M5

M5 Safeguarding for Øresund Metro - Concept Design

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Table of contents

Appendices

Table of attachments

ATT No.	Title/Subject	Issuer's doc. ID
1	CMC Outer Track - Ch. 40+000 to 40+700	M5-CAJV-GEN-Gen-ALG-DWG-212401-_-_
2	CMC Outer Track - Ch. 40+700 to 41+400	M5-CAJV-GEN-Gen-ALG-DWG-212402-_-_
3	CMC Outer Track - Ch. 41+400 to 42+100	M5-CAJV-GEN-Gen-ALG-DWG-212403-_-_
4	CMC Inner Track - Ch. 40+000 to 40+700	M5-CAJV-GEN-Gen-ALG-DWG-212404-_-_
5	CMC Inner Track - Ch. 40+700 to 41+400	M5-CAJV-GEN-Gen-ALG-DWG-212405-_-_
6	CMC Inner Track - Ch. 41+400 to 42+100	M5-CAJV-GEN-Gen-ALG-DWG-212406-_-_
7	Øresundsmetro Outer Track - Ch. 50+000 to 50+700	M5-CAJV-GEN-Gen-ALG-DWG-212501-_-_
8	Øresundsmetro Inner Track - Ch. 50+000 to 50+700	M5-CAJV-GEN-Gen-ALG-DWG-212502-_-_
9	Øresundsmetro Inner Track - Ch. 50+700 to 51+400	M5-CAJV-GEN-Gen-ALG-DWG-212503-_-_
10	Øresundsmetro Inner Track - Ch. 51+400 to 52+100	M5-CAJV-GEN-Gen-ALG-DWG-212504-_-_

Revision summary

Version	Date	Scope of revision	Change description
1.0	2024-05-14	First Issue	-
2.0	2024-05-15	Update	Correction to construction costs for bifurcation.

1 Sammenfatning

I forbindelse med udarbejdelse af Konceptuelt Design og Miljøkonsekvensvurdering for M5 er det undersøgt, hvilke fysiske arbejder det som minimum er nødvendige at udføre samtidig med anlæg af M5, for at sikre at en Øresundsmetro senere kan anlægges uden at påvirke driften af M5 nævneværdigt.

Undersøgelserne har taget udgangspunkt i det tidligere studie af en Øresundsmetro, hvor tog fra Malmø kører til hhv. København H og Østerport, jf. figuren nedenfor.

Undersøgelserne viser, at det som minimum er nødvendigt at anlægge et afgreningskammer i sammenhæng med v/Prags Boulevard Øst station. Det vil ikke være muligt at konstruere denne afgreningskammer senere uden at påvirke M5-driften i flere år. Det vurderes at prisen for afgreningskammeret vil være ca. **400 mio. kr**. (prisniveau 2023, inkl. 30% korrektions reserve).

Hvis det besluttes at indarbejde muligheden for senere anlæg af en Øresundsmetro, vil det i den kommende fase 2.2 af projektet være nødvendigt at foretage en række undersøgelser og/eller tilpasninger af designet:

- Udarbejde Reference Design og Kontraktdokumenter for både anlægsentreprise og Transport System entreprise.
- Udarbejde 'Safety Case' og tunnelventilationskoncept inklusive strækningen mellem v/Prags Boulevard Øst til Øresund, for at sikre en holistisk løsning der tilgodeser Øresundsmetroen.
- Foretage yderligere undersøgelser af risici knyttet til olieoplagringsfaciliteter på Prøvestenen. Desuden at få den Uafhængige Sikkerheds Assessors evaluering af, hvilke eventuelle mitigerende tiltag der er nødvendige at indarbejde i projektet.
- Indarbejde eventuelle mitigerende tiltag, jævnfør ovenstående.
- Udarbejde detaljerede faseopdelinger af anlægsarbejdet for Øresundsmetro (den del der foregår på Prøvestenen og tilslutningen til M5), så disse arbejder kan indarbejdes i den kommende driftskontrakt for M5.

- Vurdere reservekapaciteten for M5 Kontrol- og Vedligeholdelsescenter for så vidt angår ”tungt” vedligehold.

Disse arbejder vil blive udført i perioden juni 2024 til juni 2025 og det vurderes at prisen vil være ca. **10-12 mio. kr**. (prisniveau 2024, inkl. 30% korrektions reserve).

Bemærk, at der er andre undersøgelser af emner såsom indvirkningen på tog, transportsystemer, drift, vedligeholdelse, osv, som også bør gennemgås i den periode.

Ud over ovenstående vil det være nødvendigt at forberede arealreservationer og ekspropriationer for at sikre udførelsesmuligheder for Øresundsmetro. Det vil for eksempel være nødvendigt at sikre arbejdspladser følgende steder:

- Amager Strandvej 3
- Kløverparken, omkring v/Prags Boulevard Øst station
- Sydlige del af Prøvestenen

Det er endnu ikke vurderet, hvad det vil koste at forberede disse arealreservationer mm.

2 Executive Summary

In connection with the preparation of the Conceptual Design and Environmental Impact Assessment for the M5, it has been investigated which physical works are necessary to carry out as a minimum at the same time as the construction of the M5, in order to ensure that an Øresundmetro can later be built without significantly affecting the operation of the M5.

The investigations are based on the previous study of an Øresundmetro, where trains from Malmö run to, respectively, Copenhagen H and Østerport, cf. the figure below.

The studies show that to safeguard for Øresundmetro it is requried to construct a bifurcation in connection with v/Prags Boulevard Øst station. As it will not be possible to construct this bifurcation later without impacting the M5 operation for several year. It is estimated that the price for the branch chamber will be approx. **400 mil. DKK** (price level 2023, incl. 30% correction reserve).

If it is decided to safeguard for a future Øresundmetro be necessary to carry out a number of studies and develop the design as part of the Phase 2.2 works. This work includes:

- Development of the Reference Design and Contract Documents for construction of the additional bifurcation for both Civil Works and Transportation systems.
- Development of the Operation Safety Case and tunnel ventilation strategy including the sections from v/Prb to Øresundmetro that will be constructed as part of Øresundmetro to ensure a holistic solution is developed.
- Further develop the risks assessment associated with the OTC and request the Independent Safety Assessor carries out an evaluation to identify what mitigation are required.
- Design of mitigations relating to OTC, if required.
- Detailed construction sequence for construction of Øresundmetro infrastructure so details can be included in future Operations and

Maintenance contract. (Only applicable if works will be carried out in the O&M contract period).
- Assessment on the 'spare' capacity at the M5 CMC for heavy maintenance of the Øresundmetro trains. Opening dates for Øresundmetro to be confirmed.
- Preparation for expropriations, including assessment of the expropriation for the areas to be safeguarded for future construction works.

The above works will be carried out between June 2024 and June 2025 and estimated to cost between **10 – 12 mil. kr** (2024 prices, including 30% correction reserve).

Note that there are other studies into items such as the impact on rolling stock, transportation systems, operations, maintenance, etc, that should also be reviewed in the above period and not included in the above cost estimate.

In addition to the above, it will be necessary to prepare land reservations and expropriations to ensure feasibility for the Øresundmetro. For example, it will be necessary to secure worksites to be used during the construction of Øresundmetro at the following locations:

- Amager Strandvej 3
- Kløverparken, around v/Prags Boulevard Øst station
- Southern part of the Prøvesten

It has not yet been estimated what it will cost to prepare these land reservations, etc.

3 Introduction

3.1 Purpose

This report summarises the work carried out as part of the Concept Design and Environmental Impact Assessment (EIA) to ensure the safeguarding of the M5 project for a possible future connection to the Øresund metro. This work has been included as a variant is the M5 EIA. This work was requested by København Kommune and Malmo Stad and they financed work separately from the M5 EIA. The scope of work as agreed as defind in the note ref. M5-MS-ØHA-MAL-003 and as set below.

The study has had a focus on optimising the amount of infrastructure that is required to be constructed as part of M5 whilst safeguarding for the future possible connection to Øresundmetro. It has only considered the physical infrastructure, e.g., bifurcations, tunnels, etc., that is required for the safeguarding. There have been no studies into any other aspects of the connecting Øresundmetro to M5 that should be studied further, for example; rolling stock, operational safety, fire life safety, transportation systems, train controls, maintenance, etc.

3.2 Scope

The scope of the work was outlined in note reference: M5-MS-ØHA-MAL-003, that is summarised in the below list:

- Branch possibility at Prøvestenen and at v/Prags Boulevard Øst.
- Reconfiguration of CM, including consideration of risks associated with fuel depot.
- Revised flood protection for CMC.
- Alignment design of 'delta branching' to ensure that the tunnels can pass each other. Please note that this may result in station location adjustment for v/Prags Boulevard Øst.
- Track geometry on the Touchstone for access to CMC for the M5, partly during the construction of the Øresund Metro and partly during operation of the Øresund Metro to ensure that the Øresund Metro can be built without affecting the operation of the M5.
- Ramp to the Øresund Metro Tunnel.
- Alignment of the Øresund Metro crossing under the Eastern Ring Road and clarification of interfaces with the Eastern Ring Road.
- Calculation of construction costs for additional M5 infrastructure for safe Øresund metro.
- Risk assessment of the Øresund Metro in relation to existing installations at Prøvestenen, e.g. fuel tanks.
- Carry out an EIA for the infrastructure that will need to be constructed as part of M5 to safeguard for a future Øresund metro.

This report focuses on the design aspects of the infrastructure requirements for the possible connection. For the full environmental impact assessment refer to the EIA report. (note to be published summer 2024).

3.3 References

Code	Reference description
M5-MS-ØHA-MAL-003	Sikring af Øresund metro - M5

4 Operational Model for Øresund metro

The operational model for Øresund metro is based on the previous studies carried that allow for a 90 sec. train frequency to/from Malmo, with alternating trains travelling towards Østerport and København H, as shown in Figure 1.

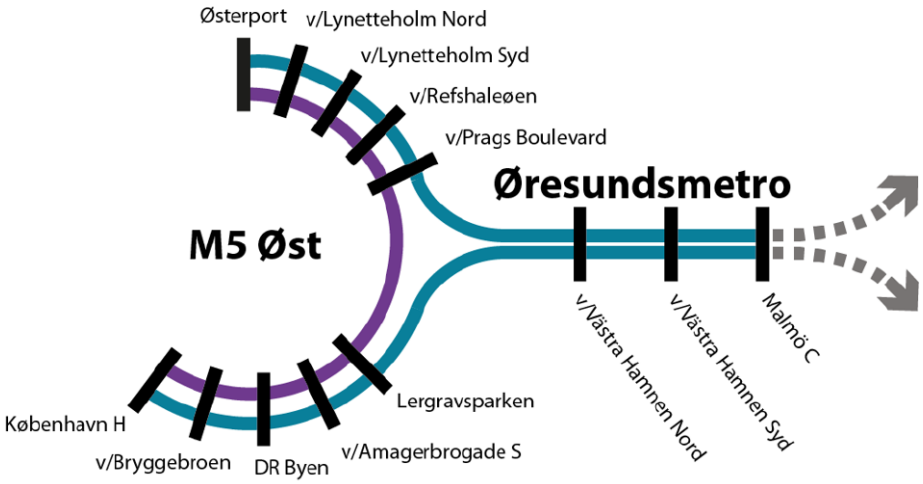


Figure 1 - Øresund metro Operational Model

To facilitate the trains travelling towards both Østerport and København H from Malmo a 'delta-junction' is required where the blue line (Øresund metro) connects to the purple line (M5), as shown in Figure 1.

In this operational model M5 trains and Øresund metro trains can each operate at a 180s frequency (with a combined frequency of 90s) on the M5 infrastructure only once M5 is extended beyond Østerport. When Østerport is a terminal station, the maximum frequency is reduced to 240s for M5 and Øresund metro trains (with a combined frequency of 120s), this will limit the frequency on the coast-to-coast section to 120s. This restriction is due to the crossover being located in front of the platform at Østerport.

4.1 Alternative Operation Model

It should be noted that an alternative operation models could also be adopted. Two possible operation models are:

- Øresundmetro trains could only operate on the southern section of M5 from Lergravsparken to København H. This would not require any additional infrastructure to be constructed as part of M5. This would limit the frequency of Øresundemetro to 180s, although a bifurcation located on the Øresundmetro ramp could provide the possibility for an additional line through Copenhagen at a frequency of 180s that would allow a combined frequency on Øresundmetro of 90s.

- Øresundmetro could not be integrated into M5 and be a standalone line.

Both alternatives would require not additional investment into M5 infrastructure.

5 Key Project Constraints

5.1 CMC

The M5 CMC shall be located on Prøvestenen and has been adjusted to the south and west as agreed with the owners and other key stakeholders. The red outline in Figure 2 shows the agreed boundaries for the CMC, that will partly be located on reclaimed land. The flood protection is outside of these boundaries.

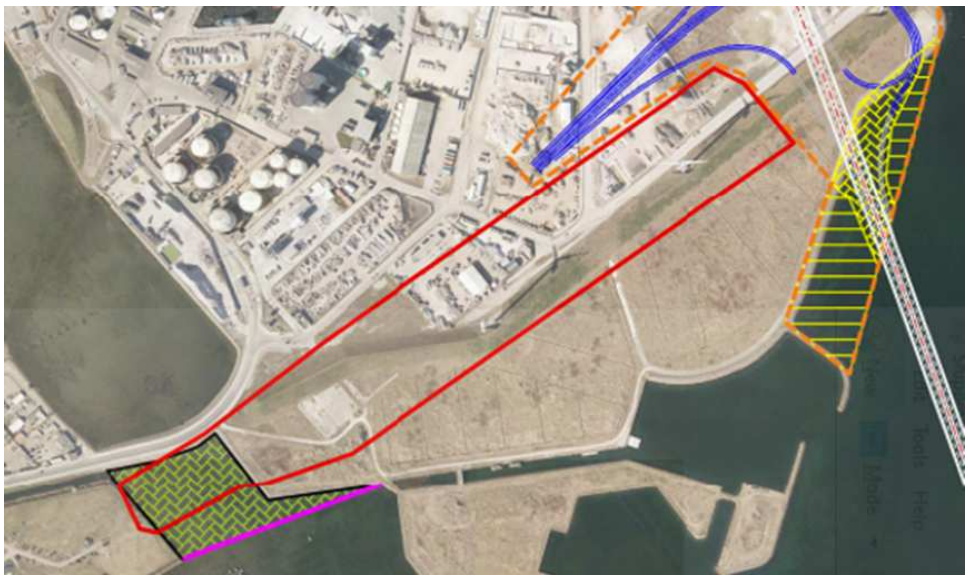


Figure 2 - CMC Location

5.2 Culvert and Drainage Channel

Other key constraints for the design of the CMC and the connection to M5 are the existing culvert connecting Prøvestens Kanal and Øresund, and the drainage channel outlet to the south of the access road to Prøvestenen, refer to Figure 3. Both impact the placement of the ramps, both towards M5 and towards Øresund metro.

To cross the culvert connecting Prøvestens Kanal and Øresund the rail level needs to be at approximately +3m DVR to allow for 1.5m above mean sea level, 0.5m of structure, and 1m of track build-up (assumed ballasted track).

Note that the drainage channel that runs alongside Prøvestensbroen and acts as the outfall from the drainage culvert in Prags Boulevard will also interface the alignment for a possible connection from CMC to the north. It may require that this drainage channel is relocated, or works are required to allow the TBM to pass safely, e.g., ground improvement, channel placed in a structure, this is described further in Section 6.2.2.

