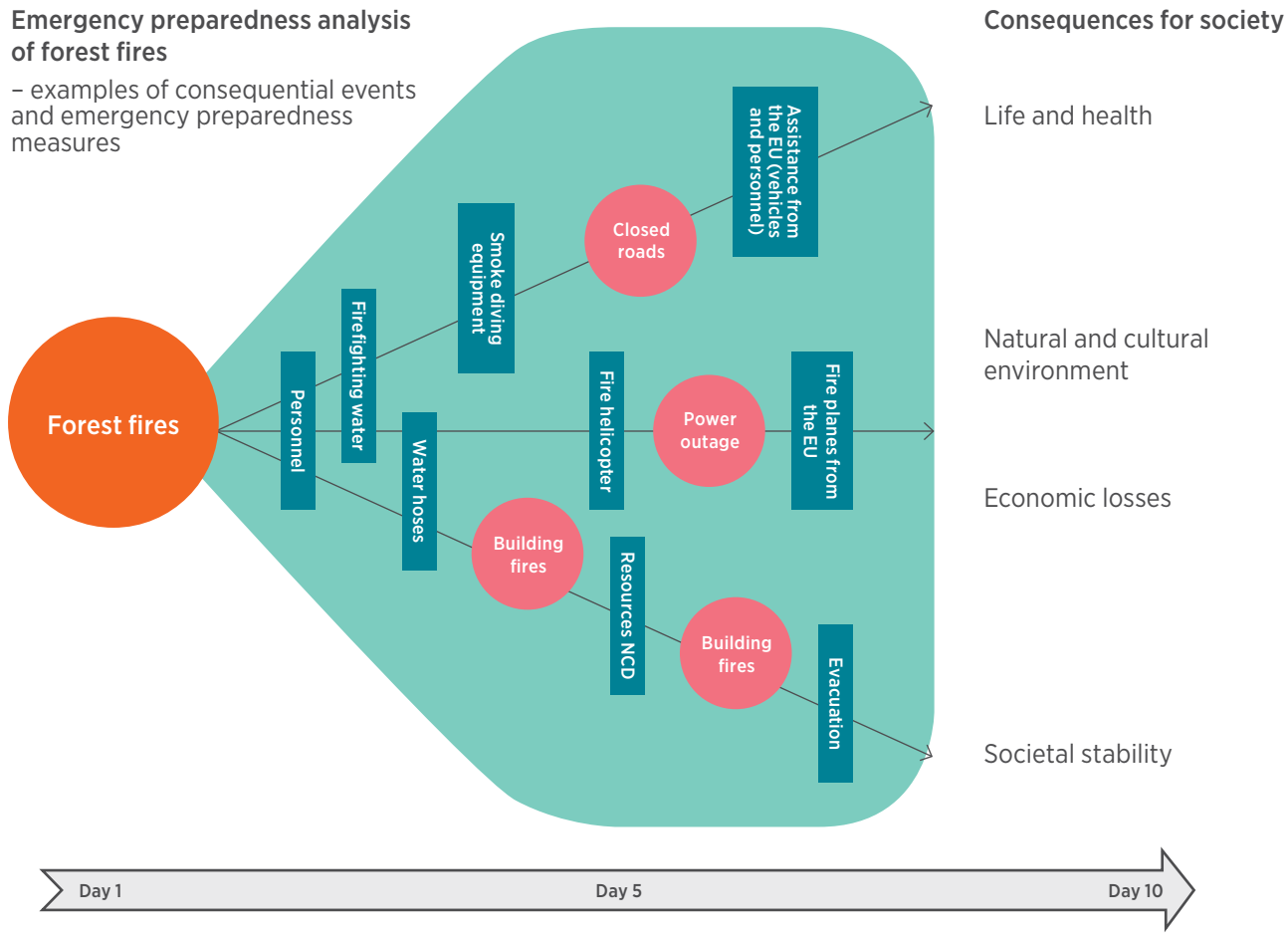


FIGURE 13. The figure shows the right-hand side of the bow tie model that is analysed in an emergency preparedness analysis (ref. chapter 3 Procedure).

Consequential events are events other than the main event that a forest fire can cause and that can impact the management of the fire and have consequences for the population. The analysed consequential events are illustrated in the figure above.

The consequences for the population (the four societal assets on the far right of the figure) are caused by the main event, the forest fire, by the consequential events (marked as circles) and by the barriers/emergency preparedness measures (marked as bars).

5.1 CONSEQUENTIAL EVENTS OF THE FOREST FIRES

Power supply
In general, forest fires primarily cause local power outages. It takes a lot to impact the transmission grid so seriously that it results in outages over larger areas.

The likelihood of transformer substations being so heavily damaged that they will require total renovation and be disconnected for a prolonged period is regarded as very low. Transformer substations are built to mitigate the risk of damage caused by fires.

However, if a fire impacts an area where a transformer substation is located, the substation will still have to be disconnected until the fire has passed.

In the event of a forest fire, there will be time to plan for the possible disconnection of some substations if one sees that the substation is in the danger zone. The power company can then prepare by, for example, rerouting the power grid and regulating power generation such that one is not reliant on the substation.

Fire A: The fire near Neslandsvatn represents no risk to the power supply at a national or regional level. At a local level, the power supply in the area of the fire and adjoining areas would be disconnected. Adjoining areas would mainly include areas from which people have been evacuated. Power supplies to other customers in Drangedal Municipality would not be impacted. However, the possibility of backup supply in case of other events would be somewhat weakened. A fire such as that described in the scenario would cause major damage to the overhead grid and grid substations within the area of the fire. Restoring damaged grid substations and high voltage lines would take around two to four weeks.

Fire B: Important power lines run through the area impacted by the fire. Disconnecting, or damage to, the lines would impact, but not cause outages in, the power supply in the Eastern Norway region since there is a lot of grid infrastructure in the area and a lot of redundancy. However, in the Darbu area, it is likely that there would be local, and some regional, power outages if an important transformer substation had to be disconnected because of the forest fire.

Fire C: In the Trysil area, operational disruptions would occur if an important transformer substation had to be disconnected, although the Norwegian Water Resources and Energy Directorate (NVE) does not regard this as very likely. There is a greater likelihood that regional grid lines that supply Trysil would be impacted by a fire. If the fire resulted in the disconnection of both lines that supply Trysil, there would nevertheless be sufficient capacity to supply the area from a transformer substation further south in the municipality. In the holiday cottage areas in the Trysilfjell mountain area most of the supply has been constructed as a buried cable system and would be largely unaffected by the forest fire.

If the fire spread to both sides of the river in Trysil, this would probably result in almost the whole of Trysil Municipality experiencing power outages for shorter or longer periods, depending on how long the fire lasted and any damage the fire caused to the line network.

Electronic communications

Electronic communications could be impacted by power outages or the base stations and the transmission network being damaged by the fire. In the event of damage to base stations and infrastructure, repair times would depend on the extent of the damage and might range from hours to several days.

In the event of power outages, generators and batteries are supposed to provide capacity and coverage in the networks. Most base stations use batteries as their backup power source. The batteries in commercial networks have capacity for two to four hours of power supply and at least eight hours in Nødnett, and outages would occur gradually as the batteries run out. Those base stations and transmission points equipped with generators would function for as long as they were refuelled and did not malfunction.

It is common for fibre cables to be cut in connection with clean-up work that requires excavation. The various mobile phone operators largely use shared infrastructure out to the base stations, and it is thought that the consequences for the various operators would be relatively similar. Nødnett is generally more resilient than commercial networks with respect to interruptions to transmission since Nødnett base stations are linked together in a ring structure. In the event of interruptions to transmission at one point, the traffic can be rerouted the opposite way. Nødnett is also based on radio line transmissions to a greater degree than the commercial networks.

Nødnett has options for compensating for coverage failures by using functions such as direct mode and repeaters for expanded coverage, ref. section 2.6.

Fire A: The area's Nødnett base station would drop out when the fire reached level 2. Several important areas in the fire zone would lose coverage, others would experience reduced signal strength[33].

[33] Reduced signal strength could result in indoor terminals not having coverage.

The fire service would largely be able to compensate for the failure in coverage by using other functionality in Nødnett.

There are three commercial network base stations in the area that would be impacted by the Neslandsvatn fire. None of these base stations are equipped with emergency generators and would, in the event of a power outage, consequently fail after two to four hours. It is also deemed likely that these base stations and other infrastructure (fibre cables) in the impacted area would be destroyed in the fire. Some of the area affected by outages would in all likelihood be covered by overlapping coverage in the area, although local outages of the internet and landline and mobile phone networks would occur.

