3. Infrastructure

3.1 Introduction

This chapter provides information on the infrastructure of Bane NOR's rail network and other railway infrastructure linked with this rail network, and which is provided to anyone that has access to operate services on this rail network.

Supplementary information on Chapter 3 can be found in the Annexes to the Network Statement.

Banedata and Register of Railway infrastructure (RINF) include information on infrastructure in this chapter.

The intention is to cover RUs' existing and new information requirements in connection with the planning of their train production.

The Network Statement does not provide sufficient information on infrastructure properties with a view to specifying, designing or constructing vehicles that are compatible with the Bane NOR infrastructure. To meet such requirements, please see the Bane NOR document Technical Rules, Supplementary information and regulations, Ch. 1.

Information on linked private railway infrastructure is only covered insofar as Bane NOR possesses information about it.

3.2 Extent of network

3.2.1 Limits

The geographical scope and restrictions of the rail network are shown in a line map – cf. Annex 3.2.1.

3.2.2 Connected Railways Network

3.2.2.1 National border crossings

There are four border crossings between Norway and Sweden. These are described in the table below – cf. Annex 3.2.1. None of these border crossings involves a change of track gauge. '

Passing the national border involves a change in the visual signalling system.

Border station	Line
Riksgränsen (SE)	Ofotbanen
Storlien (SE)	Meråkerbanen

Border station	Line
Charlottenberg (SE)	Kongsvingerbanen
Kornsjø (NO)	Østfoldbanen

Neighbouring country IM
Trafikverket - Swedish Transport Administration

Neighbouring country's administration
Trafikverket – Head office:
Postal address: Röda vägen 1, S-781 89 BORLÄNGE, SE
Telephone: +46 771 921 921
Email: trafikverket@trafikverket.se
Internet: www.trafikverket.se

Norwegian Customs and Excise
Postal address: PB 8122 Dep., N-0032 OSLO, NO
Telephone: +47 228 60 312
Email: tad@toll.no
Internet: www.toll.no

3.2.2.2 Linked networks, including private tracks, dockside railways, freight terminals and sidings

Norway has no rail network in the traditional sense, apart from the rail network administered by Bane NOR. There is a small number of privately owned tracks and lines. These tracks are mentioned in the Network Statement as they may be used in connection with the rail network administered by Bane NOR.

Passing the domestic branch points may involve changing loading gauge, axle load, power supply system, signalling system, etc.

Linked tracks and lines – cf. Annex 3.2.2.2

Sidings – cf. Annex 3.6.2.6.

In a number of instances, Bane NOR has chosen to remove points between the rail network and sidings that have not been used for a long time. Any RUs that would like such points to be re-established should contact Bane NOR's OSS function: oss@banenor.no.

3.2.3 Supplementary information

For information on the rail network of relevance to vehicles, please see the Bane NOR document Technical Rules, Supplementary information and regulations.
Please see Bane NOR's infrastructure database, «Banedata», for a summary of infrastructure properties sorted by geographical area.

Please contact the OSS to order from this database: oss@banenor.no

Please see Bane NOR's sidings database for further information on (private) sidings.

Please contact the OSS to order data from this database: oss@banenor.no

3.3 Network description

3.3.1 Geographic identification

3.3.1.1 Track typology

The rail network is mostly made up of single tracks. However, double tracks have been established on most of the routes closest to Oslo. There are parallel railway lines on just a small number of sections – cf. Annex 3.2.1.

3.3.1.2 Track gauges

The only track gauge for the rail network and linked public and private tracks is 1435 millimetres (4' 8½«).

3.3.1.3 Stations and nodes

Line map – cf. Annex 3.2.1. See Route description for the rail network.

The true distance between the individual stations on a railway line can be found in Bane NOR's route diagram for the section in question. Distances are specified in kilometres.
http://www.banenor.no/kundeportal/ruter-og-sportilgang/grafiske-togruter/

Route diagrams can be downloaded free of charge.

The length of railway tracks at stations are shown in the Network Statement, annex 3.6.1.2 Stations, in Route description for the rail network and in Bane NOR's route diagrams.

3.3.2 Capabilities

3.3.2.1 Loading gauge

International reference contours

The rail network, with all its track sections, satisfies the following international reference contours (both static and kinematic specification):

G1 (UIC 505-1/prEN 15273-1)

GA (UIC 505-1/prEN 15273-1)

GB (UIC 505-1/prEN 15273-1)

Combined transports according to UIC 596-6
The maximum permitted size of combined transports (Combined Transport Profile Number, CTPN) for

the individual line sections is shown in the Line map – cf. Annex 3.3.2.1.1

International loading gauges for containers and semitrailers, up to P/C 410, etc. and up to P/C 80, etc. are applicable on the lines shown in Annex 3.3.2.1.1.