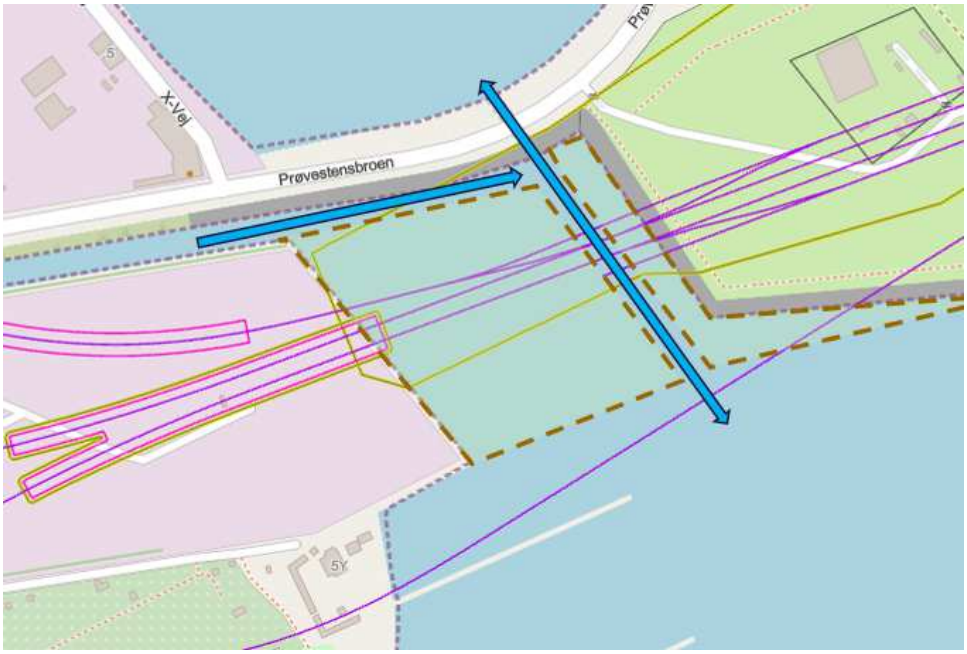


Figure 3 Culvert and drainage constraints (Culvert and drain channel shown as blue arrows, reclaimed land shown as brown dotted line)

5.3 Constraints in Kløverparken

Due to interfaces with a future road and development of the alignment within Kløverparken the alignment has been relocated approx. 36 m to the east compared to the alignment included in the Programme Study, refer to Figure 4. The alignment was relocated to allow for adequate space to construct a new road connecting Forlandet to the north and Amager Strandvej to the south. Furthermore, the alignment needed to consider the large tower that is part of a major drainage installation located in the north part of Kløverparken adjacent to Forlandet (circled in red in top left of Figure 4).

With the alignment moved to the east it increases the challenges of connecting the Øresund metro tracks with the M5 tracks south of v/Prags Boulevard Øst station whilst maintaining suitable alignment for the operation.

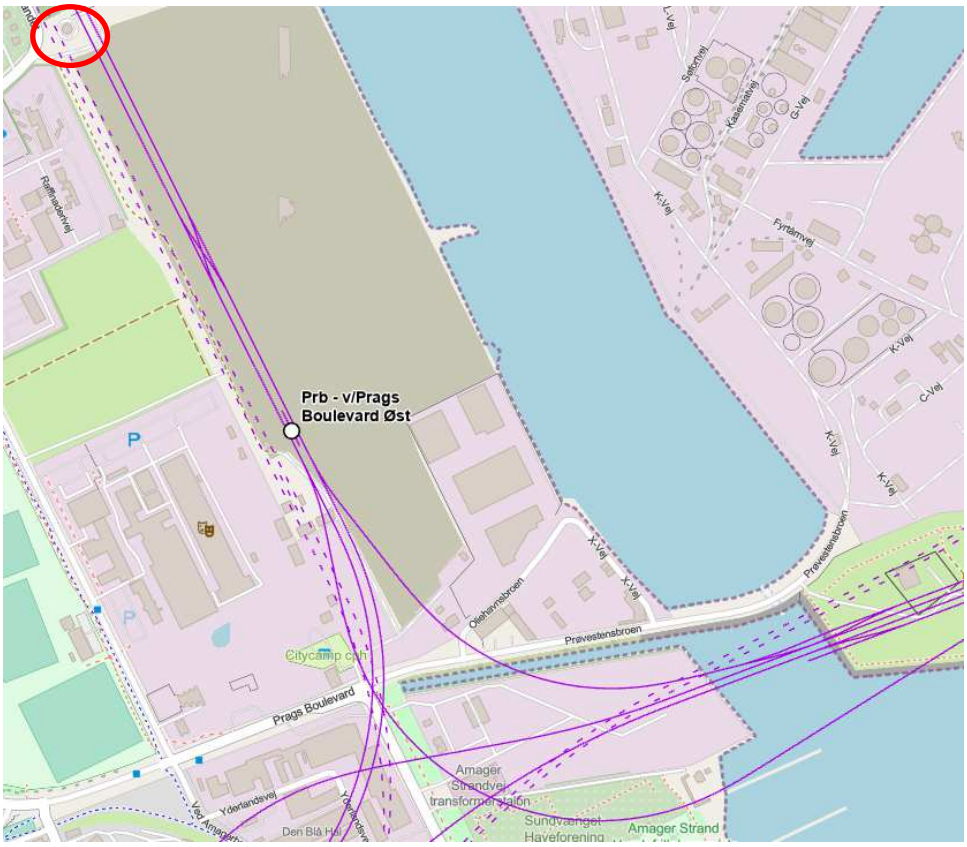


Figure 4 - Relocation of alignment in Kløverparken (Dotted lines is alignment from Programme Study, solid lines is concept design alignment)

5.4 M5 CMC and Øresund metro trains

The trains for the Øresund metro will not be stabled at the M5 CMC. The stabling and daily cleaning and maintenance will be carried out at a facility in Sweden. However, it will be possible to use any spare capacity of the relevant equipment for substantial maintenance. If it is decided to implement Øresund metro a more detailed study should be carried out to determine the how much capacity, there will be at that M5 CMC when Øresund metro is opened.

6 Operational model for CMC and connection to M5 main line

6.1 M5 CMC & Connection without Øresund metro

The CMC for M5 will be safeguarded for the possibility to expand to account the full M5 ring (including the perspective line between Kh and Kk) and for trains at 90 sec. headway. The connection from the CMC to the mainline will be from a bifurcation between Lergravsparken station and v/Prags Boulevard Øst with the direction of travel towards Lergravsparken, refer to Figure 5. The bifurcation may be located at either Jenagade (Basis) or at Lergravsparken (Variant), both options are included in the EIA.

During ramp-up and ramp-down all trains will be launched or received via the bifurcation towards Lergravsparken.

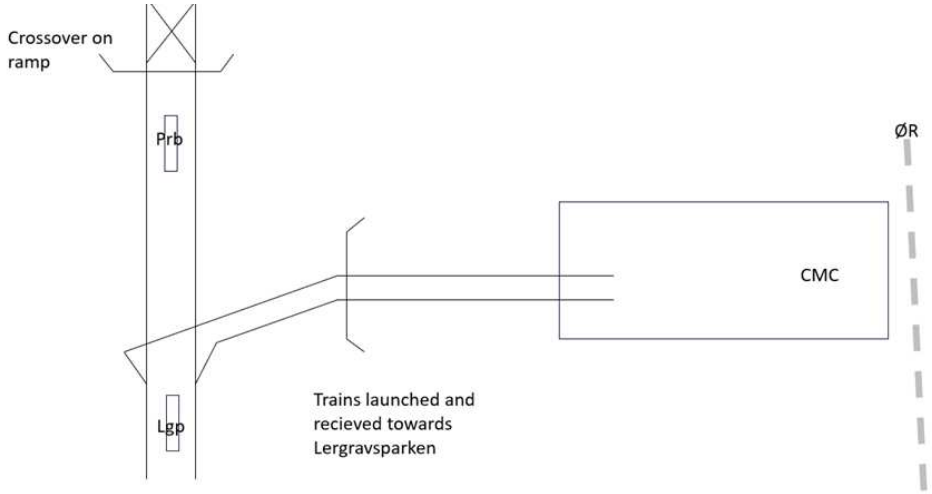


Figure 5 - M5 CMC Connection without Øresund metro (ØR - Østlig Ringvej)

6.2 M5 CMC & Connection with Øresund metro

Previous studies into the possible connection between M5 and Øresund metro have include a connection from Øresund metro track into the CMC as the tracks passes Prøvestenen. Direct access to the CMC for trains to and from Malmo provides improved operational robustness if there is a disabled train that needs to be removed from the system. As the Øresund metro feeds into M5, the same way M4 feeds into M3, if there is an incident on the Øresund metro it could impact the M5 operation and visa-versa. Therefore, having the ability to extract a disabled train from the system as soon as possible minimises the disruption to the operation of both lines.

There are also potential benefits to M5 operation with the introduction of the connection from the CMC to the north at Prags Boulevard Øst. This will enable the trains to be launched in two directions that will approximately half the time needed to ramp-up/ramp-down when the train frequency changes, e.g. before and after rush hour. This will also reduce the number of train kilometres, reducing wear and tear, maintenance, and energy use.

It should be noted that although there are benefits to both operational robustness of both lines and normal operational benefits to M5 from a connection between CMC/Øresund metro to v/Prags Boulevard Øst, there are also significant challenges, and it is not an absolute requirement to safeguard for Øresund metro.

Therefore, as part of this study 3 different options have been studied:

- Option 1: All tracks can access CMC directly, refer to Figure 6.
- Option 2: Tracks from v/Prags Boulevard Øst to Øresund metro by-pass CMC, refer to Figure 9.
- Option 3: Tracks to and from v/Prags Boulevard Øst to Øresund metro by-pass CMC, refer to Figure 10.

The following sections outline the study of the different options, the possibilities and concludes on which option has been the basis for the wider study into what infrastructure needs to be constructed as part of M5 to safeguard for a future Øresund metro connection. Furthermore, it is identified which infrastructure should be constructed as part of M5 and which should be constructed as part of Øresund metro.

6.2.1 Option 1: All tracks can access CMC directly

With consideration of the above it is ideal to have the connections from Øresund metro, i.e., to both north and south as shown in Figure 6.

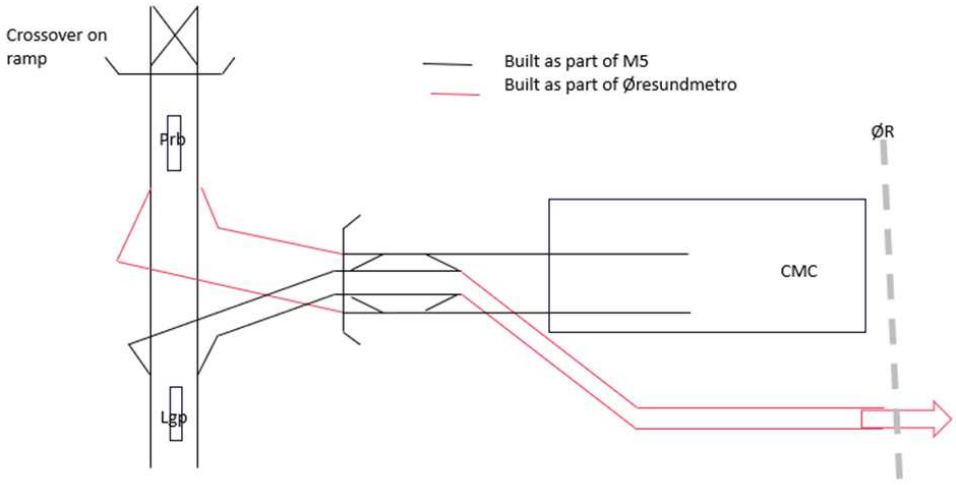


Figure 6 - All tracks can access CMC directly.

Unfortunately, due to the restriction with the culverts, refer to Section 5.2 and the need for the tunnels to cross one another it is not possible to get this arrangement to work.

The track from v/Prb to Øresund metro will need to cross over a total of 4 tunnels, very close to where the tunnels converge at the bifurcation, refer to item 1 in Figure 7 below. This results in this tunnel being too shallow for a bored tunnel. It cannot go under the tunnels connecting the CMC to the bifurcation toward Lergravsparken because those tunnels need to dive at a steep gradient so they are in the limestone when they pass under the development are west of Amager Strandvej.

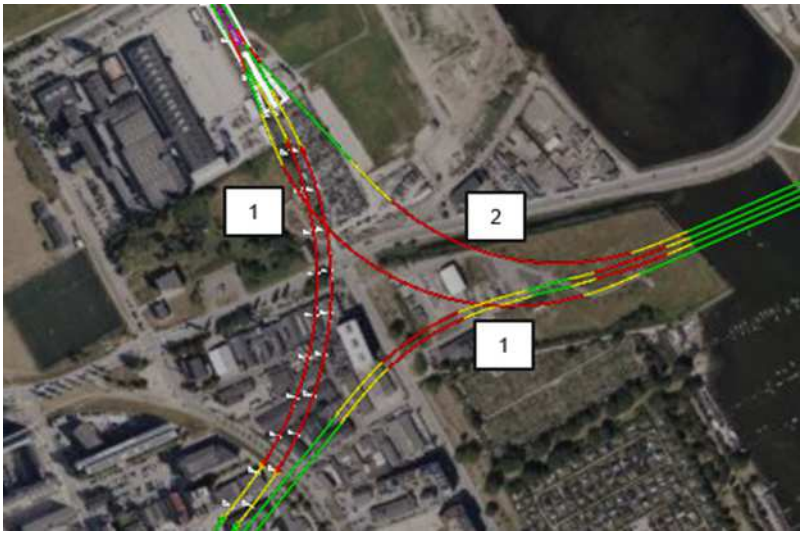


Figure 7 - Alignment Constraints – All Øresund metro tracks connecting to CMC.

The track from Øresund metro to v/Prb, via CMC (Label '2' in Figure 7) will be a very shallow crossing under the drainage channel adjacent to the Prøvestensbroen road, item 2 in Figure 7. This tunnel will be approx. one tunnel diameter below the surface except where it crosses under the drainage channel where the cover is less than one tunnel diameter. It is therefore assumed that the drainage channel will need to be placed within a concrete box culvert at this location to enable the bored tunnel to pass very close under the base of the channel, refer to Figure 8. This would be constructed as part Øresund metro project and would require the temporary diversion of the drainage channel for the construction of the concrete box.

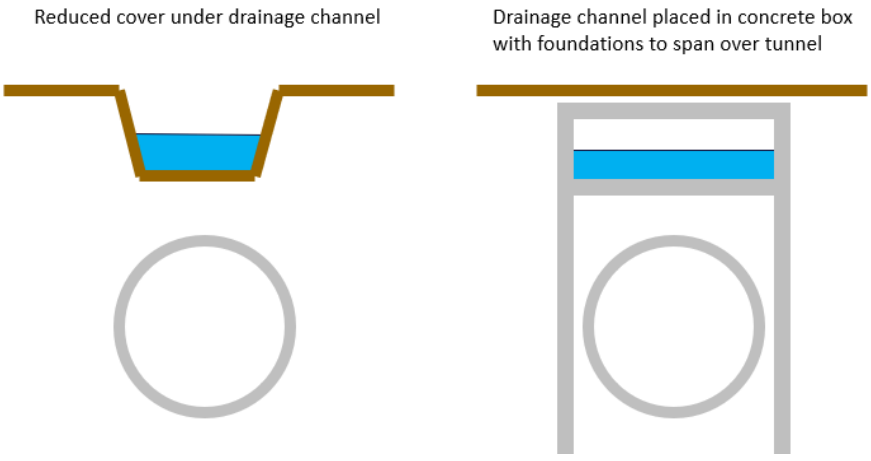


Figure 8 - Drainage channel.

With the constraints imposed on the tunnel for the tracks from v/Prb to Øresund metro, item 1 in Figure 7, this is not considered a feasible solution and therefore this option has not been progressed.

6.2.2 Option 2: Tracks from V/Prags Boulevard Øst to Øresund metro by-passes CMC

To avoid the challenges with the v/Prags Boulevard Øst to Øresund metro track crossing the other tunnels, it is possible for this track to connect directly from the Øresund metro ramp to the bifurcation at v/Prags Boulevard, by-passing the CMC, as shown in Figure 9. The tunnel for the track from v/Prags Boulevard Øst to Øresund metro would connect to Øresund metro in the Øresund metro ramp structure on Prøvestenen. This provides adequate alignment length for the tunnels to dive below the tunnels connecting the CMC with the bifurcation toward Lergravsparken.