Fire B: There are no commercial network base stations or Nødnett base stations in the area that would be impacted by the Darbu fire. The base stations located outside the area, and that provide coverage within the area, are believed to be supplied with power from adjoining built up areas. As long as these base stations were not affected by a power outage in the area, the fire would not have consequences for electronic communications services.

Fire C: One of Nødnett's base stations would be lost when the fire reaches level 2, and this would result in the loss of communication with helicopters on transport missions in and out of the area. The forest fire helicopters would, however, not be impacted. There would be overlapping coverage from other base stations in the area affected by the fire, albeit with lower signal strength and some increase in the likelihood of capacity problems.

Around 15 base stations are located in the area impacted by the Trysil fire. Few or none of these base stations are equipped with a permanent emergency generator set and would, in the event of a power outage, drop out after two to four hours. It is also deemed likely that these base stations and fibre cables in the impacted area would be destroyed in the fire. Some of the area affected by outages would in all likelihood be covered by overlapping coverage in the area, although local outages of the internet and landline and mobile phone networks would occur.

Usability of roads and railway lines

If major and important stretches of road are closed, it is important to maintain emergency preparedness on other roads in the area. There will often be a need to improve the road network in the impacted area to ensure access for the operational personnel. In these circumstances, contractors will have to be safely escorted into the area.

Power outages can also impact traffic systems over large areas. The Norwegian Public Road Administration's traffic control centres (TCCs) that monitor the traffic systems are alerted in the event of power outages by alarms sounding. TCCs will lose communication with all the safety equipment in tunnels and signs and boards will go dark. Battery-based backup power has generally been installed for the most important functions, although these will run out after an hour.

If the TCCs lose communications and a tunnel loses power, the tunnel will be closed, and mitigation measures will be considered. Such measures could be setting up fixed signs, establishing guards, driving in convoys, etc.

Railway lines can be directly impacted by fires making it unsafe to operate trains. The impact may also be indirect in that the power supply, signalling systems or communications between train operators and train traffic control centres fail.

The forest fires would result in a number of closed roads in the impacted areas. Railways lines would also be impacted by the fires.

Fire A: The Neslandsvatn fire would mainly affect county road Fv256. The volume of traffic on this stretch of road is relatively low (800 vehicles per 24-hour period) but it is an important local road for the area. The Sørland Line would also be closed. Goods and passengers on the Sørland Line between Eastern Norway and Kristiansand and Stavanger would have to transfer to road for a long period of time.

Fire B: The Darbu fire would affect the most road users due to the closure of the E134 highway, which is an important classified road connection with a relatively high volume of traffic (10,500 vehicles per 24-hour period). Several bypass roads in the area

would also be affected and the traffic would largely be diverted around Hvittingfoss.

The Sørland Line would be closed at level 2 in the scenario, although it could also be affected at level 1.

Fire C: In Trysil, virtually all of the roads in the area would be closed.

5.2 CONSEQUENCES FOR SOCIETY

Impact assessments are relevant for the emergency preparedness analysis because they influence the degree to which the risk associated with the dimensioning scenario is considered acceptable or not.

Analyses of Crisis Scenarios (ACS) assesses two consequences types for each of five different societal assets. The consequences are quantified and scored using a common scale. The overall consequences of each scenario are shown on a scale from very small to very large, which provides a basis for comparing the consequences of the various scenarios.

The risk analysis of 'Three Simultaneous Forest Fires' from 2011 made such assessments with respect to the consequences for the population. The analysis is comparable with the level 1 scenario in this analysis in which a total of 100 km² of forest is affected. Compared with the other risk analyses in ACS, the overall societal consequences of these fires were considered small. The forest fire scenario primarily impacts the natural environment.

In an emergency preparedness analysis, the consequences do not need to be quantified since there is no need for comparisons with other scenarios. Below we describe the consequences of level 2 forest fires in words based on an escalation of the consequences of the fires analysed in ACS.

Life and health
Strong, varying winds could catch fire and rescue crews and other emergency personnel near the forest fires by surprise and, in the worst case, result in them being surrounded by flames. Deaths could not be ruled out. The ability to evacuate means that it is fairly improbable that lives would be lost among the general population.

Smoke and fire injuries could also be expected. Smoke inhalation can cause both acute and chronic injuries. Emergency personnel would also be vulnerable to broken bones, etc. Especially vulnerable groups, particularly people with respiratory diseases, would be at risk even if they did not remain in the immediate vicinity of the fire. The smoke would spread over large areas and be noticed many miles away.

Early evacuation would limit the extent of injuries among the local population, although some might mental health reactions as a result of worrying about family, houses, livestock, etc.

In the event of road closures and the loss of electricity and electronic communications outages, evacuation and rescue efforts would be even more demanding. The consequential events due to the forest fire could also result in delays to medical assistance for people living at home who depend on the municipal health service. The use of healthcare professionals in rescue missions and at evacuation centres might result in other patients having to wait.

Nature and culture
The total burned area at level 2 would be approximately 187 km² or 187,000,000 m².

In the impacted areas, the fire would cause significant changes to the environment and it would take several decades before its normal condition was restored. Fires can have a profound impact on animal communities, including birds, fish and mammals. The long-term effects would primarily be changed successions[34] in the nutritional conditions for species. The recreational value of the areas would also be significantly degraded for a long time.

[34] A term used to describe changes to the species composition of an area over time.

The cultural heritage sites and cultural environments located in the areas covered by the fires have not been surveyed. However, the protected wooden buildings in Fossesholm in Vestfossen would be threated if the Darbu fire reached level 2.

Economy
A large proportion of the areas affected by the fires consist of productive forest that would largely be lost. It is also estimated that about 100 homes and at least 1,000 holiday cottages would burn down. In addition to this, the fires could result in the loss of infrastructure such as power lines, base stations, transmission cables for electronic communications, and more. Operational buildings containing equipment and vehicles would be lost. The costs of the firefighting efforts and subsequent clean-up would be substantial. It is estimated that the total direct economic losses would be in the range of NOK 5–10 billion.

Social stability
Although forest fires are a known event with known consequences, the scale of these fires would cause unrest in the population, including in areas other than those directly affected. A perception that the fire services and authorities lacked control of the forest fires could contribute to frustration and less confidence in the authorities.

This forest fire scenario would result in disruptions for the inhabitants of the impacted areas. Many inhabitants would have to be evacuated due to the risk of the fire spreading. Others would have to be evacuated in areas where smoke and soot became a problem. It is assumed that up to 3,000 people would need to be evacuated from their homes for several days.

Temporary road closures and the loss of electricity and electronic communications would cause disruption to daily lives. The fire in Darbu would have particularly serious consequences because it would result in closure of the E134 highway. Traffic between Oslo/Drammen and Kongsberg, Notodden, Rjukan, Numedal and towards Western Norway would have to switch to significantly longer diversions.

Democratic values and capacity to govern
Democratic values and capacity to govern is the last of the societal assets for which consequences are assessed in ACS. Forest fires would have no impact on the two consequence categories under this value.

Overall, the consequences of the three fires would be considerable. The fires would result in substantial economic losses, a temporary loss of natural assets, health problems for vulnerable groups in the population and quite significant challenges in local daily life.

CHAPTER

06

The overall challenges

Every forest fire starts off small. The best thing is to put them out as soon as possible and the vast majority of forest and wilderness fires are thus quickly brought under control by local fire and rescue services. The scenarios discussed in chapter 4 describe fires of a significant magnitude. The descriptions do not state why the fires have developed to become as large as they have in this case. This is because the reasons behind the development of the fires are not relevant for the emergency preparedness analysis.

Natural conditions determine how fast a fire spreads: wind, temperature, air humidity and moisture in the vegetation, topography, tree species and the density of the forest. The ability to gain control of the fire's development will depend on access to water, personnel and equipment resources and communication, and on expertise, management, organisation and cooperation.

The situation described in chapter 4 is particularly demanding because so many forest fires are occurring at the same time: three of them are large in scope, but others are also out of control. The efforts present particular challenges with respect to professional firefighting expertise and, not least, with respect to how the resources should be organised and managed. These challenges escalate as the situation with the fires steadily becomes more serious. At some point in time, they will exceed the level that the current emergency preparedness can manage.

6.1 AT A LOCAL LEVEL

Municipalities are responsible for emergency preparedness for fires. Most municipalities have their own fire and rescue services, while others cooperate intermunicipally.

Personnel resources

Fire and rescue services vary in size. The total operational force with a professional firefighting background in fire and rescue services must number at least 16 people.[35] Many of the smaller ones largely rely on part-time employees.