National gauges
To ensure maximum utilisation of the Norwegian infrastructure, in particular the curve deflection according to which our lines are constructed, the following national gauge has been established:

- Dynamic gauge NO1
  Dynamic gauge NO1 prEN 15273 and the conditions on which this is based – cf. Annex 3.3.2.1.2. The gauge may be offered on all line sections with ordinary traffic.
- Static wagon gauge with extra height
  Multipurpose gauge: Developed for tall, closed wagons equivalent to «multipurpose». May be used for all kinds of rolling stock on the line sections and under specific conditions – cf. Annex 3.3.2.1.3.

In case of trains which exceed the stated loading gauges, an application for special consignments must be sent to Bane NOR, cf. section 4.7.1. Applications are sent to spesialtransporter@banenor.no

Regarding traffic on tracks that are not in use, including possible loading gauges, cf. Annex 3.2.2.2, contact oss@banenor.no

3.3.2.2 Weight limits

3.3.2.2.1 Axle load

Domestic map – cf. Annex 3.3.2.2.1.

3.3.2.2.2 Weight per running metre

Domestic map – cf. Annex 3.3.2.2.2.

3.3.2.3 Line gradients

Tabular summary of determinative gradients and for graphic presentation of vertical profiles – cf. Annex 3.3.2.3.

3.3.2.4 Line speeds

According to Traffic rules for the rail network, the maximum speed limit for passenger trains is 210 km/h, and 100 km/h for freight trains.

Line speed profiles by line – cf. Annex 3.3.2.4.

3.3.2.5 Maximum train lengths

The chapter is deleted.

3.3.2.6 Power supply

Bane NOR provides electricity for the running and heating of trains. Map showing all electrified lines in Norway – cf. Annex 3.3.2.6.

3.3.2.6.1 Voltage and frequency

Nominal system voltage is 15,000 Volts (RMS) alternating current for all electrified lines. Nominal frequency is 16 2/3 Hz for all electrified lines.

The power supply of the rail network is typically characterised by large distances between supply points and small, distributed converter stations.

For trains with converter traction systems, experience shows that software developed for use of the same stock in continental Europe often has to undergo subsequent optimisation with regard to functionality on the train itself and in order to avoid an acceptable power oscillations between the train and the power supply.

For supplementary information, please see Technical Rules, https://trv.jbv.no/wiki/Rolling_stock/Supplementary_information_and_regulations Ch. 8.

3.3.2.6.2 Maximum train current

Current consumption

The power supply of the rail network is divided into capacity classes as shown in the map – Maximum train current: Power consumption – cf. Annex 3.3.2.6.

In the case of low voltage, it is presumed that the driver will further limit power consumption.

For Classes C1 and C2, this is especially relevant under special conditions involving reduced capacity. For Class C3, this may also be required during normal operation.

In particular, this is important in trains which do not have automatic current limitation according to EN 50388 in the event of low catenary voltage.

On some lines, the available power is a limiting factor with regard to capacity utilisation, cf. Route description for the rail network, Ch. 2.3.

Current during use of regenerative braking

The power supply of the rail network is divided into capacity classes as shown in the map – Maximum train current: Regenerative braking – cf. Annex 3.3.2.6 Electrified lines.

3.3.2.6.3 Catenary – height and horizontal displacement

The height of the catenary varies from 4600 to 6200 mm. Sections of the railway network have a higher minimum height. Please contact Bane NOR for further information on this.

The catenary's deviation from the centre of the track is nominally 400 mm and in severe winds maximum 700 ± 50 mm for old contact lines and 550 ± 30 mm or 500 ± 30 mm for newer contact lines.

The profile of the pantographs is defined in Technical Rules, book 540, Chs. 4 and 5.

3.3.2.6.4 Contact pressure from pantograph

Limits for forces between the pantograph and the catenary are specified in Technical Rules, book 542, Ch. 5.

Limits for aerodynamic balancing of pantographs are specified in Technical Rules, Supplementary information and regulations, Ch. 8, Annex e. The contact lines are dimensioned for a wind load of at least 30 m/s perpendicular to the catenary.

If there are several active pantographs on a train, the number of pantographs and the distance between them can be factors that help determine the maximum train speed permitted. In this case, separate acceptance from Bane NOR is required for the various routes.