The track connection from Øresund metro to v/Prags Boulevard Øst still have a direct connection to the CMC, see Figure 9. This configuration will allow for the ramp-up in both directions, north and south, gaining the operation benefits. However, trains can only smoothly return to the CMC from the south (i.e., without turning back) and therefore the M5 ramp-down will not benefit in this configuration.

Although the operation robustness and flexibility are not as good as Option1, this option does still provide several options for dealing with unforeseen events.

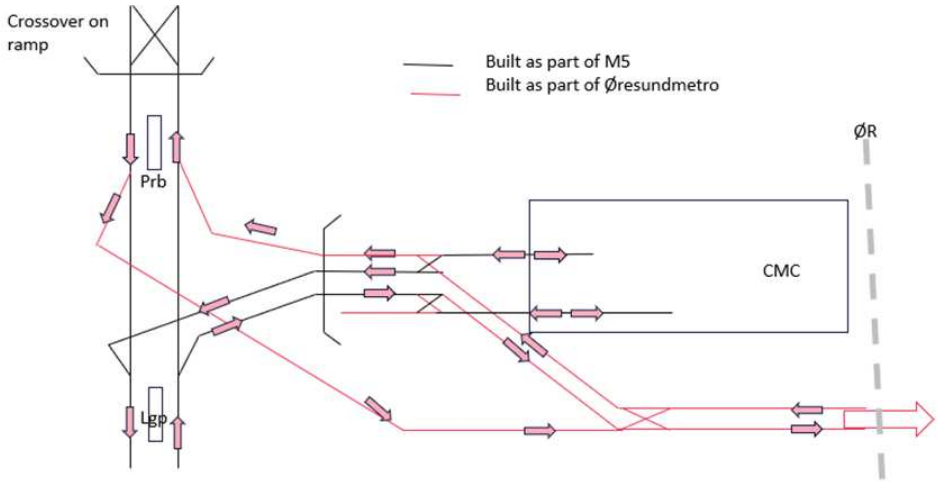


Figure 9 - Tracks from V/Prags Boulevard Øst to Øresund metro by-pass CMC.

The challenge of crossing under the drainage channel with the tunnel containing the track from Øresund metro to v/Prags Boulevard Øst remain but can be dealt with as described in Section 6.2.1.

6.2.3 Option 3: Track to and from V/Prags Boulevard Øst to Øresund metro by-pass CMC

Option 3 only maintains the connection between M5 and the CMC from the south (i.e., from the bifurcation towards Lergravsparken). This is the same for the M5 without the safeguarding for Øresund metro, therefore there are no benefits for the ramp-up or ramp-down of M5. Also, it is not possible remove failed trains or insert trains from/to the north, so this lowers operational robustness.

The tunnel connections between Øresund metro and v/Prags Boulevard bifurcate from Øresund metro at the Øresund metro ramp structure on Prøvestenen and would be constructed as part of Øresund metro, refer to Figure 10.

There is still a track connection from Øresund metro to the CMC where Øresund metro connects to the track towards Lergravsparken, refer to Figure 10.

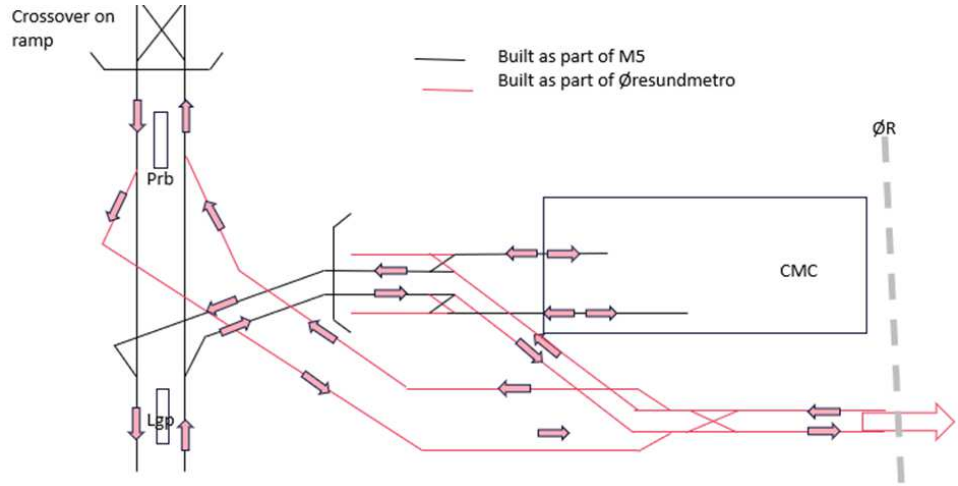


Figure 10 - Track to and from V/Prags Boulevard Øst to Øresund metro by-pass CMC.

This option removes all direct connections from the track to the north from the CMC, although trains can access the CMC via a number of turnback movements.

6.3 Conclusion Operational model for CMC and connection to M5 main line

With consideration of the above assessment Option 1, although preferred from an operational robustness point of view, is not physically possible due to the various project constraints. Option 2 and 3 both safeguard for the operation model described in Section 4, but Option 2 provides better operational robustness and benefits to the operation of both lines.

Option 2 & 3 both have the same requirements in terms of what needs to be constructed as part of M5, i.e., the bifurcation at v/Prb. Therefore, this is what should be included as part of the safeguarding for Øresund metro.

It is also important to assess the feasibility of the constructing of the remaining infrastructure that will connect M5 and Øresund metro, for example the tunnels between Øresund metro and v/Prb and the ramp on Prøvestenen and identify the possible impact on the operation of M5. This assessment is included in Section 9.

7 Infrastructure to be constructed as part of M5 for inclusion in EIA

The infrastructure that needs to be constructed as part of M5 to safeguard for a possible future Øresund metro has been assessed to be a bifurcation at v/Prb. This has been included in the M5 EIA as a variant.

7.1 Bifurcation at v/Prb

As the bifurcation is located adjacent to the station it will be a flat bifurcation, similar to the bifurcation at Øster Søgade for M4 from M3 between Østerport and Trianglen stations.

When reviewing the possibility to reduce the size of the bifurcation structure to be constructed at v/Prb two main options where reviewed. One option with a bifurcation south of the station and one with a bifurcation parallel with the station. The intension with the bifurcation parallel to the station is to reduce the overall size of the structure reducing costs and CO2. Further studies has shown that when the alignment was adjusted to avoid clash between a M5 train at the platform and the Øresund metro joining or leaving M5 the possible reduction in the size of the structure was smaller than expected, refer to Figure 11. As the parallel solution also results in trains from Malmo not being able to stop at v/Prb it has been decided to progress with the bifurcation south of the station at this stage and that has been included in the EIA, refer to Figure 12.

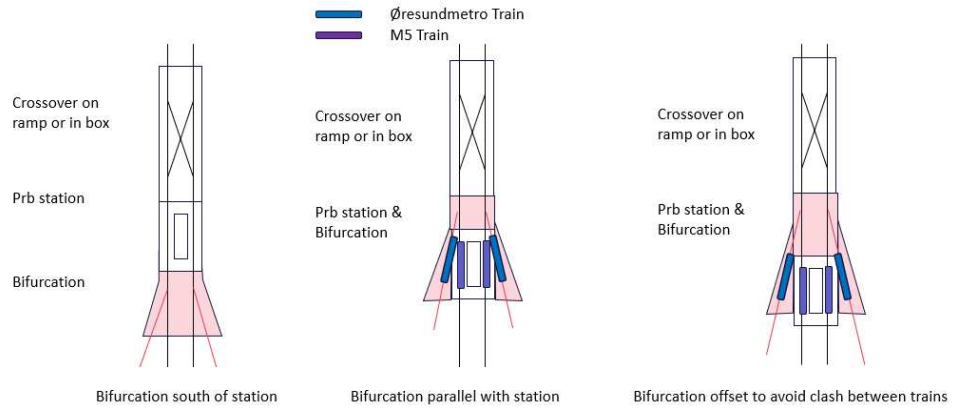


Figure 11 - Bifurcation structure options.

Figure 12 - v/Prb Bifurcation included in EIA.

The bifurcation structure proposed for safeguarding for Øresund metro is the same for both the Basis alignment where the alignment is elevated between v/Prb and v/Ref and the Variant where the alignment is underground between v/Prb and v/Ref.

The bifurcation will need to be designed to receive the TBMs constructing the tunnels from Øresund metro to v/Prb, tunnels 1 & 2 in Figure 23, p. 29. This will require areas within the bifurcation shaft that are separate from the operational tracks to enable the TBMs to be received into the shaft and extracted without disrupting the M5 operation. These areas will need access to surface for preparation of TBM break through and TBM extraction. This design concept was part of the design for the Øster Søgade bifurcation on M3, that incorporated 'chimneys' from track level to surface for TBM extraction and this design can be adopted at this location to safeguard for the future TBM extract, refer to Figure 13, Figure 14 and Figure 15.

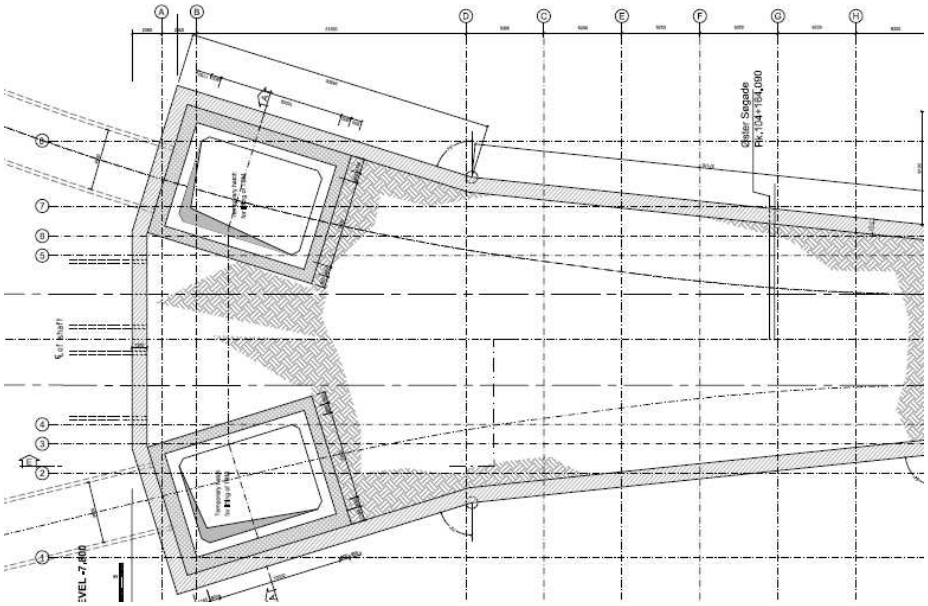


Figure 13 - Part plan of Øster Søgade showing TBM extraction 'Chimneys'.

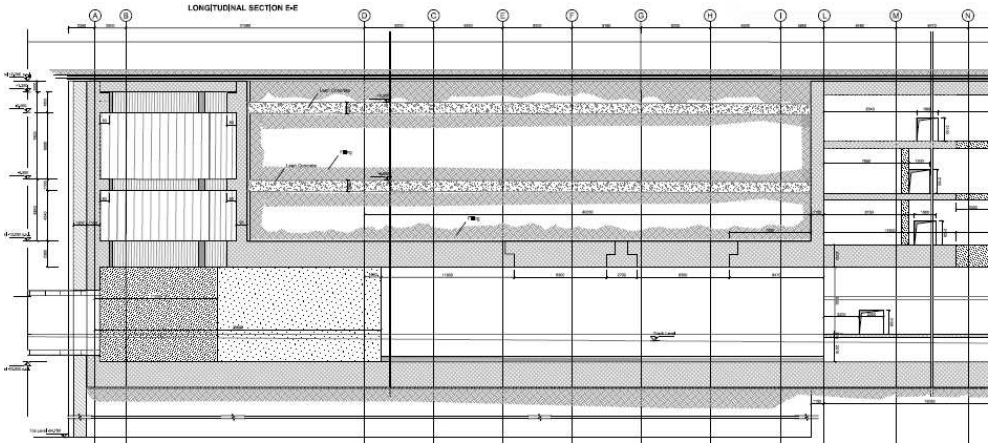


Figure 14 - Part long section of Øster Søgade showing TBM extraction 'Chimneys'.

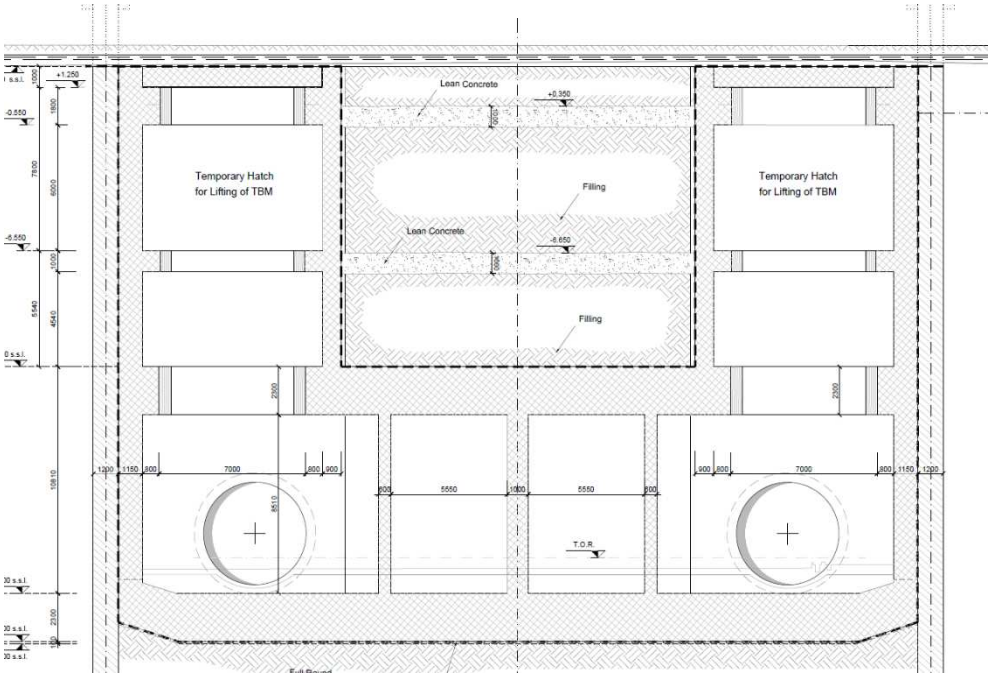


Figure 15 – Cross-section of Øster Søgade showing TBM extraction 'Chimneys'.

Furthermore, worksite area will need to be safeguarded for the extraction of the TBMs and closure of the shaft. An example of this is from M4 Sydhavn TBM extraction at Havneholmen shaft that was approximately 3,500 m^2, refer to Figure 16. Although the worksite at v/Prb would need to be larger as there are two openings at two different locations, either side of the main line, and not stacked as at Havneholmen shaft. This is described further in Section 9.1.2.