If their own resources are insufficient, the chief fire officer will contact neighbouring fire and rescue services to request support. Fire and rescue services have a reciprocal duty to provide assistance to the extent that they can spare the resources given their own emergency preparedness situation.[36]

When a forest fire escalates, the need for personnel will quickly exceed what can be met by professional firefighters. Heavily forested areas will often have a forest fire reserve linked to the fire and rescue service that can be called out.[37] However, the Norwegian Civil Defence represents the most important reinforcement resource. Requests for assistance can also be made to the Norwegian Armed Forces, where the Norwegian Home Guard will represent the closest force one can count on. Volunteers also often make themselves available, and one can even hire people on short-term contracts.

Forest fires of the magnitude described here can last a very long time. There will, therefore, be a need to rotate personnel. This means that far more personnel must be involved than those in action at any one time.

Expertise

However, the challenges relating to access to personnel are smaller than the challenges associated with the expertise they possess. Many small fire and rescue services largely rely on part-time personnel, and around 60 per cent also have a part-time chief fire officer. The expertise in forest fires varies and to some extent depends on the size of the fire and rescue service. In some places, the level of expertise is low compared to the local risk forest fires represent.

[35] Regulation of 6 June 2002 No. 729 on the organisation and dimensioning of fire services, section 4-1.
[36] The Act of 14 June 2002 No. 20 relating to the prevention of fire, explosion and accidents involving hazardous substances and the fire service (Fire and Explosion Prevention Act), section 15, paragraph three.
[37] Ref. Regulation of 6 June 2002 No. 729 on the organisation and dimensioning of fire services, section 4-12.

The expertise of reinforcement personnel will not be on a par with that of the firefighters. The forest fire reserve and the Norwegian Civil Defence do some training in fighting forest fires; the Norwegian Home Guard does not.

> The higher the proportion of reinforcement personnel included in the operational force, the lower the average level of expertise will be. Such a development is unavoidable as a fire escalates and this will place limits on the firefighting efforts.

Equipment
Local fire and rescue services do not have enough equipment of their own to be able to manage forest fires of the type described in the scenarios. Some can be borrowed from other fire and rescue services. The Norwegian Civil Defence will bring its own equipment, which is compatible with what the fire and rescue services use, and may, depending on the situation, bring equipment for use by the fire and rescue service if necessary.

Meanwhile, the Norwegian Home Guard does not have its own firefighting equipment and will need to be equipped by others. The same is true for others involved in the firefighting efforts.

The forestry industry has both personnel and machinery that can be used in firefighting efforts, including felling machines that can clear firebreaks and remove vegetation around residential and holiday cottage areas, critical infrastructure, etc. Local farmers also have equipment that may be useful. As a fire develops, the equipment will experience ever increasing rates of malfunction or be lost.

Water lifting capacity for aerial firefighting is essential. It is in the escalation phase to level 1 and beyond to level 2 that helicopters and any planes from abroad will play an important role. There are no helicopters in Norway with heavy-lift (more than 3,000 litres) capabilities in its emergency preparedness. Fire planes (which can hold up to 10,000 litres of water) are currently only found in Southern Europe.

Local management and organisation
In principle, firefighting efforts should be organised in accordance with the Unified Management System (UMS), ref. the discussion in section 2.7. A UMS is based on a predefined organisation and division of responsibilities and facilitates delegation as events escalate. Every leadership position must have a span of control of three to seven people, tasks or functions. In practice, achieving an ideal control range has proved to be difficult. If the tasks are not very complex, experience shows that a personnel span of control of 10–15 people, or even more than this, works fine. In the event of a major forest fire, the operational commander will divide up the area of the fire into sectors, each with their own organisation, and where the leaders report directly to the operational commander.[38]

In this way, the organisation will grow in line with the development of the fire. When a fire develops rapidly and new personnel are constantly arriving, maintaining an overview and planning both the current and following day's management will become challenging.

In one of the fires described in the scenarios, a maximum of 950 people will be involved in the firefighting in rotating shifts. In accordance with UMS, 150–200 of these should ideally have leadership positions. A large proportion of the professional fire and rescue personnel may therefore be assigned to leading others with less expertise in firefighting. At the same time, administrative functions such as HSE, catering, accommodation, logistics, transport, etc. must all be addressed.

Inadequate management capacity and expertise in the local fire and rescue services was one of the main findings in the national evaluation report following the forest fires in Sweden in 2018:

> *"During the summer's fires, the management broke down as far as several of the major rescue efforts are concerned. This was largely due to the fact that the rescue services that were affected by the major fires were small and thus vulnerable, as well as a lack of preparation and experience in fighting forest fires."*[39]

[38] User Guidelines for the Norwegian Incident Command System (in Norwegian). (DSB, Norwegian Environment Agency, Norwegian Coastal Administration, 2011)
[39] Forest Fires in the Summer of 2018 (in Swedish), Swedish Government Official Report SOU 2019:7

When life and health are threatened, the police are responsible for rescue efforts. It is the police that can order evacuations of inhabitants in areas that are threatened by fire. As far as the fire service is concerned, this means that the overall effort will be led by the police from the moment the police ascertain that life and health may be at risk. The police also have the legal authority to assume operational command earlier than this, ref. section 2.2. Nevertheless, the police will be completely reliant on the fire service's professional firefighting expertise in its operational command unit and in many cases the work in the two operational command units will run in parallel.

The transition from managing fires as purely a fire-fighting mission to the firefighting work being part of a rescue effort may be fluid. During the fires in Lærdal, Flatanger and on Frøya in 2014, operational command was addressed by both the fire service and the police. According to the DSB's evaluation report, there were several examples where it was unclear who was actually commanding the efforts.[40] This is of course unfortunate.

Communication during firefighting efforts
One basic prerequisite for managing fires as large as those at level 2 in the scenario is a well-functioning Nødnett. Nødnett basically has functionality that makes it highly suitable for use in complex and extensive management situations.

However, the higher the number of personnel involved in the firefighting, the further it will be between the Nødnett terminals. Some of the stakeholders who may contribute do not have access to Nødnett and the contact with them will, therefore, go via the ordinary mobile phone network, which will complicate communication.

In fire A (the Neslandsvatn fire), Nødnett and commercial mobile phone networks fail at level 2 in the scenario. Base stations can be lost in fires, there may be damage to the transmission network, or the power supply may fail. In such a situation, Nødnett terminals can be used locally in direct mode and radios with repeater functionality can expand the area in which direct mode works or expand coverage from a nearby base station to also cover the area where the forest fire is burning.

The bigger a fire becomes, the more likely it is that it will affect critical infrastructure and that this will create problems for the firefighting efforts. This will, not least, apply to communication with forest fire helicopters involved in the efforts. If Nødnett fails, the safety of personnel could be reduced to such an extent that they would have to be pulled out of the area.

A fire can also cause roads to become unusable and this would cause problems for the cooperation on fire and rescue efforts. More personnel and equipment would have to be moved by helicopter and the ability of leaders in different sectors to contact each other would be reduced.

Relationship to other stakeholders
In addition to leading the firefighting work, the fire and rescue service's operational commander must deal with other stakeholders with responsibility for the potential consequences of a fire such as forest owners, power companies, telecommunications operators, the Norwegian Public Roads Administration, Bane NOR and the municipalities involved.

Not least, contact with the municipal management is important. Emergency preparedness for fires is a municipal responsibility. A forest fire could impact a number of important societal functions and many of these are municipal, such as schools, kindergartens, nursing homes, etc. The municipal health service must have an overview of people who would be particularly vulnerable in such a situation, and who would need extra help in the event of evacuation. Municipalities have to arrange accommodation where it is needed.[41]

Forest fires of this magnitude and severity present major management and administrative challenges. An organisation of significant scope and complexity must be built up in an ongoing manner and in line with the development of the fire.

No chief fire officer in Norway has experience in leading efforts of the magnitude involved here and no training in organising and managing such forest fires has been provided.

[40] The fires in Lærdal, Flatanger and on Frøya in the winter of 2014. (DSB 2014, in Norw.)

[41] Act relating to the municipal preparedness duty, civil protection measures and Civil Defence (Civil Protection Act) (LOV-2010-06-25-45), section 12.

6.2 REGIONAL COORDINATION

When fires grow from being local to regional events, the resources of a larger area must be organised and deployed in the firefighting efforts. Such events affect large parts of society, and this means that other stakeholders will increasingly become involved. In addition to firefighting, fires must be managed as rescue actions, ref. section 2.2, and civil protection crises. The police, health service, infrastructure owners and agencies will increasingly play a role in the management.

Coordination of the fire service's resources
The local chief fire officer is responsible for firefighting efforts. The individual fire and rescue services are independent units and there is no formal structure that links fire and rescue services together at a regional (or national[42]) level.