Supplementary regulations: Teknisk regelverk, Supplementary information and regulations, kapittel 8, appendix e

3.3.3 Traffic control and communication systems

3.3.3.1 Signalling systems

Cf. the Train Operation Regulations, Ch. 9. togframføringsforskriften kapittel 9

Signalling systems include signals, interlocking systems and line block systems and apply to stations, level crossings, landslide warning systems, etc.

The signalling systems must signal to trains whether they can run on the line in question. The interlocking systems must secure safe routes for trains in motion. In order to show a «go sign», the route after the signal must be checked and guaranteed clear of other trains, signals in the opposite direction must show a «stop sign» and all points must be set to the correct position for the chosen route.

3.3.3.2 Traffic control systems

Cf. togframføringsforskriften, kapittel 5, the Train Operation Regulations, Ch. 5 Annex 3.3.3.2.

3.3.3.2.1 Centralised traffic control

Centralised traffic control is a system that monitors traffic electronically. In the centralised control office, the traffic controller – who monitors traffic on long-distance routes, i.e. over several stations – receives information about the exact position of the train. Most of the railway lines in Norway use centralised traffic control. Coverage map – cf. Annex 3.3.3.2.

3.3.3.2.2 Lines without centralised traffic control

Some lines still have a system using manual announcements. This system means that a block post keeper at one station has to make contact by telephone with a colleague at the next station before the train is permitted to leave the station. This ensures that there are never two trains on the same block section at the same time. This section is now reserved for this train and no other activity is permitted until this train has arrived at the next station.

Coverage map – cf. Annex 3.3.3.2.

3.3.3.3 Communication systems

Cf. the Train Operation Regulations, Ch. 2, section III.

GSM-R is used as the communication system between trains and traffic controllers.

Traffic controllers, block post keepers and drivers communicate in Norwegian.

Coverage map – cf. Annex 3.3.3.3

3.3.3.4 Train control systems

Lines with centralised traffic control on the rail network are equipped with a system for train speed monitoring. The two systems used in the rail network are ATC and ERTMS.

ATC will eventually be replaced by ERTMS as the system for speed monitoring.

ATC = Automatic Train Control **ERTMS** = European Rail Traffic Management System

3.3.3.4.1 ATC

If a train passes a red signal, the ATC system will activate the train's emergency brake and stop the train. If the speed limit is exceeded, a warning signal sounds in the driver's cab and the speed is reduced. Approx. 90% of all ATC lines are equipped with partial ATC equipment (DATC), which means that speeds are only monitored at signals.

Approx. 10% of all ATC lines are equipped with full ATC equipment (FATC), which means that speeds are monitored constantly. Lines equipped with ATC – cf. Annex 3.3.3.4.

3.3.3.4.2 ERTMS Level 2

On lines equipped with ERTMS Level 2, a running permit and velocity profile are sent from the signalling system to the train via GSM-R. In normal driving mode (FS/OS), a train cannot run without having received a running permit. If the speed limit is exceeded, a warning signal sounds in the driver's cab and the speed is reduced. If a train exceeds its End of Authority (EoA), the train is automatically brought to a halt.

FS = Full Supervision

OS = On-Sight

EoA = End of Authority

Lines equipped with ERTMS – cf. Annex 3.3.3.4.

To prevent axle counter faults, only wheels compatible with ERA/ERTMS/033281 are to be used. This is applicable to both Infrastructure (contractors, machinery) and Services (enterprise).

3.4 Traffic restrictions

3.4.1 Specialised infrastructure

Cf. the Railway Regulations, § 8-8.

3.4.1.1 The Gardermoen Line

Restrictions on Romeriksporten
Freight trains carrying dangerous goods are not allowed in the Romeriksporten when there is a passenger train in the tunnel.

Restrictions on the culvert at Gardermoen station
Freight trains should not be planned through the culvert at Gardermoen station (Oslo Lufthavn) in the annual route plan.
Freight train activity shall constitute the least possible obstacle to any other train traffic stipulated in the route plan.

3.4.1.2 The Østfold Line – eastbound

As of the third quarter of 2015, the Ski – Mysen – Sarpsborg line is equipped with ERTMS Level 2, and version 2.3.0d of the system is used. Only rolling stock with an ERTMS onboard system compatible with ERTMS version 2.3.0d will be granted approval to run on this line.

3.4.2 Environmental restrictions

3.4.2.1 Noise

Noise restrictions are specified by general Norwegian legislation, cf. the Neighbours Act, the Pollution Control Act and the Planning and Building Act in particular.