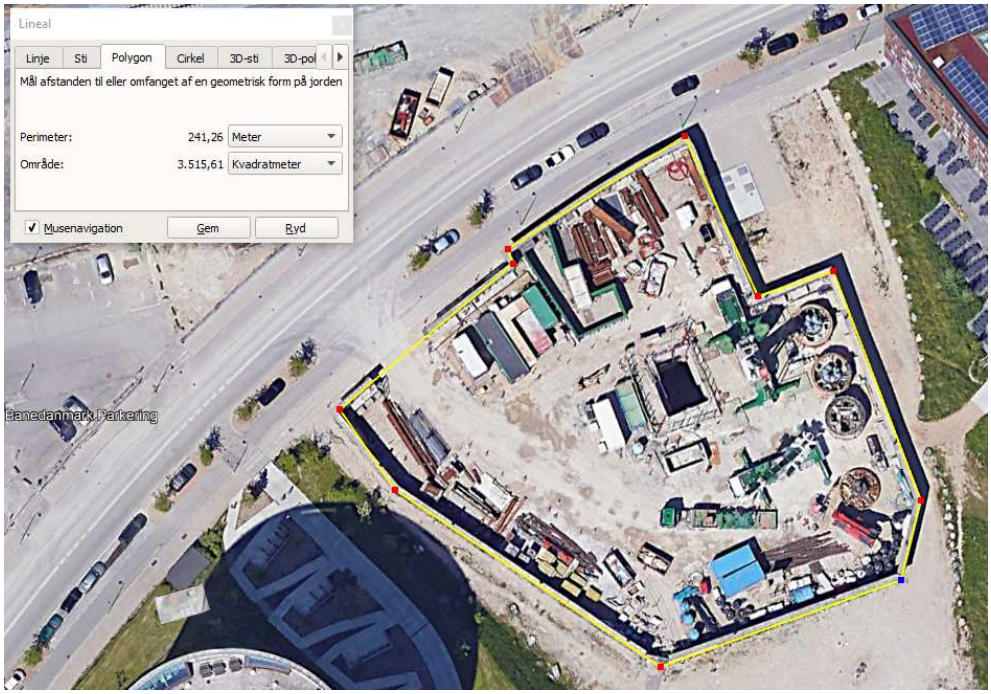


Figure 16 - M4 TBM Extraction Worksite at Havneholmen.

7.1.1 Utilities at v/Prb

There is a major alignment corridor that runs between Forlandet and Amager Strandvej. The bifurcation is wider than the station box due to the separation of the tracks at one end. The wider yellow footprint (area that is required to be free from active utilities) has been checked against the existing utilities in the area and confirmed there is no clash, refer to Figure 17.

Figure 17 - Utilities and Bifurcation.

7.2 Alignment and Risk from Oiltanking Copenhagen A/S Syd (OTC), matr. 479, 480, 481

OTC undertakes the import, distribution and storage of fuels, which includes jet fuel, diesel and petrol. In connection with approval of the company, Rambøll has carried out risk analysis including calculation of site-specific risk and maximum consequence zones. The resulting 'Iso curves' for the calculations are shown in Figure 18.

Figure 18 - OTC Risk zone (Ramboll risk calculation).

These risk curves have been overlaid on the alignment for the connection to Øresund metro as can be seen in Figure 19. The light blue curve is the limit of area of maximum consequence. As can be seen from Figure 19 the alignment of the tracks for trains travelling from Øresund metro to both v/Prb and Lergravsparken are at the edge of the maximum consequence zone, although at this location the tracks are just below ground level. Whether or not any mitigation measures are required has not yet been concluded and will require more detailed quantitative risk assessments and evaluation by both the Independent Safety Assessor and the relevant Railway Authority. The tracks could maybe be covered to mitigate this risk.

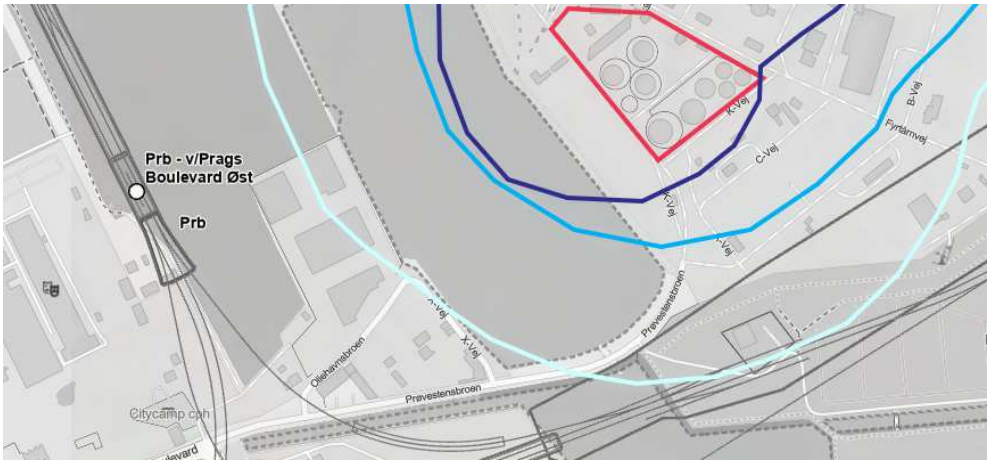


Figure 19 - Øresund metro alignment and OTC risk curves.

The Ramboll risk assessment also assess the possible pressure waves resulting from an incident at OTC, Figure 20. The alignment at ground level is within the 50-mbar area. The pressure wave may be a risk to the trains as they travel through the CMC area at ground level, if an incident occurs at the same time as a train passes. Within this zone it is likely that windows will be blown out and it may cause instability in the train resulting in derailment. The level of risk will need to be assessed, including a detailed quantitative risk assessment of the probability of a train passing at the same time as an explosion at OTC. The risk assessment with consideration of both the probability and the consequence will need to be evaluated by the Independent Safety Assessor and agreed with the relevant railway authority. If the risk is considered unacceptable it would be possible to mitigate by enclosing the tracks at ground level in a concrete structure that could be backfilled over (sometimes referred to as a 'green tunnel'). An example is shown in Figure 21 from the HS2 project in the UK. This structure could be constructed as part of the Øresund metro project and does not need to be safeguarded for at this stage.

Figure 20 - OTC Pressure waves

Figure 21 - Green tunnel example from HS2 in the UK.

7.3 CMC layout Safeguarding

To connect the Øresund metro to M5 alignment it has been checked that the space within the CMC area can be arranged to make room for the Øresund metro ramp whilst also providing space for the trains for the 'full ring' at 90s frequency. A possible layout of the CMC and Øresund metro ramp is shown in Figure 22.

It has been confirmed that for the safeguarding of Øresund metro no changes need to be included in the CMC layout that is required to be constructed as part of M5. A possible construction sequence for the Øresund metro ramp and CMC is described in Section 9.2.

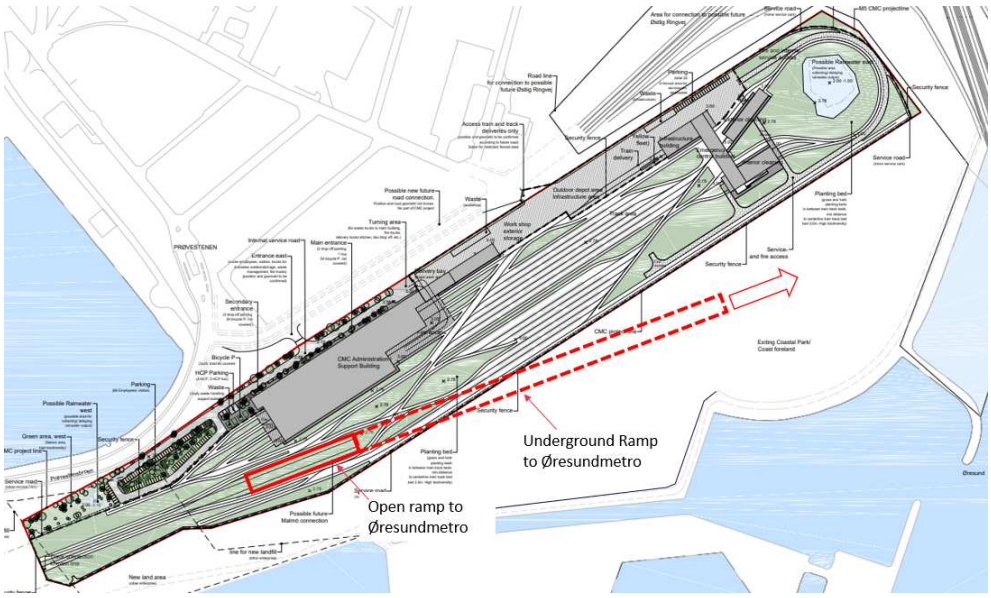


Figure 22 - M5 CMC and Øresund metro Ramp (Storm surge embankment not shown).

7.4 Flood Protection for CMC

It has been confirmed that for the safeguarding of Øresund metro no changes need to be included in the flood protection of CMC as to be constructed as part of M5. Note that the flood protection will need to be temporarily modified during the construction of Øresund metro as described in Section 9.

8 Additional Costs if Variant to Safeguard for Øresund metro is progressed

8.1 Additional Design and Construction Costs for M5

To safeguard for a possible future connection of Øresund metro to M5 and allow for the operational model described in Section 4, whilst not have a significant impact on the M5 operation, it has been determined that an additional bifurcation will be required south of v/Prb station. As well as the design work specific to the bifurcation there are other activities that need to be carried out in the development of the project relating to the line wide design considerations such as safety, ventilation, etc.

8.1.1 Phase 2.2 Work

The following design, risk, safety and engineering work will need to be carried out in the next phase of the project if it is decided to safeguard for the Øresund metro:

- Development of the Reference Design and Contract Documents for construction of the additional bifurcation for both Civil Works and Transportation systems.
- Development of the Operation Safety Case and tunnel ventilation strategy including the sections from v/Prb to Øresund metro that will be constructed as part of Øresund metro to ensure a holistic solution is developed.
- Further develop the risks assessment associated with the OTC and request the Independent Safety Assessor carries out an evaluation to identify what mitigation are required.
- Design of mitigations relating to OTC, if required.
- Detailed construction sequence for construction of Øresund metro infrastructure so details can be included in future Operations and Maintenance contract. (Only applicable if works will be carried out in the O&M contract period).
- Assessment on the 'spare' capacity at the M5 CMC for heavy maintenance of the Øresund metro trains. Opening dates for Øresund metro to be confirmed.
- Preparation for expropriations, including assessment of the expropriation for the areas to be safeguarded for future construction works.

The above works will be carried out between June 2024 and June 2025 and estimated to cost an estimated of between **10.000.000 - 12.000.000 kr** (2024 prices, including 30% correction reserve).

8.1.2 Construction work for Bifurcation

Construction costs for the bifurcation including all detailed design, approvals, supervision, expropriations, etc. assuming that the switches (trackwork that allows trains to switch from one track to another) are installed as part of the M5 to minimise disruption to M5 operation at a later date. This is for the works carried out between June 2025 and the opening of M5.

The construction estimate for this work is **400 mil. kr**. (2023 prices, including 30% correction reserve).

8.2 Further Additional Costs for Safeguarding (Not yet assessed)

Several areas will need to be safeguarded for both temporary and permanent use for the Øresund metro connections that will not be constructed as part of M5. These areas are described in Section 9 and include for example:

- Worksite in Kløverparken and Amager Strandvej 3 for the construction of the ramp and possible cut and cover tunnels.
- Worksite in Kløverparken for TBM extraction.
- Tunnel alignment safeguarded so future developments do not make it impossible or prohibitively expensive to construct the Øresundmetro connections, for example deep piles or anchors extending into the tunnel envelope, developments placing a large loads on the tunnels, .
- Worksite areas on Prøvestenen south of the CMC.

The relevant expropriation or other legal measures should be implemented to ensure the relevant areas are safeguarded. This may result in additional costs that have not been assessed.

9 Feasibility of future construction works

The feasibility of constructing the remaining infrastructure for the connection of Øresund metro to M5 has been assessed based on operational model Option 2 as described in Section 6.2.2. The infrastructure that will need to be constructed as part of the Øresund metro project to connect to M5 are shown in Figure 23 and include:

1. Tunnel 1 for the track for trains travelling from v/Prb to Øresundmetro.
2. Tunnel 2 for the track for trains travelling from Øresundmetro.
3. Ramp structure for tunnel 2.
4. Ramp for Øresundmetro main tunnel and bifurcation for tunnel 1.

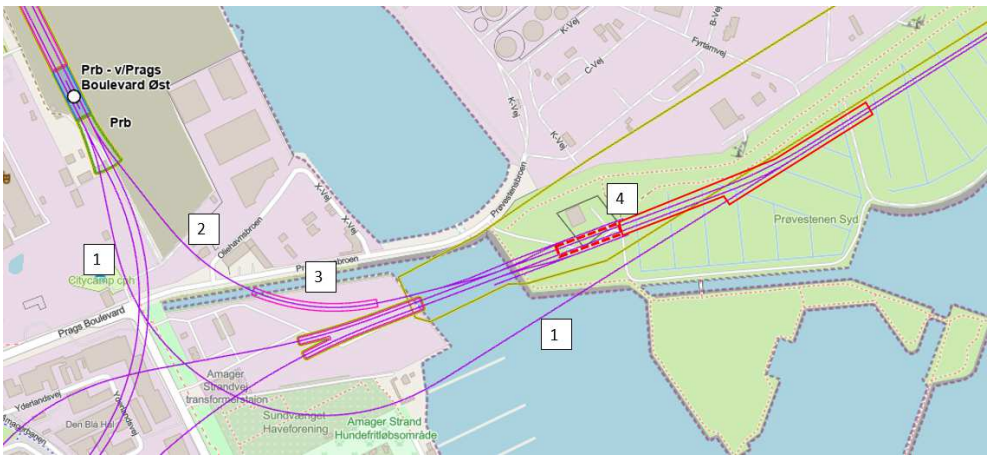


Figure 23 - Infrastructure to connect Øresund metro to M5.

9.1 Tunnelling and Alignment

The bored tunnels, label 1 & 2 in Figure 23, these tunnels are assumed to be the same size as the M5 tunnels, approx. 4,9 m internal diameter if a bored tunnel. There are a large number of tunnels that have to weave between each other to make the connections between all 3 points, e.g. v/Prb, v/Jng (bifurcation), and the CMC/Øresundmetro. Figure 24 shown the complexity of the tunnel configuration, with the tunnels labelled 1 & 2 required to be constructed as part of Øresundmetro.

Note that the assessment has been made assuming the bifurcation at v/Jng. If the M5 to CMC bifurcation is moved to Lergravsparken it should have a beneficial effect on the alignment and tunnelling constraints.

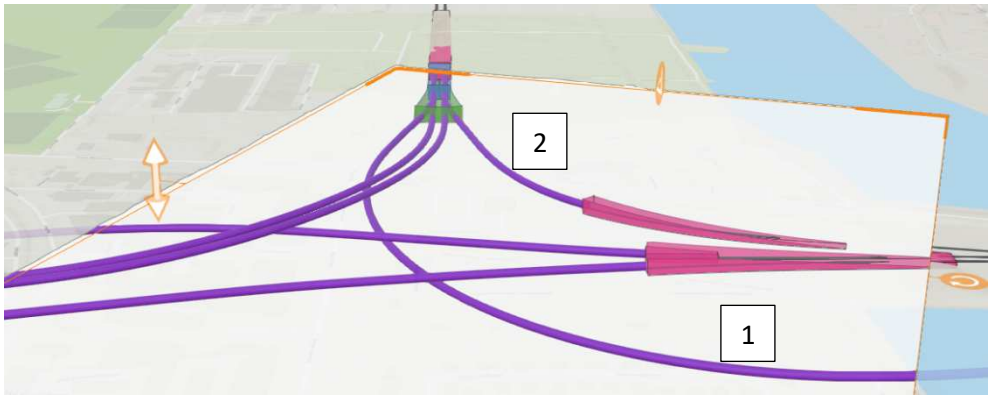


Figure 24 - Tunnel Configuration.

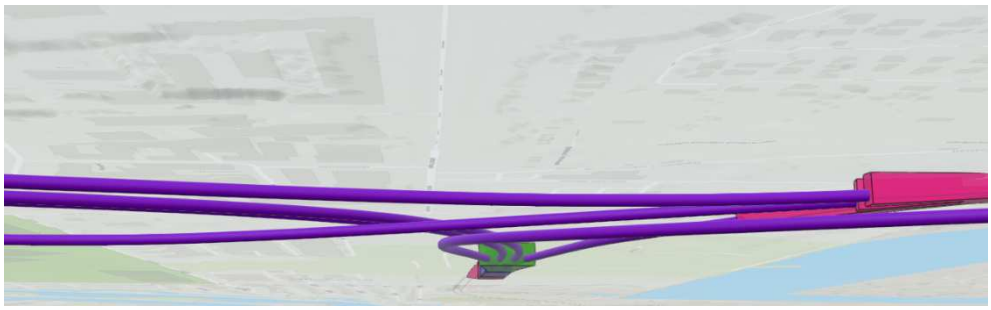


Figure 25 - Tunnel Weave seen from underneath.