The regulations require fire and rescue services to enter into agreements with neighbouring fire and rescue services and other relevant stakeholders in order to facilitate the receipt or provision of assistance in the event of acute fire and accident situations. Therefore, regional coordination will initially take place by the operational commander responsible for the firefighting efforts requesting assistance from neighbouring fire services. The extent to which resources are made available will depend on the emergency preparedness situation in the individual fire and rescue services.[43] Meanwhile, the duty to provide assistance is not limited to fire and rescue services with which agreements exist.

110 operations centres play an important role in relaying requests for support and assistance regionally. The colocation of 110 operations centres and the police's 112 operations centres also facilitates effective information sharing during forest fire management. The 110 operations centres constitute an informational hub for fire and rescue services within a police district, but have no role or authority related to local resource allocation.

Coordination of the emergency services' efforts
The role of the police in rescue efforts pursuant to section 27 of the Police Act is described in section 2.2. RSCs and local rescue management will be able to maintain coordination between emergency services within the police district's boundaries. The coordination can also include the affected municipalities and infrastructure agencies at a tactical level.

However, it is rare for the police to establish RSCs with local rescue management. In the vast majority of cases, fires last for such a short time that there is no point in organising the efforts in this way. Therefore, there is little experience to build on.

Management of social consequences
Forest fires will result in consequential events such as the disruption of road and rail connections, power and electronic communications outages, etc. (ref. chapter 5). This will have regional effects and result in the county governor playing an important coordinating role. The county governor's knowledge of critical societal functions, the environment and natural assets, as well as agriculture and forestry, is important when planning forest fire efforts. According to the instructions, the county governor must coordinate the civil crisis management at a regional level.[44] In the case of serious adverse events, the county governor and affected chief constables must immediately establish contact to assess the situation. The county governor will survey the municipalities' needs and can convene the county emergency preparedness council with a view to "reaching agreement on what civil measures should be implemented and what requests to submit to the Norwegian Armed Forces." Therefore, the county governor's coordination role is on more of a strategic level. In other words, the primary role of the county governor is to support affected municipalities and regional stakeholders, and this coordination role is on a strategic level and not an operational level.

> Regional structures exist for the coordination of rescue efforts and community crisis management during a forest fire. However, there is no equivalent system or structure for the regional coordination of the fire services' resources.

[42] DSB is the national fire prevention authority but is not authorized to take over command during an incident in a municipality.
[43] Act of 14 June 2002 relating to the prevention of fire, explosion and accidents involving hazardous substances and the fire service (Fire and Explosion Prevention Act), § 15
[44] Regulation of 19 June 2015 No. 703 Instructions for the county governors' and Governor of Svalbard's work relating to civil protection, emergency preparedness and crisis management, chapter IX

Can a municipality be relieved of responsibility for firefighting efforts?

Responsibility for the firefighting efforts in the major forest fires in Västmanland in 2014 and in Gävleborg County in the summer of 2018 was transferred from the local fire service to the county administrative board, which is equivalent to county governor offices in Norway.

As mentioned above, there is no formal structure in Norway for fire management at a regional level. In the event of a major forest fire, the management support mechanism (see the discussion under section 2.3) will come into effect in connection with forest fire helicopter being granted. A local chief fire officer (who leads the firefighting efforts pursuant to the legislation) will in such cases be able to receive support from a fire service officer from another fire service with greater expertise in forest fires. The question is, what would happen if, in a hypothetical case, this proved insufficient, i.e. that regional and national authorities determine that it is necessary to change the division of responsibilities if one is to gain control of the fire.

The instructions for county governors do not give them the authority to take over responsibility from municipalities like the county administrative board did in Sweden in 2014 and 2018.[45]

Pursuant to section 27, paragraph one, of the Police Act, the police have a responsibility to initiate and organise rescue efforts where people's life and health are at risk.[46] Paragraph three covers situations where it is primarily material assets that are at stake.

According to paragraph three, in accident and disaster situations it is incumbent on the police "to implement such measures as are necessary to avert danger and limit damage." The provision continues as follows:

"Until responsibility is assumed by another authority, the police shall organise and coordinate the relief work." The two sentences in paragraph three probably need to be read in context. The provision granting authority *"to implement such measures as are necessary"* will thus apply until another authority can take over. Whether the measures must be limited to *organise* and *coordinate* will be a matter of interpretation.

Another provision describing the role of the police can be found in the Police Instructions. According to section 2-2, the police shall "[u]pon request provide other public authorities with protection and assistance during the performance of their duties when this follows from law or custom, and otherwise intervene on their own initiative in other authorities' areas in cases where this is deemed necessary to protect life, health or important societal assets."[47] Neither paragraph three of the Police Act nor the Police Instructions were written with a situation in mind in which the firefighting efforts during a forest fire are insufficient to bring it under control. What the provisions are probably primarily intended to cover are situations in which the police arrive first on the scene of an event that falls under the jurisdiction of the fire and rescue service or some other authority.

Therefore, the provisions are hardly meant as a legal basis for the police to intervene and take over the chief fire officer's formal responsibilities during a fire. Nevertheless, in a chaotic situation, and where the management of the firefighting efforts is not functioning in practice, the police might perhaps determine that the provision provides legal authority to intervene, possibly viewed in conjunction with the police's general authority or the principle of necessity.

However, the general picture is that it is uncertain whether, and the degree to which, the provisions of the Police Act and the Police Instructions would apply in a situation where the chief constable considers that there is an urgent need to change the division of responsibilities associated with firefighting efforts.

Several sector laws, for example within the health sector, have provisions that authorise interventions by central government in relation to municipalities and others in crisis situations. However, the Fire and Explosion Prevention Act provides no such legal authority.

The emergency preparedness authorisation committee has submitted a proposed general Act on special authorities for the government in the event of extraordinary crises.[48]

[45] The Swedish county administrative board's authority provisions apply at times of war; in times of peace they require a special decision by the government (Regulation (2017:870) on the county administrative board's crisis preparedness and duties in the event of high emergency preparedness)

[46] The Act of 4 August 1995 No. 53 relating to the police (Police Act)

[47] Regulation of 22 June 1990 No. 3963 General service instructions for the police (Police Instructions)

[48] Official Norwegian Report NOU 2019:13 Når krisen inntreffer

6.3 NATIONAL COORDINATION AND MANAGEMENT

In a situation involving numerous simultaneous fires, a need could arise to prioritise resources across county and police district boundaries. Resources would have to be obtained from other counties and regions, even if this weakens the emergency preparedness in these areas more than one would find defensible from a local perspective.

At some point, the event would be deemed a national crisis situation. The Ministry of Justice and Public Security would assume the role of lead ministry and the Crisis Council would convene.[49] The reporting from local to central authorities would follow three lines: from the police districts via a joint rescue coordination centre (JRCC) to the Ministry of Justice and Public Security (for rescues), from the police districts via the National Police Directorate (for the police's other areas of responsibility during fire management) and from the municipalities via county governors and DSB to the Ministry of Justice and Public Security.[50] There are no formal firefighting reporting channels.

The government has its own reinforcement resources that will be made available for firefighting efforts. The Norwegian Civil Defence has personnel and equipment. The Norwegian Home Guard can be used as reserve personnel. In addition to this come forest fire helicopters that are leased in by DSB and possibly also helicopter support from the Norwegian Armed Forces.

> As per today, no national authority can manage the overall personnel and equipment resources in a situation where one must prioritise between different fire sites.

The police have relatively wide-ranging authority to manage rescue efforts in acute situations where life and health are at risk.[51] However, neither JRCCs nor the National Police Directorate have experience in coordinating the resources and efforts of different agencies and have little firefighting expertise. Therefore, it does not seem likely that JRCCs or the National Police Directorate will simply assume such a national role in a situation such as the one described. Therefore, it does not seem likely that JRCCs or the National Police Directorate will simply assume such a national role in a situation such as the one described.

DSB's management support mechanism, which offers experienced fire service officers (ref. chapter 2) to local operational command units, will come into effect at the same time as helicopter resources are allocated. DSB also maintains contact with the EU's Emergency Response Coordination Centre and with neighbouring countries and will play a key role in connection with requests for assistance and the receipt of support from abroad. The Norwegian Civil Defence resources will be deployed by the national civil defence staff group in DSB.

DSB is the national supervisory authority for municipal and intermunicipal fire and rescue services, but does not fight fires, and therefore has no expertise within it ranks that could take over responsibility from local chief fire officers. However, DSB has general fire science expertise and can make use of its professional networks, nationally and internationally.