Further provisions concerning noise restrictions and other environmental conditions are included in the ATS section 10.2.6.3.

Among other things, local noise restrictions mean that whistles must not be sounded at certain level crossings during the night. These level crossings are signposted.

In connection with the acceptance of vehicles, noise requirements will be a part of the rolling stock acceptance process, cf. Ch. 2.7.

3.4.2.2 Discharges from toilets

In urban regions, passenger train rolling stock with open toilet systems may not be used unless the toilets are kept locked. This applies to the following routes:

- The Drammen Line from Oslo S to Drammen
- The Gardermoen Line from Oslo S to Eidsvoll
- The Gjøvik Line from Oslo S to Hakadal
- The Main Line from Oslo S to Lillestrøm
- The Bergen Line from Bergen to Arna
- The Østfold Line from Oslo S to Ski

Use of rolling stock with open toilet systems is not permitted on the Sørlandet Line.

Open toilet systems may not be used when the train is standing at a station or a halt.

3.4.2.3 Environmental hazards

3.4.2.3.1 Lines vulnerable to landslides/avalanches

Due to the topography in Norway, parts of the rail network are vulnerable to landslides and avalanches of various kinds. Landslide/avalanche detection systems are installed on the most exposed lines – cf. Annex 3.4.2.3.1.

3.4.2.3.2 Collision with animals

In rural areas, frequent collisions with animals on the track may sometimes occur. These animals are primarily elk and reindeer – cf. Annex 3.4.2.3.2.

3.4.3 Dangerous goods

No restrictions.

3.4.4 Tunnel restrictions

- Transportation of «HAZARDOUS GOODS», pursuant to RID regulations, hazard classes 1-9 is not permitted in the Romerike Tunnel
- Transportation of «HAZARDOUS GOODS», pursuant to RID regulations, hazard classes 1-9 is not permitted in the culvert at Gardermoen Station.

To minimise exhaust emissions in tunnels, it is recommended that the driver should drive as smoothly as possible.

Tunnels more than 2 km long – cf. Annex 3.4.4.

3.4.5 Bridge restrictions

Bane NOR has no bridge restrictions.

Bane NOR has two bridges with special rules for passing trains: the Skansen and Nidelven bridges, both governed by Trondheim station.

Rail traffic has priority over shipping, and so the normal position for the bridges is «ready for train». Normal opening hours for shipping are advertised locally in the daily press when a timetable and local shunting plan have been prepared and actioned by Bane NOR.

Information on bridge opening times can be found on the Port of Trondheim website: http://trondheimhavn.no/bruapningstider.aspx

3.5 Availability of the infrastructure

All lines are essentially open to rail traffic round the clock.

Any regular closures or restrictions due to inspections and maintenance work will be reported by the IM as part of the capacity allocation process, cf. Ch. 4.5.

On lines without centralised traffic control, where stations are staffed by a block post keeper to the necessary extent, the staffing (and thus the opening hours) could be determined by the need for infrastructure capacity reported in connection with the capacity allocation process.

Applications for routes for additional trains, which may require extra station staff, must be made well in advance.

3.5.1 The Valdres Line

The line from Eina to Dokka is currently closed.

3.6 Service facilities

3.6.1 Passenger stations

3.6.1.1 Classification and description

Bane NOR does not use a classification system for stations.

Information on all stations, see Annex 3.6.1.2 Stations.

3.6.1.2 Stations

A summary of public facilities, a map, information on train heating systems and tracks and platforms for all stations are shown in Annex 3.6.1.2 Stations. Schematic track plans for selected stations are also provided better.

3.6.2 Freight terminals

General information:

The geographical location of freight terminals, a more detailed description and contact details are provided in the following annexes:

- 3.6.2.1 Freight terminals
- 3.6.2.3 Port terminals
- 3.6.2.4 Timber terminals
- 3.6.2.6 Annex 3.6.2.6 Sidings

Services provided at the terminals:

Bane NOR's services:

Bane NOR's range of services at the rail terminals is generally limited to access to tracks and loading lanes.

Bane NOR offers no services beyond this. At certain terminals, agreements have been entered into between Bane NOR and terminal operators which allow terminal operators to offer services on Bane NOR tracks and loading lanes. The scope of the services offered varies from one terminal to another.

Information on services at freight terminals:

For services available at railway terminals, see
https://www.banenor.no/kundeportal/jernbanen-i-norge/infrastruktur/godsterminaler/

Services provided at ports:

For further information, contact the port in question or visit the port's website.