The alignment for the tunnel configuration has been very challenging especially considering the recent and possible future development in the area and the interface with the foundations of those buildings. Speed restrictions of 80 kph are required to allow for greater gradients to be implemented on the curves so the tunnels weave between one another can dive below the limestone as soon as possible, to reduce the interface with future development area. Tunnel 1 in Figure 24 passes under the M5 mainline tunnels and the M5 connection to the CMC and results in the M5 mainline tunnels being higher than basis alignment, this can also be seen in Figure 25. If it is decided to safeguard for a possible future Øresund metro and the construction of tunnels 1 & 2 as part of Øresund metro it is important that the alignment of the M5 allows for space for the Øresund metro tunnels. As well as considering the other constraints such as future developments and geology.

9.1.1 Tunnels and Development interface

Figure 26, shows the tunnel alignment in relation to the limestone level. It should be noted that this is a preliminary assessment of the limestone level and additional ground investigations will be carried out in the subsequent phases to confirm the actual level. The limestone level is important as it is approximately the deepest level of driven piles which is a common foundation method for multiple story buildings. The purple tunnels in Figure 26 indicating where the tunnels may be above the limestone level and therefore could clash with any future piles, if the buildings are piled.

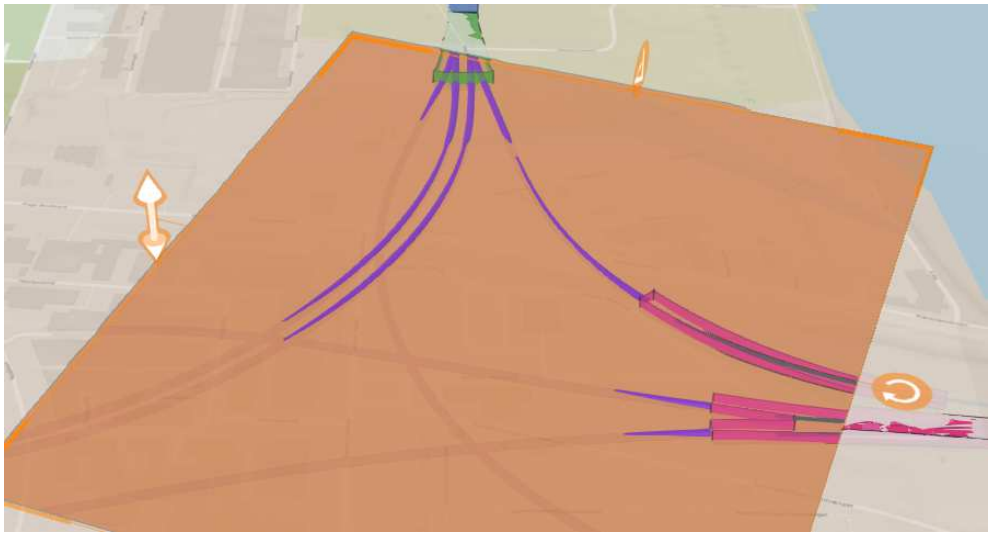


Figure 26 - Limestone level and tunnels.

Figure 27 - Local Plan.

Figure 27 shows the layout of buildings that are part of the approved local plan. The tunnels that pass under the building in the northeast corner of the area, at the intersection of Amager Strandvej and Prags Boulevard could clash with the building foundations, if the building is piled and dependent on the depth of the piles.

If there is a clash between the piles and tunnels this could be resolved by optimisation of the tunnel alignment and/or by placing speed restriction on the Øresund metro connection (Tunnel 1) of approx. 60 kph along approx. 500-600m of the alignment south of v/Prb bifurcation. This will enable the tunnels to dive faster and allow the M5 tunnels to go deeper so they are in the limestone prior to

entering the development site. If this variant is progressed further the tunnel alignment will need to be coordinated with the detailed design of the relevant buildings.

It should be noted that without the Øresund metro connection the M5 tunnels are deeper and below the limestone level as they enter the development area as they are not constrained by tunnel 1 connecting Øresund metro to v/Prb, this can be seen in Figure 28.

Figure 28 - Limestone levels and tunnels without Øresund metro connections.

As can be seen in Figure 26, tunnel 2 is very shallow and above the limestone level for the entire length between the CMC and v/Prb. There are currently no approved local plans in this area. The area along the tunnel alignment should be safeguarded to ensure that the piles are not installed that would make it impossible to construct the tunnels.

It is also important to safeguard the worksite areas for the future construction. If tunnel 2 is constructed as a bored tunnel an area for construction of the ramp and for extraction of the TBM will be needed as shown by the red dotted areas in Figure 29.

Due to the shallow nature of tunnel 2 it may be an option to construct the whole length of the tunnel with cut and cover methods. It is therefore recommended that area is safeguarded for the worksite required to construct a cut and cover tunnel along this alignment. The worksite area required for this would be the combined area of the red and blue dotted areas in Figure 29.

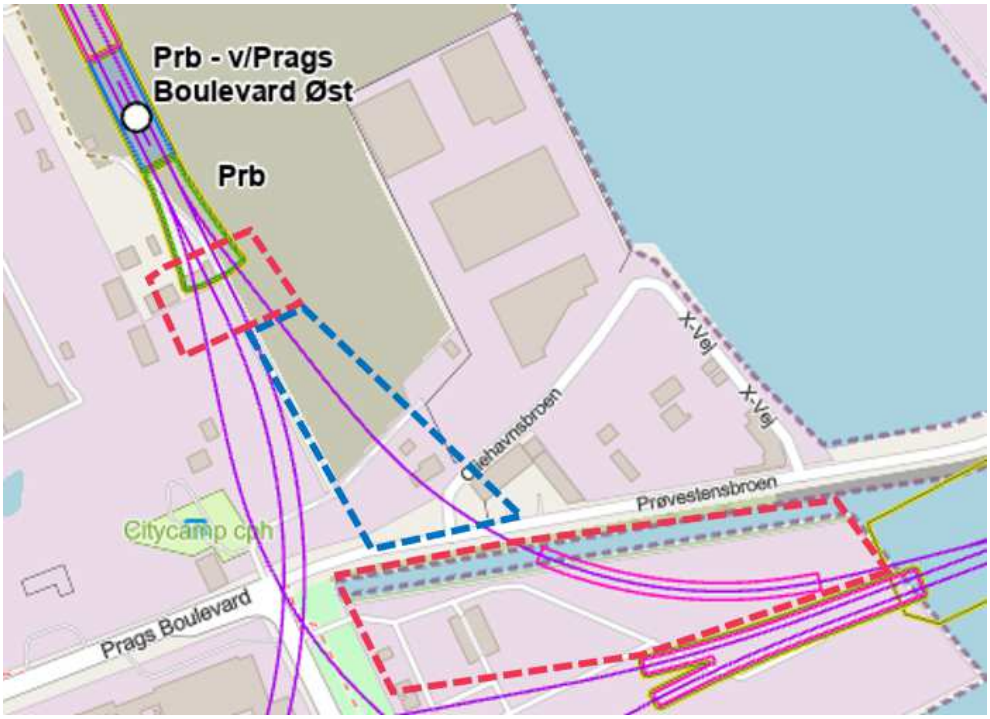


Figure 29 - Possible Worksite Areas to be safeguarded for construction of tunnels and TBM removal during construction of Øresund metro.

9.1.2 Tunnelling Worksite for tunnels 1 & 2

If both tunnels 1 & 2 are bored tunnels, a tunnelling worksite will be needed for their construction. It is assumed that the TBMs will be launch from the ramp structure in Amager Strandvej 3 and from the Øresund metro ramp south of the CMC, location of the TBM launches indicated by blue arrows in Figure 30.

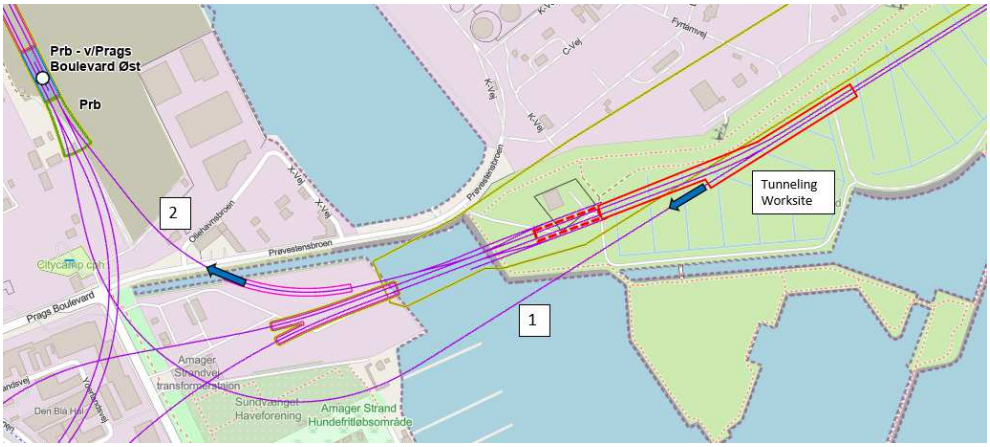


Figure 30 - TBM launch location (Blue arrows)- Red outline is the Øresund metro ramp structure.

A tunnel worksite normally occupies approximately 40.000m^2 depending on the shape and layout of the site, especially in relation to the TBM launch location and direction of travel. Tunnel worksites can be smaller although the smaller the site the more it impacts efficiency and safety. The tunnel worksite for the tunnel 1 will

be located within the same worksite as that for the Øresund metro ramp structure, south of the CMC on Prøvestenen. It is assumed that that main logistical hub (for segment storage and delivery and removal of soil) for the tunnel worksite for tunnel 2 is located at the same location and connected to the launch location at Amager Strandvej 3 via the Øresund metro ramp. Therefore, the Øresund metro ramp will need to be constructed prior to the tunnel works.

9.2 Øresund metro Ramp Structure

The ramp structure for the Øresund metro will connect the Øresund metro bored tunnel with M5, refer to Figure 31. As can be seen from Figure 31 the ramp structure crosses the CMC area, and the construction of the ramp will need to be sequenced with relocation of track to ensure that any disruption to the operation of the CMC and therefore M5 is kept to a minimum. Furthermore, the flood protection for the CMC and ramp structure also needs to be maintained during the construction works. This is described further in Section 9.2.1.

Figure 31 - Location of Øresund metro ramp structure.

The ramp structure will be similar to the construction of other ramps on the Copenhagen metro system. The shallow part of the ramp that is open and will likely be constructed using sheet piles, with the cut and cover part of the ramp constructed using secant piles with a concrete roof. The exact length of the ramp structure required for the Øresund metro will be dependent on the requirements of the Øresund metro project, for example TBM launch, ventilation equipment, etc. The ramp will be similar to the sketches shown in Figure 32 and Figure 33.

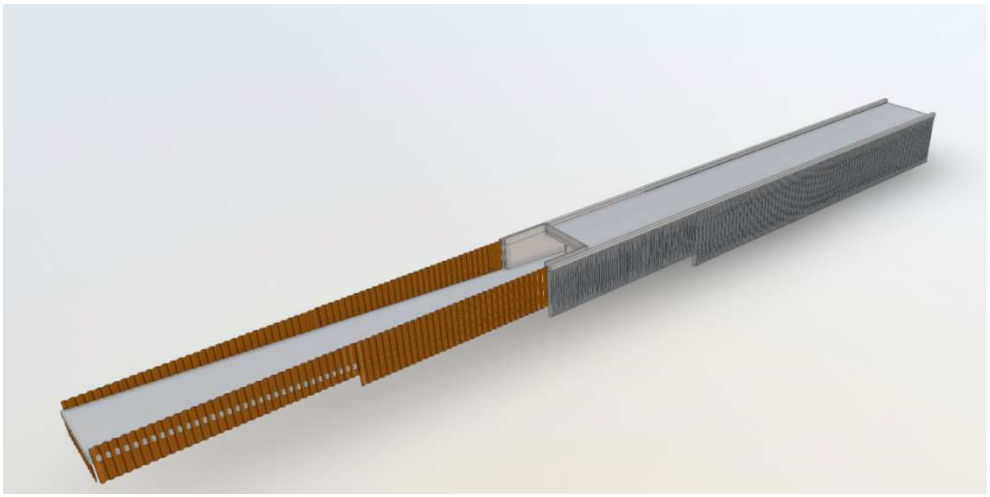


Figure 32 - Asymmetric view of typical ramp structure (Note bifurcation not shown, length of cut and cover may vary).

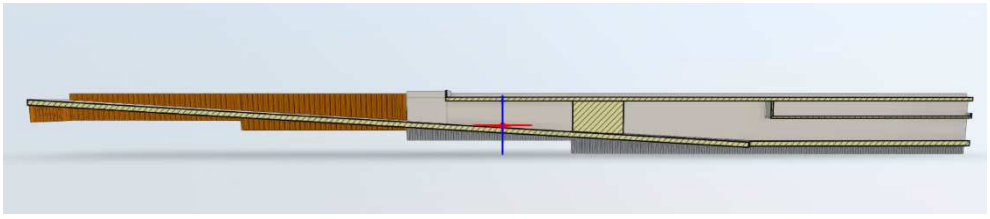


Figure 33 – Long section of typical ramp structure (Note bifurcation not shown, length of cut and cover may vary).

9.2.1 Øresund metro Ramp Construction

A feasibility study into construction sequence and the required the track movements in CMC has been carried out, as shown in the sketches in Section 9.2.2. The feasibility study has assumed that the works are carried out when the CMC is servicing the required trains for the section of M5 from København H to Østerport with a train frequency of 180s. If it is decided to extend M5, and/or increase the train frequency prior to construction of the Øresund metro ramp, a detailed study should be undertaken to demonstrate that the construction of the ramp is still possible without having a significant impact on the operation of M5 or identify what works need to be carried to safeguard for the Øresund metro.

The construction sequence presented in Section 9.2.2 could be optimised and phases combined or overlapped. However, the construction sequence shown demonstrates that it is possible and therefore it is considered safeguarded.

9.2.2 Øresund metro Ramp Sequence

Phase 0 – CMC layout for Kh to KK with 180s headway. Note the green area around the CMC is the flood protection embankment.

Figure 34 - CMC for Kh to KK 180 headway.

Phase 1 – Relocation of tracks to make space for worksite to modify the culvert/drainage channel.

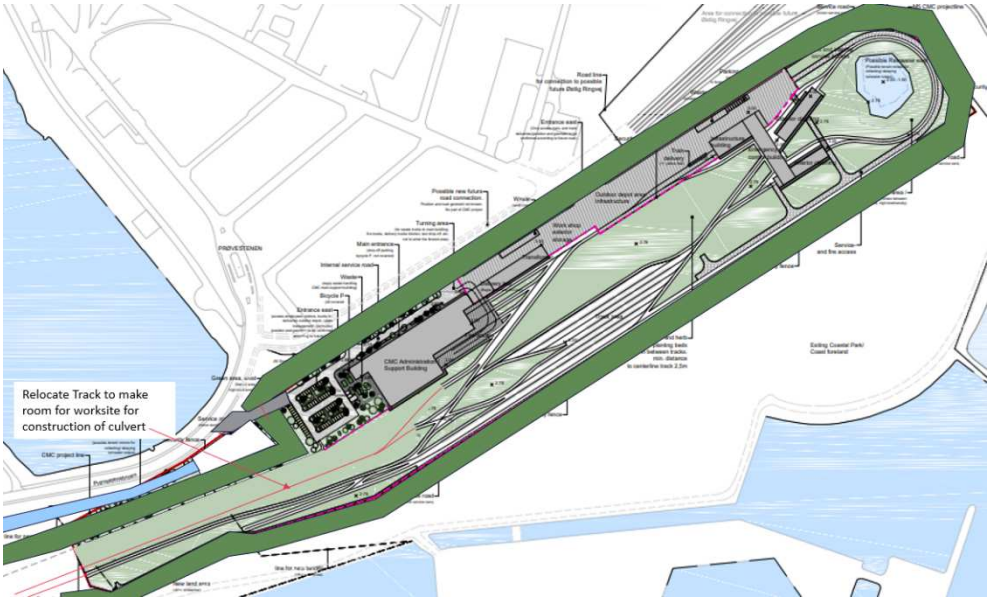


Figure 35 - Phase 1 - Øresund metro Ramp Construction Sequence.