In the forest fires in Sweden in 2018, the Swedish Civil Contingencies Agency (MSB), which is roughly equivalent to DSB in Norway, assumed responsibility for coordinating resources at a national level despite it not having formal authority to do so. MSB acted based on the experiences from the major forest fire in Västmanland in 2014.

In the evaluation report after the fires in 2014, MSB suggested that an *action principle* should be fundamental for society's crisis preparedness. In the case of serious events, stakeholders should act proactively and initiate the necessary measures even if the situation is unclear.

According to the evaluation report, reactions to MSB's actions during the 2018 fires were mixed. None of the stakeholders questioned the fact that

[49] Ref. Instructions for the ministries' work with civil protection and emergency preparedness (Ministry of Justice and Public Security, 2017)), Chapter VIII.

[50] Other agencies (health, roads, railways, electronic communications, and power) will also report in their own sector channels

[51] Ref. section 27 of the Police Act, among others.

MSB took on a national authority role while the fires were ongoing. However, in retrospect, two of the three county administrative boards most involved in the management have been critical of this, pointing out that MSB overrode regional area responsibility. However, the government report on the handling of the fires states that MSB's actions were necessary and that MSB's mandate with respect to "focusing and prioritising national and international resources needs clarification."[52]

JRCCs currently assign helicopter support upon receiving requests from chief fire officers relayed via 110 operations centres. However, JRCCs do not wish to play such a role since they do not have the expertise necessary to prioritise between different requests/fires, and because the arrangement could impact JRCCs' primary functions.[53] According to the organisation plan for rescue services, JRCCs can, if necessary, assume management and coordination responsibilities from a local rescue sub centre (RSC) if one has been established. Meanwhile, JRCCs have neither the capacity nor the expertise to assume such a role in the area of forest fires.

6.4 SUMMARY

Fire and rescue services are organised and dimensioned to manage ordinary local events. There is no authority at either a regional or national level that can manage the efforts in the event of numerous serious fires at the same time and where resources have to be prioritised across fire services.

The challenges can be summed up with the words *expertise, organisation, responsibility and authority.*

The larger the forest fires get, the greater the need for firefighting expertise. However, the number of firefighters with the necessary expertise is limited and will be a scarce resource both in the operational command unit and in the practical firefighting efforts.

[52] Swedish Government Official Report SOU 2019:7
[53] Letter from Joint Rescue Coordination Centre South Norway to DSB, 20 February 2019

CHAPTER

07

Results of the emergency preparedness analysis

The emergency preparedness analysis should answer the following analysis questions:

1. Level of ambition: What is a dimensioning fire in a ten-year perspective? What sort of a forest fire should we be able to manage?
2. Current emergency preparedness: What sort of fire could we manage with the current emergency preparedness? To what extent could we manage the dimensioning forest fire?
3. Required emergency preparedness: What would it take to be able to manage the dimensioning forest fire? What are any shortcomings in the current emergency preparedness?
4. Initiative: What measures would strengthen the current forest fire emergency preparedness?

We have assumed a national perspective in this analysis, although it also includes general local and regional conditions of relevance for overall forest fire emergency preparedness.

As the conducted analysis is an emergency preparedness analysis and not a full risk analysis, it only discusses forest fire management and not prevention. This does not mean that prevention is less important, but preventive measures must be identified via another analysis. Meanwhile, this analysis does use some results from a previous risk analysis of forest fires[54] as a basis for discussing likelihood (chapter 4 and section 7.1) and consequences (section 5.2).

7.1 WHAT IS A DIMENSIONING FOREST FIRE?

A 'dimensioning scenario' is an analytical concept that is used in emergency preparedness analyses as a starting point or as a benchmark for assessing current emergency preparedness and the desired/required emergency preparedness. What a dimensioning forest fire would be is a choice and a prerequisite for the further analysis and proposed measures. In other words, following up an emergency preparedness analysis must start with determining whether the dimensioning forest fire chosen for the analysis is the level of ambition we want for forest fire emergency preparedness in Norway.

In this analysis we describe and discuss three different forest fire scenarios that represent three different levels of forest fire. Scenario/level 1 is based on the risk analysis in 'Three Simultaneous Forest Fires' from 2011. This risk analysis is based on the Froland fire and other forest fires in the summer of 2008. The forest fire season of 2018 also had similarities to with the risk analysis since there were very many simultaneous smaller forest fires[55]. Such a fire situation is challenging to manage, but the consequences were acceptable both in practice and in the risk analysis (see section 5.2).

At level 2, each of the three fires is about twice as large. At level 3, the Trysil fire has developed into an explosive firestorm and spread further towards densely populated areas. The three levels are described in greater detail in chapter 4.

Level 1 forest fires are in many ways 'the forest fires of yesterday'. We have experienced similar fires, and these are fires for which we train. Therefore, they are expected to be manageable with the current emergency preparedness in the future as well, even though they make great demands on management and resources. The likelihood of such fires occurring is deemed to be relatively high: 2 per cent annual likelihood or around 85 per cent likelihood in a 100-year period.[56] This indication of likelihood is based on the likelihood in the next ten years being twice as high as the likelihood indicated in the risk analysis from 2011 due to the effects of climate change.

Level 2 forest fires are to a greater extent 'the forest fires of tomorrow'. They are about twice as large in scope/area as level 1 fires and last for longer. The expected increase in periods of droughts due to the effects of climate change as well as the experiences from Sweden in 2018 suggest that this is not an unrealistic scenario in Norway. A level 2 forest fire is estimated to have an annual likelihood of 1 per cent or around a 65 per cent likelihood in a 100-year

[54] Risk analysis of 'Three Simultaneous Forest Fires' from 2010, last published in DSB's Analyses of Crisis Scenarios 2019.

[55] Some 140 forest and wilderness fires were recorded on 13 July 2018.

[56] The following formula is used for converting the annual likelihood (p) of an event to the likelihood of it occurring in a 100-year period (N): 1 - (1-p)N

period. Such a forest fire is larger than we have experienced in Norway to date and would really challenge the current emergency preparedness.

The consequences for the population could be far worse than in scenario 1. The risk associated with a level 2 forest fire suggests that the ambition should be to be able to manage a forest fire of this level. There was also agreement about this in the analysis seminar.

Level 3 with an explosive forest fire (firestorm) is a 'horror scenario' that would be very difficult to manage through firefighting. The efforts would have to be aimed at reducing the damage: 'closing off' the fire to control its spread and evacuating everyone from the danger zone. Experiences from other countries show that traditional firefighting is of no use and that such fires require expertise, situational understanding and resources that we do not currently have in Norway. The likelihood of a level 3 forest fire is low, but its estimated annual likelihood is 0.5 per cent or a 40 per cent likelihood in a 100-year period. Such fires therefore cannot just be ruled out either. Rather than building up firefighting resources, one should instead upgrade the expertise in, and understanding of, the phenomenon.

A level 2 forest fire is used as the dimensioning scenario for the rest of the analysis.

7.2 WHAT SORT OF FOREST FIRE COULD WE MANAGE WITH THE CURRENT EMERGENCY PREPAREDNESS?

Norway currently has 240 municipal fire and rescue services. Around 60 per cent of current chief fire officers work part-time. 45 per cent of these work less than 50 per cent of a full-time position, 30 per cent less than 25 per cent of a full-time position.[57] The capacity and expertise of the fire and rescue services vary greatly. Some fire and rescue services have large, full-time forces with special forest fire expertise, while others may have a chief fire officer working 25 per cent of a full-time position with 16 part-time fire service personnel and no fixed shift system.[58]

The review of the three levels of fire scenarios (described in chapter 4) in the analysis seminar concludes that in most places our current emergency preparedness could manage a level 1 forest fire and probably a scenario between a level 1 and a level 2. It is highly doubtful that we could manage a level 2 forest fire today. We are unable to document either through emergency preparedness action plans or exercises that this could be managed today.

The size of a level 2 fire requires greater resources and expertise than local fire and rescue services have on their own today. The local fire management unit would become overloaded when several hundred personnel from different areas had to be organised while at the same time a prolonged effort needed to be planned. There is no regional or national organisation that automatically convenes when a situation involving a fire exceeds the management capacity of local fire services. No one has authority to prioritise resources across municipalities, counties and regions.

Today, level 2 fires would be managed under the management of the local fire and rescue service with assistance from neighbouring fire services and national support functions. The support from other fire and rescue services would be uncertain since they would also have fires or a high risk of fires. There would be a shortage of professional firefighting expertise. The situation would require improvisation and different local solutions. The consequences for life, health and material assets can be far greater with level 2 fires than with level 1 fires.