3.6.3 Marshalling yards and train formation facilities, including shunting facilities

See the list in Annex 3.6.3.2.

3.6.4 Storage sidings

See the list in Annex 3.6.3.2.

3.6.5 Maintenance facilities

Further information about addresses and contacts is provided in Ch. 5 Services. See also the summary in Annex 3.6.5 Additional technical areas and emergency rolling stock, and Annex 3.6.3.2 Marshalling yards, stabling and workshops.

3.6.6 Other technical facilities, including cleaning and washing facilities

3.6.6.1 Installations in connection with "Rolling stock condition monitoring – TWMS"

Wheel damage detectors are available at the following locations:

- Langum – Sørlandet Line – between Gulskogen Station and Mjøndalen Station
- Huseby – Drammen Line, left main track – between Brakerøya Station and Lier Station
- Høyseth – Dovre Line – between Ler Station and Lundamo Station
- Skatval – Nordland Line – between Skatval Station and Langstein Station
- Straumsnes – Ofoten Line – between Narvik Station and Straumsnes Station
- Haugfjell – Ofoten Line – between Katterat Station and Bjørnfjell Station

Acoustic detectors (for bearing damage) are available at the following locations:

- Huseby – Drammen Line, right main track – between Lier Station and Brakerøya Station
- Huseby – Drammen Line, left main track – between Brakerøya Station and Lier Station
- Skatval – Nordland Line – between Skatval Station and Langstein Station
- Straumsnes – Ofoten Line – between Narvik Station and Straumsnes Station

Alarms are sent to the RUs directly or via the «DROPS» system.

Wheel damage detectors and acoustic detectors are linked to a central monitoring system, Fleet One, which is owned and run by Bane NOR. RUs themselves have to carry out regular monitoring themselves. All passes indicate the status of wheel bearings and flat spots on the train's wheels. RUs themselves are responsible for exploiting the benefits from this. Bane NOR will receive alarms when the flat spot alarm exceeds a defined threshold. The train will then be asked to reduce its speed or stop, depending on the degree of severity.

In instances in which the infrastructure is damaged, the system will be used to assess who is responsible for the damage.

The system is available via a web interface known as FleetONE. If access is required, use the following URL: http://hsd.jbv.no/FleetOne/ and click on «Register» in the top right-hand corner.

RUs are responsible for ensuring that all trains/wagons are registered with an RFID in accordance with applicable principles for RFID structure. The aim of this is to identify wagons in the monitoring system and hence provide clear, fast notification to the train companies in the event of flat spots and/or bearing damage. It is particularly critical for traffic controllers to provide fast response to trains in the event of high flat spot alarms.

Hot box detectors are available at the following locations:

- Haugan – Nordland Line – between Vikhammer Station and Midtsand Station
- Hegra – Meråker Line – east of the Hegra halt
- Skatval – Nordland Line – between Skatval Station and Langstein Station
- Straumsnes – Ofoten Line – between Narvik Station and Straumsnes Station (hot wheels only)

The results of these measurements are processed at each individual installation and transferred to a SQL database at Marienborg in Trondheim every time a train passes.

Alarms are passed directly to the Central Region train controller via a separate interface, who then stops the train and passes on the information to the RU.
Data is not available via a web interface at present.

3.6.6.2 Wagon weighbridges

Wagon weighbridges are available at the following locations:

- Åndalsnes

3.6.6.3 Deicing facilities

Deicing facilities are available at the following location:

- Alnabru freight terminal

This facility must be able to service 4000 metres of freight train per day.

3.6.7 Maritime and inland port facilities

Bane NOR has no port facilities linked with railway activities.

3.6.8 Relief facilities

Bane NOR has no relief facilities.

3.6.9 Refuelling facilities

See the list in Annex 3.6.5.

The refuelling facilities shown in Annex 3.6.5.1 are all designed for refuelling with diesel.

3.6.10 Other facilities

No other facilities are offered.

3.7 Infrastructure development

Cf. the Railway Regulations, § 5-2, letter c), second sentence, etc.

A summary of infrastructure development can be found on the Bane NOR customer portal, see http://www.banenor.no/kundeportal/ruter-og-sportilgang/banetekniske-planforutsetninger/

For a summary of long-term infrastructure development, please see Bane NOR's Action Programme 2014 – 2023. White Paper on the National Transport Plan 2018 – 2029, St. meld. 33 (2016 – 17). Nasjonal transportplan 2018 – 2029, St. meld. 33 (2016 – 17)