Phase 2 – Install sheet piled wall that will function as the flood protection when embankment is removed.

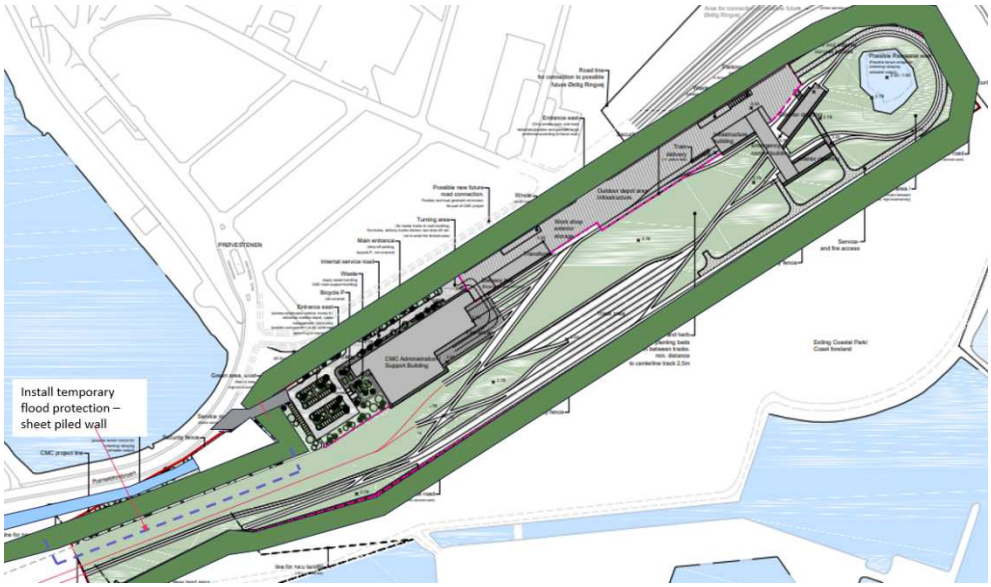


Figure 36 - Phase2 - Øresund metro Ramp Construction Sequence.

Phase 3 – Remove flood protection embankment.

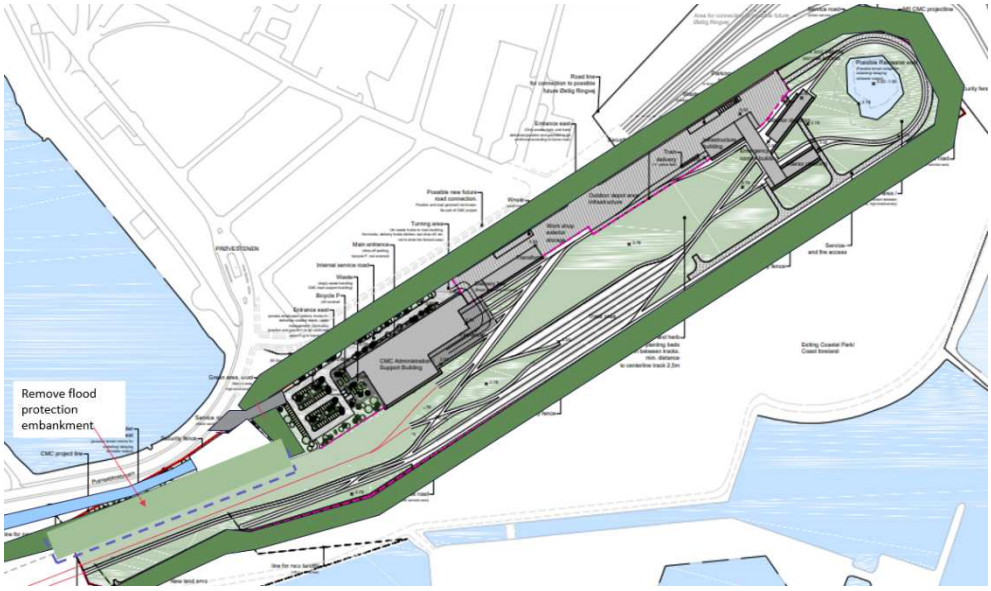


Figure 37- Phase 3 - Øresund metro Ramp Construction Sequence.

Phase 4 – Construct new concrete culvert for drainage channel and new permanent flood protection wall.

Figure 38 - Phase 4 - Øresund metro Ramp Construction Sequence.

Phase 5 – Remove temporary sheet pile flood protection.

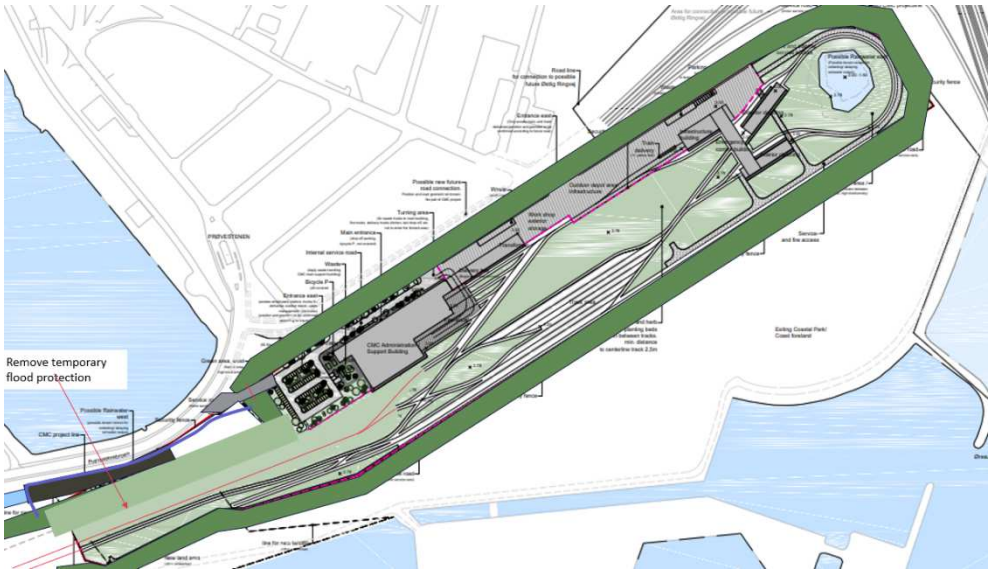


Figure 39 - Phase 5 - Øresund metro Ramp Construction Sequence.

Phase 6 – Install temporary flood protection around the Øresund metro worksite. Note, a detailed assessment of the worksite area required has not been carried out, although it will probably require a large proportion of the area south of the CMC for both tunnelling (Main Øresund metro tunnel drive and Øresund metro connection tunnels to v/Prb) and ramp construction. Temporary flood protection is required because the CMC permanent flood protection will be removed during the construction of the ramp.

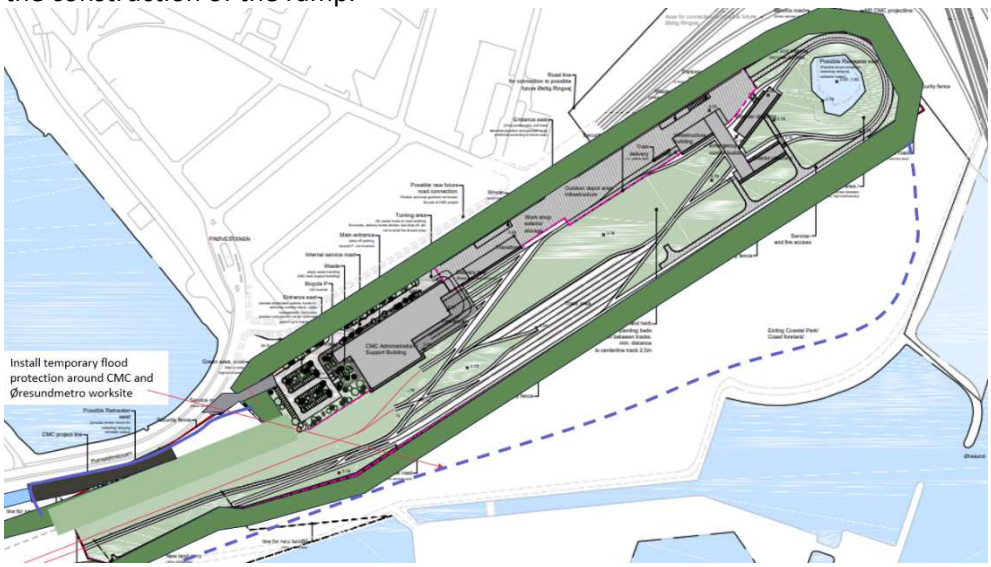


Figure 40 - Phase 6 - Øresund metro Ramp Construction Sequence.

Phase 7 – Establish main worksite for Øresund metro including a new flood protection around outside to allow for remove pf the flood protection embankment along CMC southern boundary. Install retaining walls for ramp outside of CMC area.

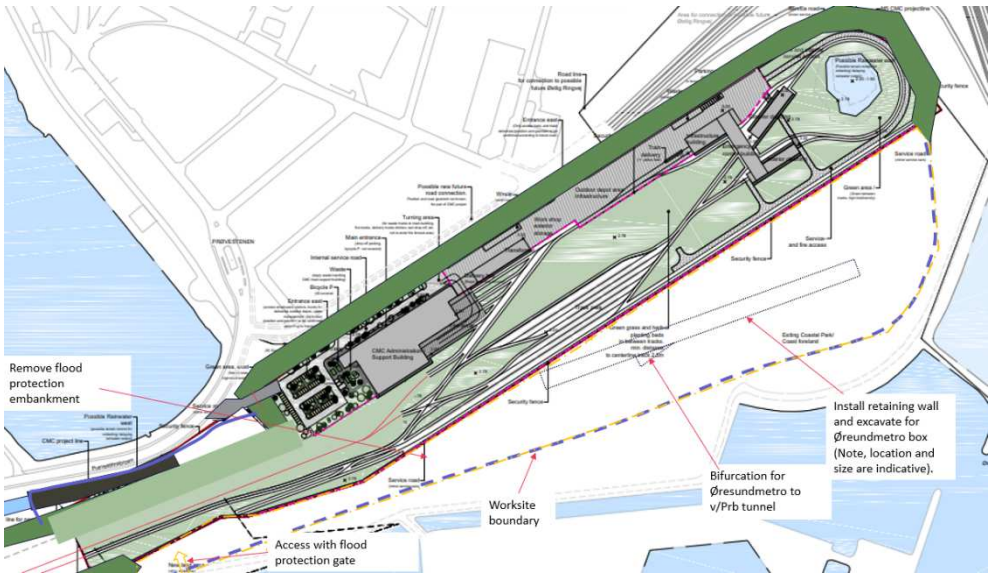


Figure 41 - Phase 7 - Øresund metro Ramp Construction Sequence.

Phase 8 – Relocate tracks in CMC towards north to allow for space for construction of ramp structure within CMC area. Tunnelling for Øresund metro towards Malmo can be carried out.

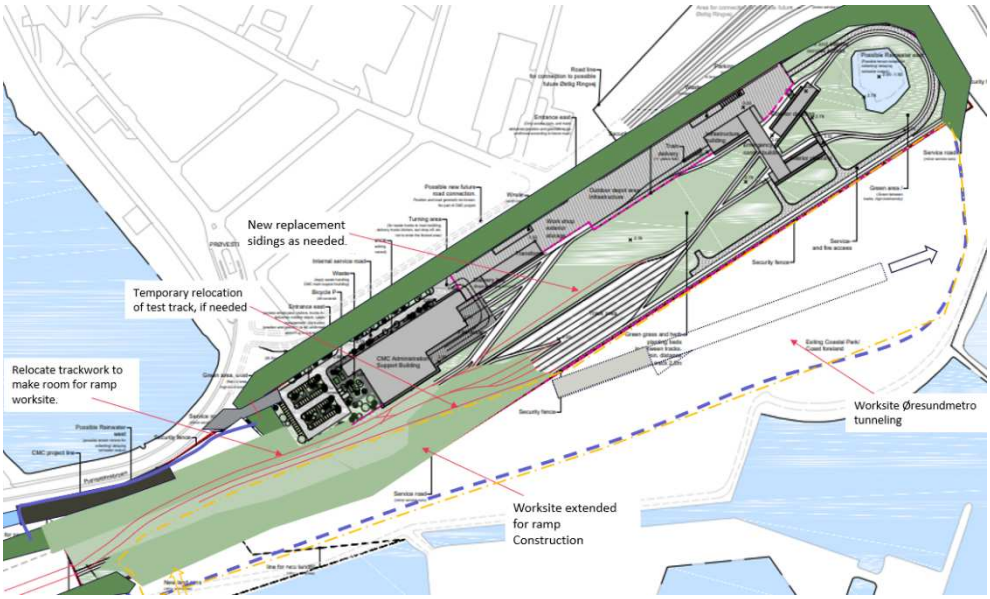


Figure 42- Phase 8 - Øresund metro Ramp Construction Sequence.

Phase 9 – Construction of ramp within the CMC area, including early completion of roof structure for underground ramp to allow tracks to be relocated over roof in next phase.

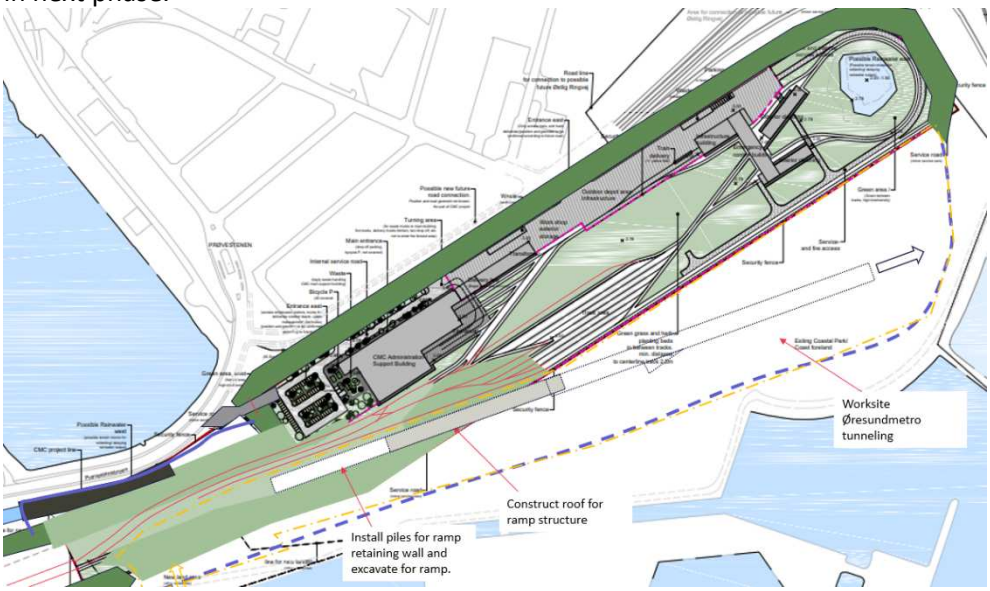


Figure 43- Phase 9 - Øresund metro Ramp Construction Sequence.

Phase 10 – Tracks relocated over ramp structure. Worksite in Amager Strandvej can be connected to Øresund metro worksite via ramp to enable tunnelling from Amager Strandvej. Tunnelling to Malmo can continue in parallel.