The current forest fire emergency preparedness is generally dimensioned to manage forest fires we are familiar with and that are equivalent to level 1. The emergency preparedness is not sufficient to manage level 2 fires, which are the dimensioning forest fires in this analysis.

[57] DSB's figures from 2018

[58] Minimum requirement in the Regulation on the organisation and dimensioning of fire services

7.3 WHAT WOULD IT TAKE TO MANAGE THE DIMENSIONING FOREST FIRE?

Local management and organisation
Fire and rescue services are a municipal responsibility and chief fire officers have legal authorities pursuant to the Fire and Explosion Prevention Act. Local fire and rescue services are staffed and equipped to manage ordinary events in their district. Managing a dimensioning forest fire as it is defined in this analysis would require the extensive coordination and prioritisation of resource use between the fire services.

A chief fire officer responsible for a large forest fire can request extra personnel and equipment from neighbouring fire services and management and helicopter support from the national level and will therefore have a large organisation to lead. This analysis stipulates that a total of 2,400 personnel from fire and rescue services, the Norwegian Civil Defence and the Norwegian Home Guard would be required to manage the three level 2 fires in this analysis (ref. chapter 4).[59] Only 20–30 per cent of these will be professional firefighters (full-time or part-time). It is estimated that a total of 800 firefighters would be involved in the efforts to fight the 50 other smaller fires in their municipalities assumed by the scenario[60]. These are theoretical calculations based on current surveyed emergency preparedness resources.

As only around one quarter of the personnel in the three large fires would be the fire and rescue services' own personnel, most would have no particular forest firefighting expertise. According to UMS, there should ideally be one leader per five personnel, tasks or functions.[61] In the event of extensive mobilisation, there would therefore be a shortage of professional fire service leaders locally. In practice, almost every firefighter would be performing a leadership role. The organisation and utilisation of the many non-professional fire resources would be an extra challenge with respect to HSE, logistics and efficiency. The management would also have to coordinate fire helicopters with ground efforts and address a series of planning and support tasks.

DSB has organised a management support mechanism with a total of 16 experienced fire service officers who can assist the responsible chief fire officers as needed. The management support mechanism comes into effect when a chief fire officer is granted assistance from fire helicopters. In the event of many simultaneous fires, many in the management support mechanism would themselves be busy in operational efforts, at the same time as there would be a great need for management support. Therefore, there would be a shortage of management support nationally. These are also the same resource people who are often involved in RSCs, county emergency preparedness boards and as DSB advisers.

"We are simply not equipped to manage such large resources locally"

"Such situations need to be managed in the line, not as a collective effort"

(quotes from the analysis seminar)

The local bottleneck would primarily be inadequate capacity to organise and lead the major efforts required for level 2 forest fires, which also include many non-firefighters.

Current emergency preparedness action plans for local fire and rescue services do not include managing a dimensioning forest fire as described in this analysis, and these are therefore not trained for.

To manage a level 2 forest fire, all fire service personnel in vulnerable areas would have to be capable of performing operational fire management. The management support mechanism must be strengthened and possibly reorganised in order to meet the capacity and expertise needs.

[59] Shifts would be worked and not everyone would be in action at the same time
[60] 50 fires with an operational force of 16 at each
[61] Uniform management system, see chapter 2. For some tasks and experienced leaders, the span of control could be greater.

Regional coordination

According to their instructions, county governors play a coordination role during crises and the management of major events that an individual municipality cannot manage alone. In such situations, networks of key stakeholders are often used in the county emergency preparedness council, in which, as a rule, the fire and rescue service also sits.[62] However, how active a role county governors take varies between the offices. County governors often take on a greater role in the case of prolonged events that require coordination of the restoration work. Both during and after the event, the county governor will contribute situation reports from the municipalities to the DSB via the 'coordination channel'.

Pursuant to section 27, paragraph one, of the Police Act, the police have the authority to initiate and organise rescue efforts when human life or health is at risk, unless another authority has been assigned responsibility. When fighting fires, the fire service is assigned responsibility and the chief fire officer leads the firefighting, ref. sections 11 and 12 of the Fire and Explosion Prevention Act.

The police have organised units in far more districts than the fire and rescue services and therefore have a more regional function. In the event of a major forest fire, the chief constable can establish local rescue sub centres (RSCs) that involve both the fire and health services. In practice it is rare for the police to establish expanded local rescue management teams and we do not have experience of this with forest fires. The police play an important role in protecting life and health during a forest fire, but have not clear mandate for, or expertise in, leading firefighting efforts.

The regionally organised 110 operations centres are subordinate to the local fire and rescue services but can in practice play a coordinating function during forest fires since they may have a greater overview of the overall fire situation than the individual fire and rescue service.

The regional coordination of efforts for major forest fires has not been tested much through both actual events and exercises. However, the emergency services have developed routines for close cooperation and collaboration when managing demanding and complex events.

Intermunicipal committees for acute pollution (IUA)

The Norwegian Coastal Administration is the pollution authority for acute pollution. The Norwegian Coastal Administration is responsible for coordinating central government, municipal and private emergency preparedness in a national emergency preparedness system. The Norwegian Coastal Administration's statutory pollution authority entails, among other things, the responsibility and authority to make decisions, carry out supervision and implement measures.

Municipalities must ensure that the necessary emergency preparedness is in place for minor cases of acute pollution caused by normal activities within the municipality. Municipalities have a duty to assist central government if central government decides to initiate an action.

All of Norway's municipalities take part in intermunicipal committees for acute pollution (IUA), which are organised into emergency preparedness regions. In the case of minor events, municipalities can implement measures on their own, although they often make use of an IUA to address the municipality's emergency preparedness. The Norwegian Environment Agency defines the regional boundaries and designates the host municipality for each region.

Pursuant to section 46, paragraph three, of the Pollution Control Act, the Norwegian Coastal Administration can decide that the government will lead the management of an action. In the case of municipal actions, the Norwegian Coastal Administration will provide the necessary assistance pursuant to section 46, paragraph two, of the Pollution Control Act. The assistance can be provided in the form of advice and by making government emergency preparedness resources available.

Source: https://www.kystverket.no/Beredskap/ansvar-og-roller/

[62] When asked by DSB in May-June 2019, nine out of ten county emergency preparedness council leaders responded that the fire service sat on the county emergency preparedness council. In one county, the fire service was represented by the 110 operations centre, although as a rule the representative on the board was a local chief fire officer.

Pursuant to section 46, paragraph three, of the Pollution Control Act, the Norwegian Coastal Administration can decide that the government will lead the management of an action. In the case of municipal actions, the Norwegian Coastal Administration will provide the necessary assistance pursuant to section 46, paragraph two, of the Pollution Control Act. The assistance can be provided in the form of advice and by making government emergency preparedness resources available.

Source: https://www.kystverket.no/Beredskap/ansvar-og-roller/

A special regional organisational structure for the operational management of major forest fires should be considered. This could be convened when there is a need to prioritise resources across different fire services. Such a structure could take the form of an intermunicipal committee in which the local chief fire officers serve as regional chief forest fire officers.

Such a model could build on the established mechanism of intermunicipal committees for acute pollution (IUA) and would not entail fundamental changes to the municipal responsibility for fire and rescue, or the county governor's coordination responsibility for events.

A general fire science strategy is to extinguish the fires while they are small and controllable. From a national perspective, this may entail a need to manage the efforts ranging from major fires to small ones in order to keep as many fires under control as possible.

National coordination and management

DSB is the state supervisory authority within the area of fire and the fire science authority at a national level. The government cannot steer municipal fire and rescue services, although it issues frameworks and guidelines through legislation, budgets, guidance, etc.

Routines have been developed for national assistance such as forest fire helicopters, management support and assistance from the Norwegian Civil Defence. Fire and rescue services also have a statutory duty to help each other if they can spare the resources. It is assumed that the current arrangements will function satisfactorily for level 1 forest fires as described in this analysis but would not be sufficient at level 2 (ref. section 7.2).

At level 2, which is the dimensioning fire for this analysis, there would be a need to coordinate and manage the efforts of different fire and rescue services across municipalities and counties. At level 1, coordination can generally take place locally with regional and national support for the local fire and rescue services. At level 2, the resources would have to be coordinated regionally and nationally in order to optimise utilisation and a management function would have to be able to prioritise between multiple forest fires if necessary. The coordination and management of forest fire efforts at a regional and national level are new functions that must have the required authorisations.

The Ministry of Justice and Public Security will be the lead ministry for any national crisis management of major forest fires. It currently has three inward reporting lines: a rescue channel (via rescue sub centres and joint rescue coordination centres), a police channel (via police districts and the National Police Directorate) and a coordination channel (via county governors and DSB). There is no fire science reporting and management line between local fire services and the central directorate and ministry level. Both a regional management function and a government competent authority are lacking with respect to a fire science management line. This limits the central authorities' ability to establish a fire science overview of the situation at a national level.