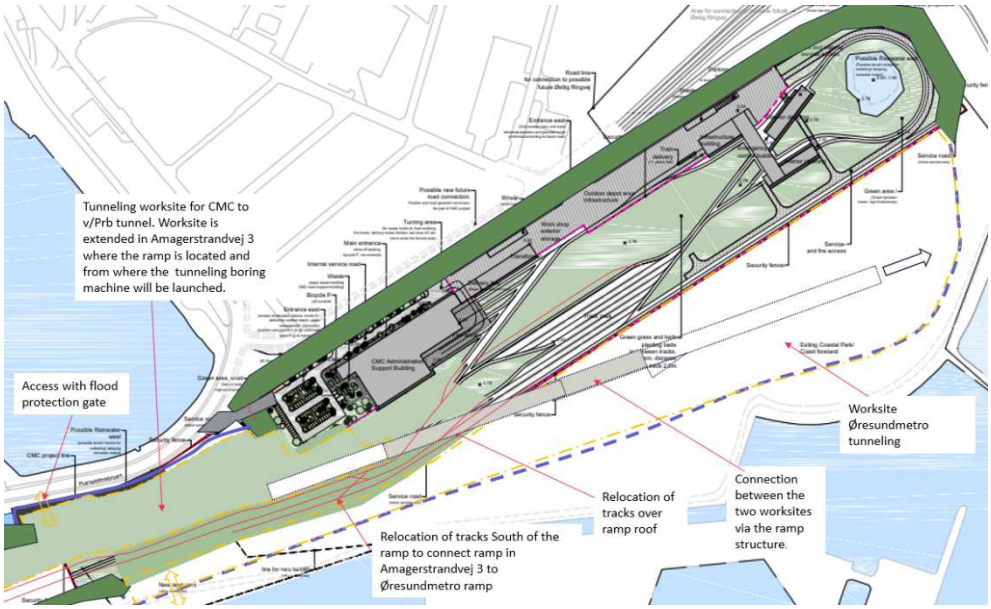


Figure 44- Phase 10 - Øresund metro Ramp Construction Sequence.

Phase 11 - Tunnelling from CMC to v/Prb completed. Final trackwork installation in CMC. Worksite for expansion of the CMC for full ring available for when required. Tunnelling and tunnel fit-out to Malmo ongoing. Tunnel from bifurcation at Øresund metro ramp to v/Prb can be carried out.

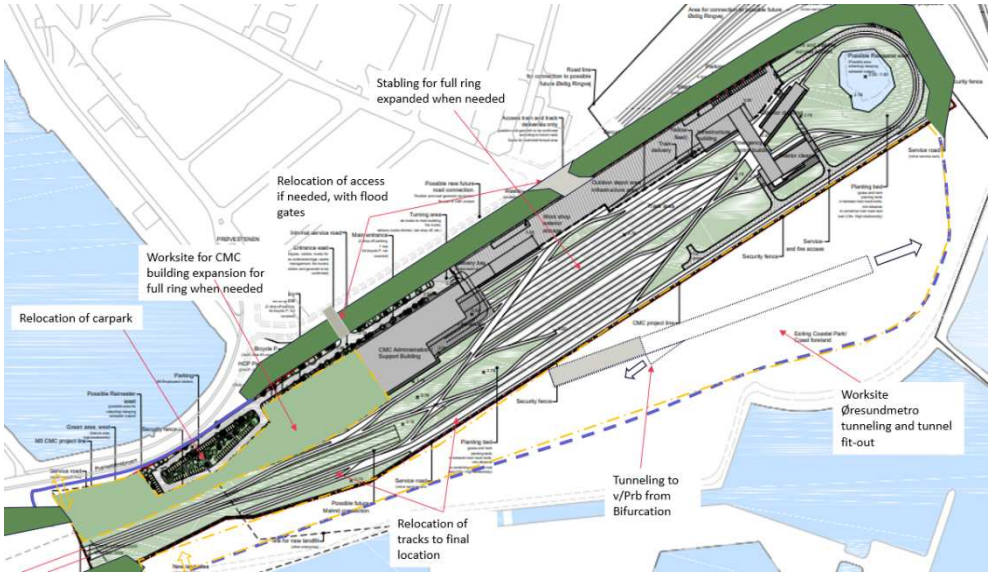


Figure 45- Phase 11 - Øresund metro Ramp Construction Sequence.

Phase 12 – Completion of tunnel fit-out works. Reinstate flood protection embankment. Possible to expanded CMC for full ring as needed.

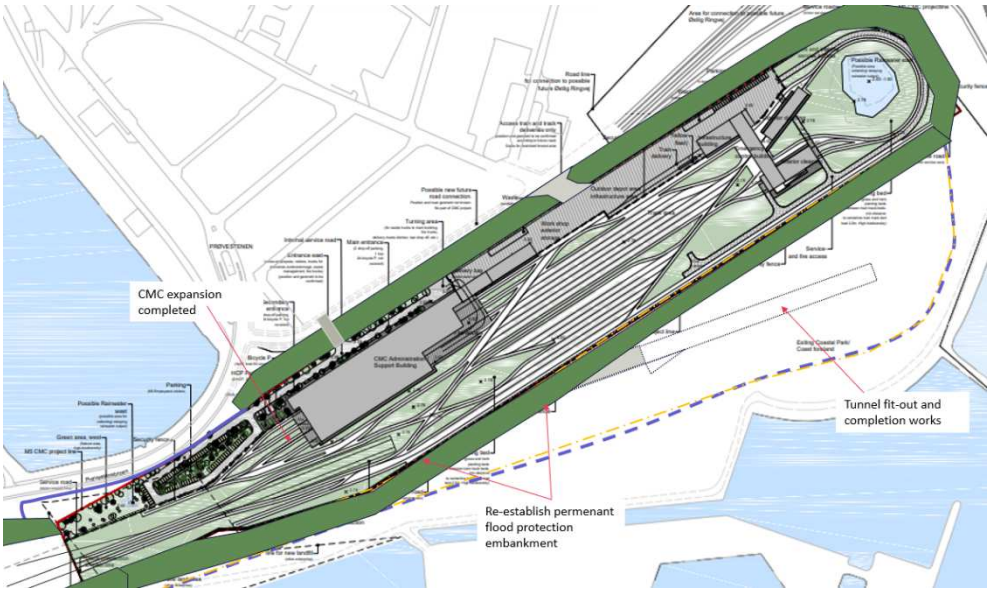


Figure 46- Phase 12 - Øresund metro Ramp Construction Sequence.

Phase 13 – All construction work completed. Area south of CMC re-established as recreation area. Some ventilation shafts and access points may be required in this area and will need to be flood protected. CMC layout shown is for full M5 ring and including ramp for Øresund metro connection.

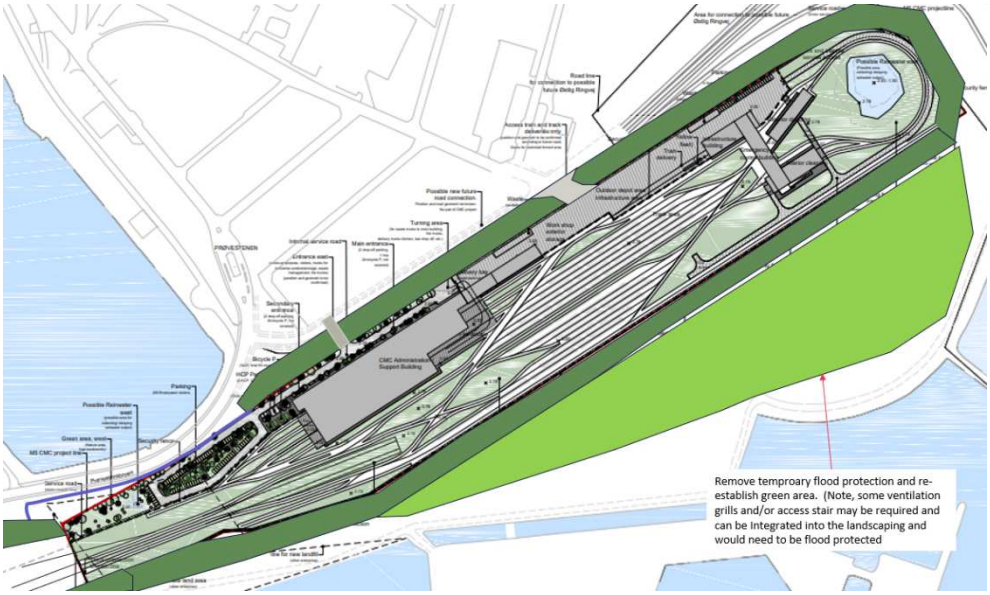


Figure 47- Phase 13 - Øresund metro Ramp Construction Sequence.

9.3 Øresund metro Tunnel to Malmo

As part of this study an alignment check has been carried out to ensure that the Øresund metro tunnel from Prøvestenen to Malmo can pass underneath the future Østlig Ringvej tunnel structure. It has been assumed that the TBM will be

able to pass 2m below Østlig Ringvej tunnel. The Øresund metro tunnel geometry from the previous studies has been used for the check and can be seen in Figure 48. A sketch of the alignment for Øresund metro crossing under Østlig Ringvej is shown in Figure 49, and drawings are included in Appendix A.

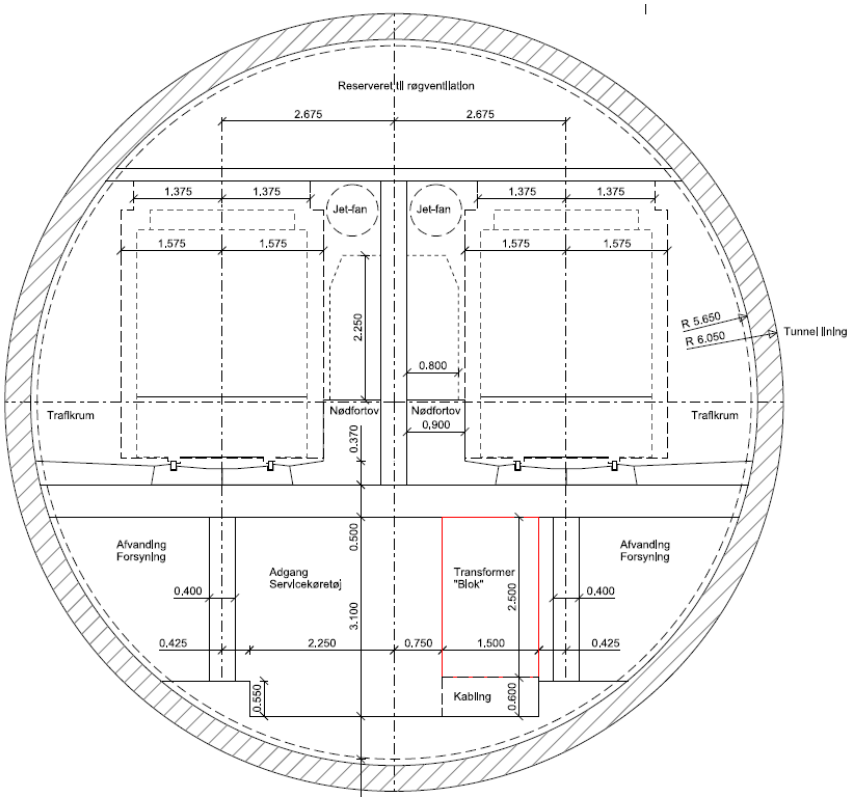


Figure 48 - Øresund metro tunnel (from previous study).

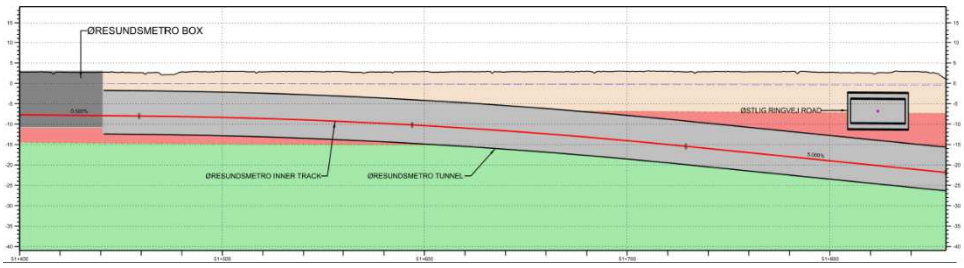


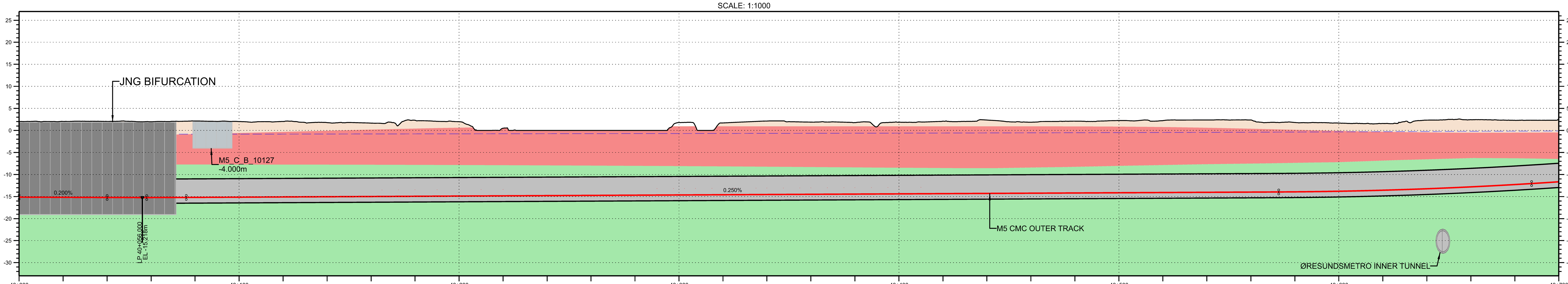
Figure 49 - Alignment for Øresund metro under Østlig Ringvej (refer to drawings in Appendix A for more detail).

It should be noted that to safeguard for the future passage of a TBM under Østlig Ringvej some modifications may be required to the Østlig Ringvej structure and/or temporary works. These have not been discussed with Østlig Ringvej and are outside the scope of this report.

Appendix A Øresund metro connection alignment drawings

PLAN

SCALE: 1:1000



CHAINAGE	40+000	40+020	40+040	40+060	40+080	40+100	40+120	40+140	40+160	40+180	40+200	40+220	40+240	40+260	40+280	40+300	40+320	40+340
EXISTING GROUND LEVEL	2.028	2.040	2.039	1.960	2.142	2.013	2.025	1.770	1.651	2.298	1.973	0.502	0.001	0.001	0.001	1.789	1.697	2.124
PROPOSED RAIL LEVEL	-15.122	-15.162	-15.202	-15.217	-15.183	-15.133	-15.083	-15.033	-14.983	-14.933	-14.883	-14.833	-14.783	-14.733	-14.683	-14.633	-14.583	-14.533
SURFACE TO RAIL DEPTH	-17.150	-17.202	-17.241	-17.178	-17.325	-17.146	-17.108	-16.803	-16.634	-17.231	-16.856	-15.335	-14.785	-14.735	-14.685	-16.423	-16.280	-16.657

CHAINAGE	40+360	40+380	40+400	40+420	40+440	40+460	40+480	40+500	40+520	40+540	40+560	40+580	40+600	40+620	40+640	40+660	40+680	40+700
EXISTING GROUND LEVEL	1.884	1.776	1.851	2.094	2.356	1.851	2.100	2.242	2.225	2.367	2.373	1.796	1.665	1.578	2.334	2.437	2.294	2.694
PROPOSED RAIL LEVEL	-14.483	-14.433	-14.383	-14.333	-14.283	-14.233	-14.183	-14.133	-14.083	-14.033	-13.983	-13.927	-13.792	-13.559	-13.228	-12.800	-12.273	-11.648
SURFACE TO RAIL DEPTH	-16.368	-16.210	-16.234	-16.427	-16.640	-16.085	-16.283	-16.375	-16.308	-16.400	-16.356	-15.722	-15.457	-15.137	-15.562	-15.237	-14.567	-14.342

TRACK VERTICAL ALIGNMENT	L= 40.000m G= -0.200%; L= 36.000m Re= 8000m; L= 496.651m G= +0.250%; L= 230.000m Re= 4085m
TRACK HORIZONTAL ALIGNMENT	L= 118.018m R= 300m; TL=30.000m; L= 311.442 m; TL=60.000m; L= 330.563m R= 1000m
CANT ALIGNMENT	u= 0mm aq= 0.64 m/s2; u= 0mm aq= 0.00 m/s2; u= 50mm aq= 0.44 m/s2
DESIGN SPEED	V = 50Km/h; V = 50Km/h; V = 50Km/h; V = 100Km/h; V = 100Km/h; V = 100Km/h

LONGITUDINAL PROFILE

SCALE: H 1:1000 V 1:500

0 50 100m
SCALE: 1:1000

0 25 50m
SCALE: 1:500

FEATURE	SYMBOLOGY
GENERAL	
M5 ALIGNMENT	
M5 MAIN WORKSITE	
M5 SAFEGUARDED WORKSITE	
M5 PROPOSED STRUCTURES	
GEOLOGY	
GROUND SURFACE (DIGITAL TERRAIN MODEL)	
FILL	
GLACIAL AND GREENSAND DEPOSITS	
LIMESTONE	
MIXED FILL (LYNETTEHOLM ISLAND)	
PRIMARY AQUIFER LEVEL	
OBSTRUCTIONS	
BUILDING FOUNDATION	
UTILITIES OF CONCERN	
OTHER OBSTRUCTIONS OF CONCERN	

Coordinates according to DKTM3.
Levels according to DVR90.