Other emergency preparedness areas such as acute pollution and radiation have national emergency preparedness arrangements with local, regional and central government parts. A regional and state emergency preparedness organisation for forest fires could be established based on the template for intermunicipal committees for acute pollution (IUA). The intermunicipal committees represent an emergency preparedness region, with the same boundaries

as the police districts and 110 regions (12 regions nationwide).

This emergency preparedness organisation can convene when a forest fire requires a large degree of coordination and prioritisation of the efforts between the different fire and rescue services. A local chief fire officer could be assigned to fulfil the regional leadership position while a major forest fire is being managed by the intermunicipal committees/emergency preparedness organisations. The chief fire officer assigned this role should report to the central authorities and be the fire science contact point for the county governor and police during regional events.

A central authority should be appointed to administer the system, support the regions in the event of major forest fires and lead a government effort that involves multiple regions.

The central fire authority should also supervise forest fire emergency preparedness. The authoritative body should have the authority and expertise to prioritise resources across fire and rescue services in crisis situations. A new emergency preparedness organisation should be authorised by the Fire and Explosion Prevention Act, although this would entail no changes to the current division of responsibilities. In other words, fire and rescue services would still be a municipal responsibility.

The figure below shows the main stakeholders in national emergency preparedness for fires and possible reporting channels. All of the channels run from the local fire and rescue service to the Ministry of Justice and Public Security, which will be the lead ministry for any national management of forest fires.

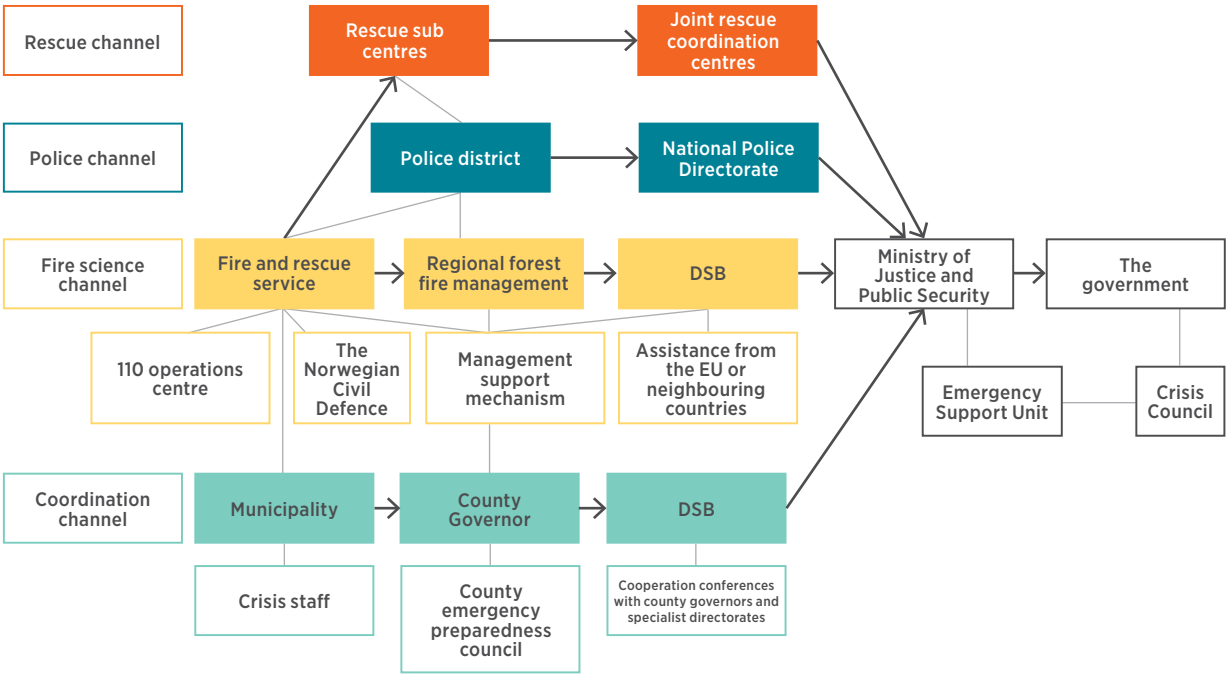


FIGURE 14. The figure shows a possible new fire science authority channel (marked in yellow) as well as the existing channels. This reporting and management channel would come into effect when any national management of forest fires is needed.

The established channels are:

1. The rescue channel, which goes via rescue sub centres (RSCs) and the joint rescue coordination centres (JRCCs)
2. The police channel, which goes via police districts and the National Police Directorate
3. The coordination channel, which goes via country governors and DSB.

The lines are primarily reporting lines up the line to the Ministry of Justice and Public Security and do not really function as control lines from the ministry down the line.

"We lack national management with expertise and authority"

"Have we got mechanisms for making the tough choices?"

(quotes from the analysis seminar)

Therefore, a new authority channel is proposed for both reporting and control in the event of serious forest fires that require national management:

4. A fire science channel that goes via regional forest fire management and DSB to the Ministry of Justice and Public Security. This channel would strengthen the management of serious events that require the regional and national coordination and prioritisation of efforts across fire services.

The regional forest fire management would be an intermunicipal function consisting of the local fire services within the region (the boundaries of which, it is proposed, should mirror those of the police districts). During a major event, the forest fire management would cooperate closely with the chief constable and the county governor.

Such a national emergency preparedness arrangement could also come into effect in the event of other serious and rare natural events that have parallels with the management of pollution, radiation and forest fires. Such events could, for example, include national crisis situations caused by storms, flooding, avalanches and landslides.

The intermunicipal committees would have to prepare an emergency preparedness action plan for forest fires in their region. This would provide a basis for training on cooperation during large forest fires at a national, regional and local level. DSB should prepare a strategic emergency preparedness action plan at a national level.

Given their round the clock watch, JRCCs perform an important function in requisitioning forest fire helicopters. However, JRCCs are rescue agencies and do not have the fire science expertise to prioritise between requests for helicopters if they are scarce. Requisitioning forest fire helicopters should be viewed in the context of the responsibilities of a national fire authority.

A government agency should be appointed to administer a national emergency preparedness mechanism for forest fires based on intermunicipal committees of fire services organised into regions. The government agency should have the authority to prioritise resources across municipalities and forest fire regions if national needs so dictate.

Expertise

Mobilising non-fire and rescue service personnel means that many will not have professional firefighting expertise. Fire and rescue service personnel have good professional firefighting expertise, although specific forest fire expertise is lacking in the fire service as well. Operational command expertise could become a scarce resource with so many personnel in action. The management support mechanism with its analytical expertise would become overloaded due to the demand at a local, regional and national level.

Norwegian fire services lack experience in managing fires of the size of the dimensioning fire in the analysis and nor are such large forest fires included in emergency preparedness action plans and exercises.

One particular challenge would be expertise in rare phenomena such as firestorms, which have to be managed in a different way to ordinary forest fires (damage limitation rather than putting out).

Better forest fire expertise, both in breadth and depth, must be built up through teaching in the Norwegian Fire Academy and contributing to international research into firestorms.

Communication equipment
Some base stations for mobile phone networks and Nødnett may be damaged in major forest fires. Destroyed power lines and transformer substations can result in power supply outages and result in the failure of electronic communications (base stations generally have backup power for two to four hours for mobile phone networks and a minimum eight hours for Nødnett). Backup solutions would be using Nødnett terminals in a limited area and the deployment of transportable base stations for Nødnett.

Detailed maps should be prepared of infrastructure in areas at risk of forest fire and training conducted in communication backup solutions.

7.4 SUMMARY OF PROPOSED MEASURES

The emergency preparedness analysis defines a dimensioning forest fire and points out weaknesses, deficiencies and uncertainty in relation to the current emergency preparedness being able to manage the dimensioning forest fire. The analysis has identified a gap between the emergency preparedness needed to manage the dimensioning forest fire (level 2) and current emergency preparedness (sections 7.2–7.3). National authorities must decide whether – and if so what – measures should be implemented to bridge this gap.

"Someone has to be able to decide which fires should not be put out"

(quotes from the analysis seminar)

Alternatively, the level of ambition regarding the sort of forest fires it should be possible to manage must be lowered to what is defined as level 1 in this analysis. In practice, this means accepting the risk associated with being unable to manage more serious forest fires than this (see the assessments of likelihood in chapter 4 and section 7.1 and of consequences in section 5.2).

The measures mentioned above are specified below. The list only contains emergency preparedness measures and not preventive measures, which would have been included in a full risk analysis. The list is meant as a starting point for further assessments of efficacy and costs.

At a national level:

- Appoint a national authority that, when necessary, has the authority to prioritise the use of resources across different fire services. 'When necessary' could, for example, be when multiple simultaneous forest fires exceed local and regional management capabilities.
  - The national authority should also prioritise the use of forest fire helicopters.
- Establish a fire science reporting and management line from a local (fire service) to a central level (Ministry of Justice and Public Security) during the management of major forest fires (see Figure 14).
- Produce a national strategic emergency preparedness action plan for managing the chosen dimensioning forest fire scenario. The plan must include how the management capacity of municipalities and fire regions will be strengthened during a forest fire.
- Strengthen and formalise the management support mechanism. Consider stronger organisational affiliation to DSB as an advisory function.
- Put in place agreements with the EU on requisitioning helicopters and fire plan capacities and participate in the cooperation promoted by RescEU-AFF.

- Maintain the Norwegian Civil Defence as a reinforcement resource for fire services in the event of major efforts, with continued training in firefighting techniques and equipment resources such as pumps and equipment for large-volume water supply.
- Clarify the potential for requisitioning and using Norwegian Home Guard personnel in forest fires.
- Prepare a national prevention analysis for forest fires that focuses on likelihood mitigation measures.

At a regional level:

- Establish an intermunicipal emergency preparedness organisation that can convene in the event of major forest fires on a regional level that require coordination and joint management by multiple fire services, without changing the day-to-day division of responsibilities.
- The chief fire officers in the emergency preparedness region must be included in a cooperation involving management support, resources support and emergency preparedness structures for major events.
- Clarify the role of county governors as a coordinating and support function at a strategic level for major forest fires.
- Prepare risk and vulnerability assessments and emergency preparedness action plans for major forest fires on a regional level that involve all relevant stakeholders. A natural region in a forest fire context could include multiple emergency preparedness regions/police districts and require their coordination. A dimensioning forest fire on a regional level must be adapted to local conditions for forest fires.
- Train in major forest fires as defined in the emergency preparedness action plan across organisational and geographical boundaries.

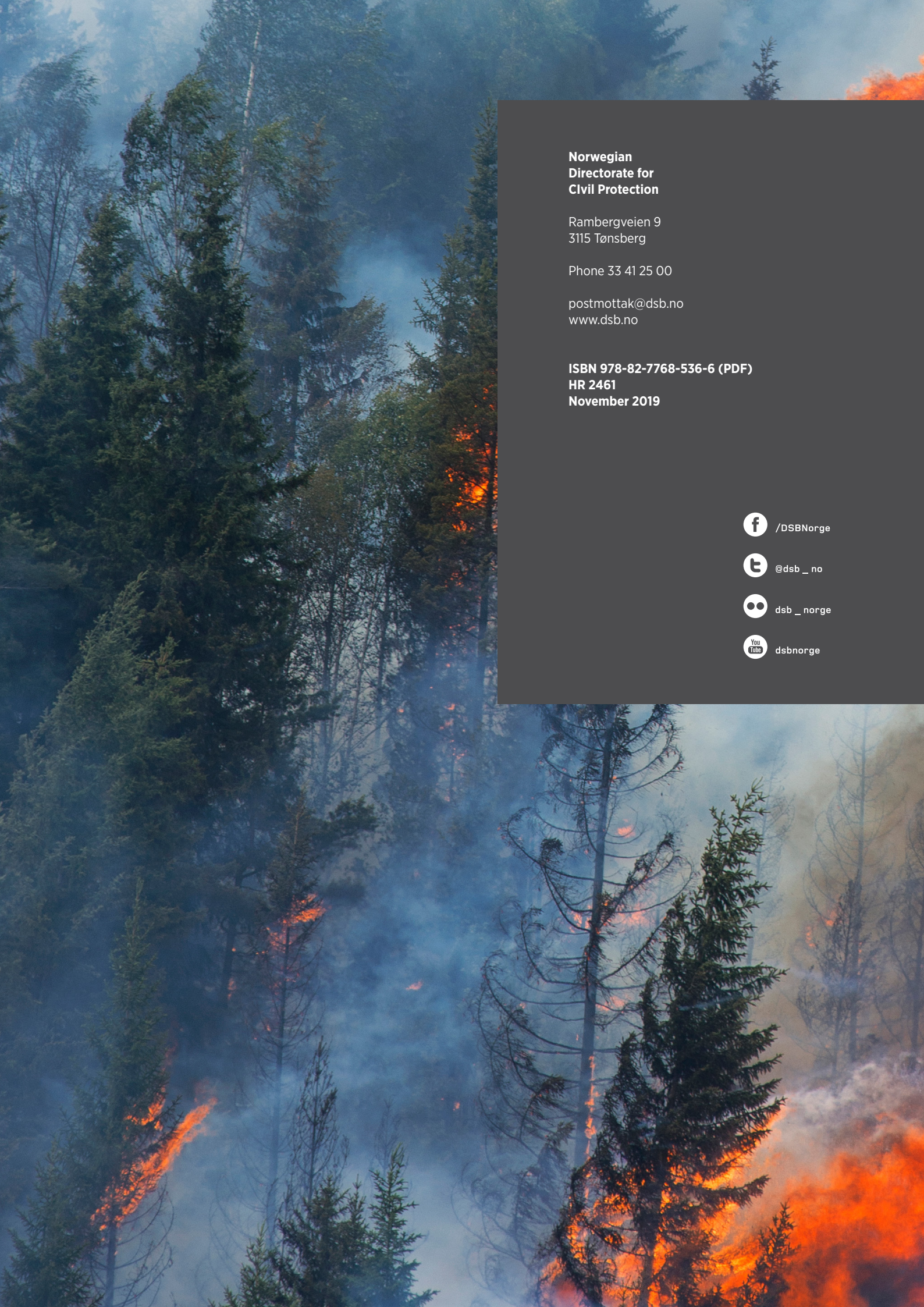
At a local level:

- Strengthen the local fire management unit's ability to organise and manage efforts in major forest fires, including by establishing routines for management cooperation between fire services and strengthening the management support mechanism.
- Prepare local risk and vulnerability assessments and emergency preparedness action plans for managing major forest fires in a ten-year perspective, designed to take account of the effects of climate change and local conditions.
- Include a future major forest fire in the municipalities' comprehensive risk and vulnerability assessment and overarching emergency preparedness action plan and involve other sectors such as the primary health service, transport and power supply in the process.
- Prepare municipal and intermunicipal prevention and emergency preparedness analyses for forest fires in addition to risk and vulnerability analyses.

Appendices

APPENDIX 1:
PARTICIPANTS IN THE ANALYSIS SEMINAR ON 29 APRIL 2019

Jon Olav Brunvatne	Ministry of Agriculture and Food (LMD)
Richard Simonsen	Helitrans AS
Asbjørn Lund	County Governor Innlandet
Andreas Urdal	County Governor Innlandet
Kjetil Løge	Skogbrand Forsikring
Ole Einar Tveito	Norwegian Meteorological Institute
Kåre Einar Skogsrud	Midt-Hedmark Fire and Rescue Service
Torgeir Andersen	Drammen Region Fire Service IKS
Steinar Strøm	Drammen Region Fire Service IKS
Bård Bråten	Chief Fire Officer Drangedal Municipality
Ann Kristin Larsen	Norwegian Water Resources and Energy Directorate (NVE)
Kari Haugdal	Southeastern Police District, Joint Operational Service
Jan Ove Grave	Norwegian Public Roads Administration, Traffic Control Centre South
Einar Braaten	Chief Municipal Medical Officer, Øvre Eiker and Nedre Eiker
Trond Sjaaeng	Norwegian Home Guard
Owe Frøland	Joint Rescue Coordination Centres
Kjell Kvamme	The Norwegian Civil Defence Aust-Agder
Janne Sundby	The Norwegian Civil Defence
Atle Sæverud	Norwegian Directorate for Civil Protection (emergency network)
Hans Kristian Madsen	Norwegian Directorate for Civil Protection
Heidi Løfqvist	Norwegian Directorate for Civil Protection
Suzanne Norvang	Norwegian Directorate for Civil Protection
Erik Thomassen	Norwegian Directorate for Civil Protection
Ann Karin Midtgaard	Norwegian Directorate for Civil Protection
Freddy J. Hansen	Norwegian Directorate for Civil Protection
Hilde R. Kommedal	Norwegian Directorate for Civil Protection
Elisabeth Næss	Norwegian Directorate for Civil Protection



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