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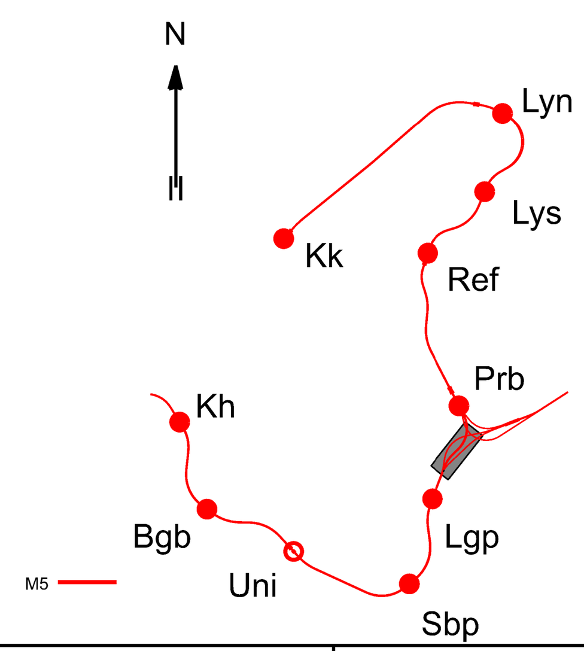

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Metroselskabet I/S
M5

Concept Design - Safeguarding Øresundsmetro Variant
General M5
Alignment - Plan & Profile
CMC Outer Track - Ch. 40+000 to 40+700

Scale:	As Indicated
Prepared by:	SASA
Checked by:	JESE
Approved by:	ALNO
Issue Date:	01.04.2024

COWI MARUP5

Document ID-No.:	Page:	Revision:
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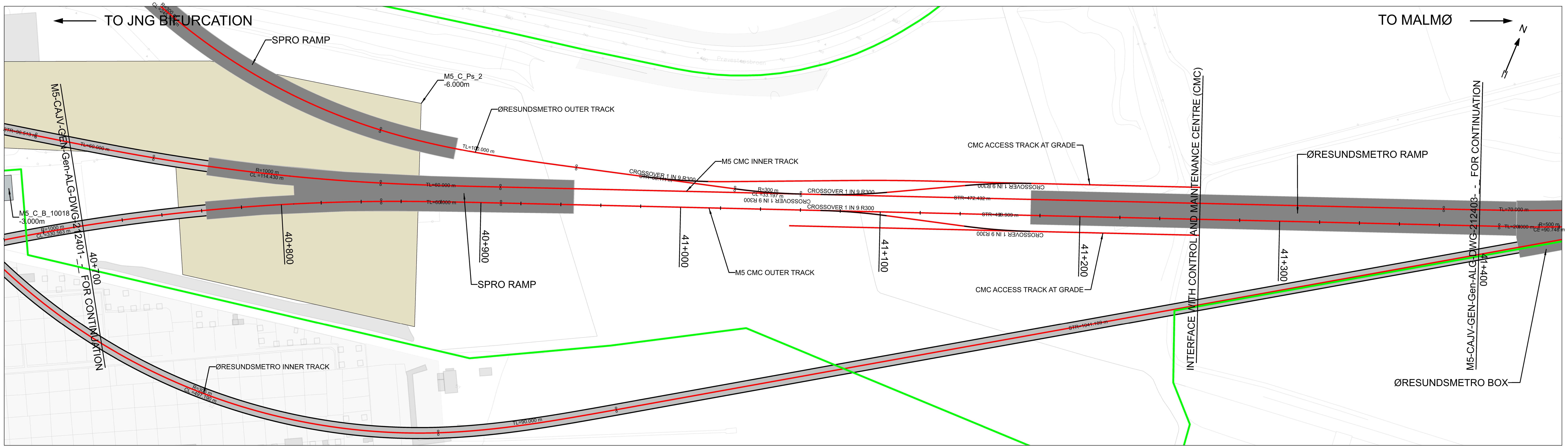

PLAN

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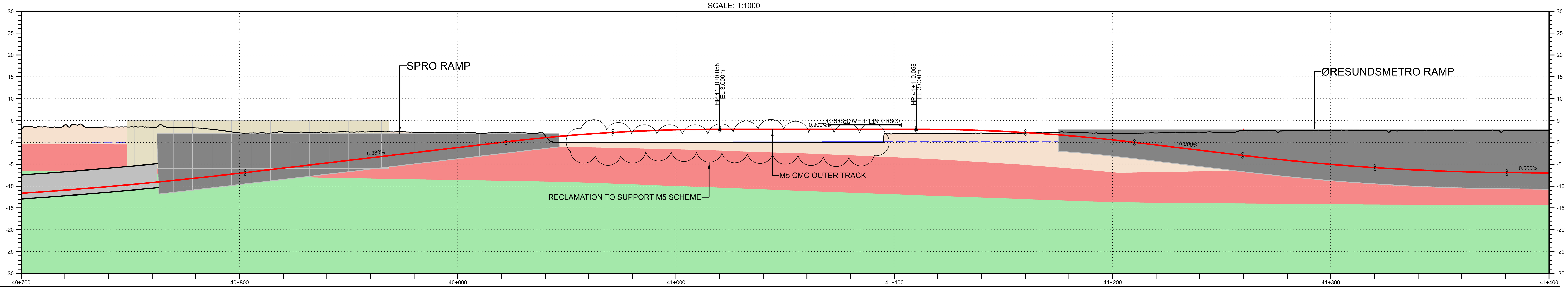

CHAINAGE	EXISTING GROUND LEVEL	PROPOSED RAIL LEVEL	SURFACE TO RAIL DEPTH
40+700	2.694	-11.648	-14.342
40+720	4.011	-10.926	-14.937
40+740	3.535	-10.106	-13.641
40+760	3.453	-9.188	-12.641
40+780	3.311	-8.171	-11.482
40+800	2.165	-7.057	-9.223
40+820	2.354	-5.882	-8.237
40+840	2.341	-4.706	-7.047
40+860	2.438	-3.530	-5.968
40+880	2.335	-2.354	-4.689
40+900	2.220	-1.178	-3.398
40+920	2.224	-0.002	-2.226
40+940	1.513	1.077	-0.436
40+960	0.002	1.918	1.916
40+980	0.002	2.519	2.517
41+000	0.003	2.879	2.876
41+020	0.003	3.000	2.997
41+040	0.003	3.000	2.997
41+060	0.003	3.000	2.997
41+080	0.003	3.000	2.997
41+100	1.993	3.000	1.007
41+120	2.066	2.970	0.905
41+140	2.160	2.731	0.571
41+160	2.117	2.252	0.134
41+180	2.347	1.532	-0.815
41+200	2.025	0.573	-1.452
41+220	2.155	-0.597	-2.751
41+240	2.180	-1.797	-3.976
41+260	2.687	-2.996	-5.683
41+280	2.678	-4.103	-6.781
41+300	2.803	-5.027	-7.830
41+320	2.760	-5.769	-8.529
41+340	2.722	-6.330	-9.052
41+360	2.713	-6.709	-9.421
41+380	2.665	-6.906	-9.571
41+400	2.756	-7.006	-9.762

TRACK VERTICAL ALIGNMENT: L= 230.000m Re= 4085m; L= 119.408m G= +5.880%; L= 97.999m Re= -1667m; L= 90.000m G= +0.000%; L= 100.000m Re= -1667m; L= 49.610m G= -6.000%; L= 121.000m Re= 2200m; L= 140.011m G= -0.500%

TRACK HORIZONTAL ALIGNMENT: L= 330.563m R= 1000m; TL=60.000m; L= 499.909 m

CANT ALIGNMENT: u= 0mm aq= 0.00 m/s2

DESIGN SPEED: V = 100Km/h; V = 100Km/h; V = 100Km/h; V = 80Km/h; V = 80Km/h; V = 80Km/h

LONGITUDINAL PROFILE

SCALE: H 1:1000 V 1:500

0 50 100m
SCALE: 1:1000

0 25 50m
SCALE: 1:500

FEATURE	SYMBOLOGY
GENERAL	
M5 ALIGNMENT	
M5 MAIN WORKSITE	
M5 SAFEGUARDED WORKSITE	
M5 PROPOSED STRUCTURES	
GEOLOGY	
GROUND SURFACE (DIGITAL TERRAIN MODEL)	
FILL	
GLACIAL AND GREENSAND DEPOSITS	
LIMESTONE	
MIXED FILL (LYNETTEHOLM ISLAND)	
PRIMARY AQUIFER LEVEL	
OBSTRUCTIONS	
BUILDING FOUNDATION	
UTILITIES OF CONCERN	
OTHER OBSTRUCTIONS OF CONCERN	

Coordinates according to DKTM3.
Levels according to DVR90.

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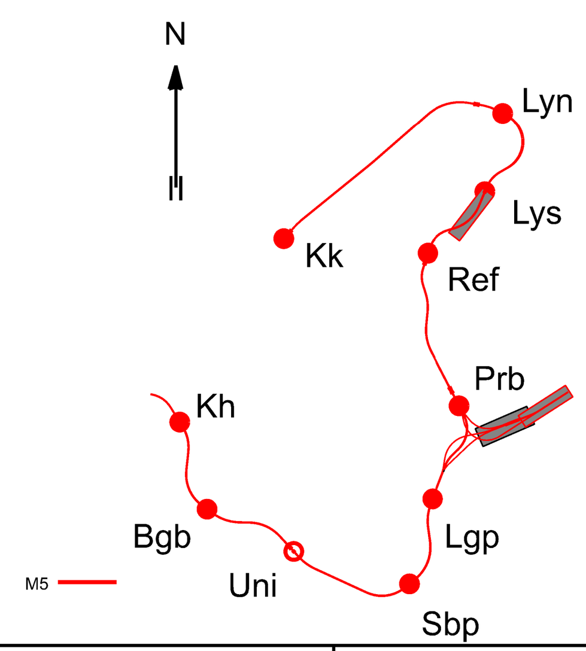

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Metroselskabet I/S
M5

Concept Design - Safeguarding Øresundsmetro Variant
General M5
Alignment - Plan & Profile
CMC Outer Track - Ch. 40+700 to 41+400

Scale:	As indicated
Prepared by:	SASA
Checked by:	JESE
Approved by:	ALNO
Issue Date:	01.04.2024

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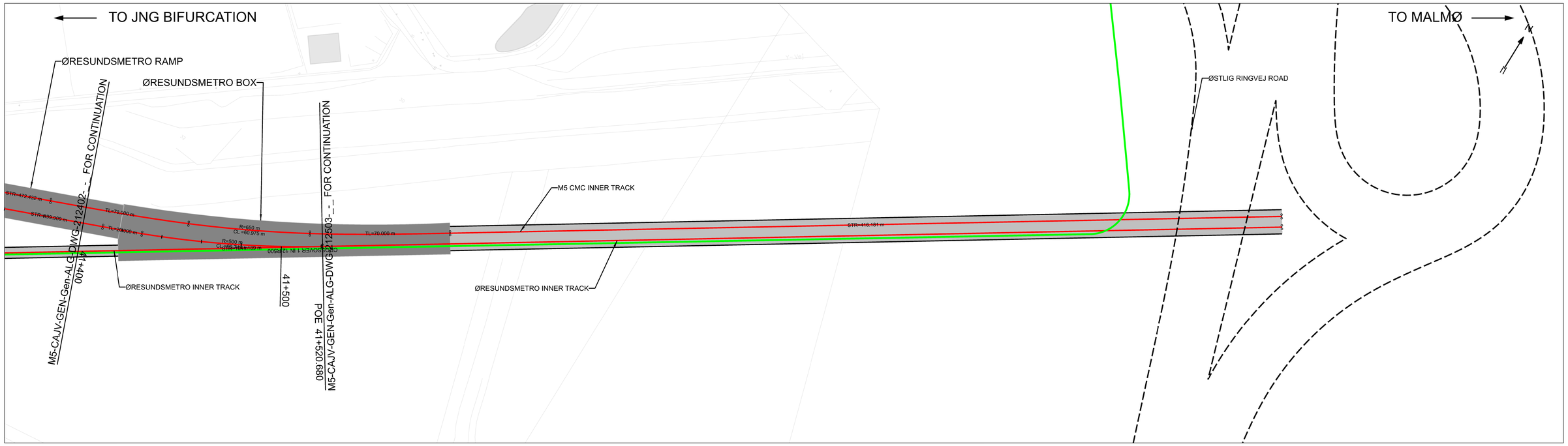

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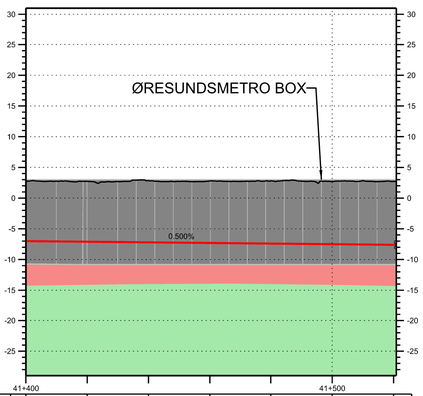

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EXISTING GROUND LEVEL	2.756	2.729	2.857	2.800	2.813	2.700	2.722
PROPOSED RAIL LEVEL	-7.006	-7.106	-7.206	-7.306	-7.406	-7.506	-7.606
SURFACE TO RAIL DEPTH	-9.762	-9.835	-10.063	-10.106	-10.219	-10.206	-10.327
TRACK VERTICAL ALIGNMENT	L= 140.011m G= -0.500%						
TRACK HORIZONTAL ALIGNMENT	L= 499.909 m	TL=20.000m	L= 90.748m R= 500m				
CANT ALIGNMENT	ω= 0mm aq= 0.56 m/s2						
DESIGN SPEED	V = 80Km/h	V = 60Km/h				V = 60Km/h	

LONGITUDINAL PROFILE
SCALE: H 1:1000 V 1:500

0 50 100m
SCALE: 1:1000

0 25 50m
SCALE: 1:500

FEATURE	SYMBOLOGY
GENERAL	
M5 ALIGNMENT	
M5 MAIN WORKSITE	
M5 SAFEGUARDED WORKSITE	
M5 PROPOSED STRUCTURES	
GEOLOGY	
GROUND SURFACE (DIGITAL TERRAIN MODEL)	
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GLACIAL AND GREENSAND DEPOSITS	
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MIXED FILL (LYNETTEHOLM ISLAND)	
PRIMARY AQUIFER LEVEL	
OBSTRUCTIONS	
BUILDING FOUNDATION	
UTILITIES OF CONCERN	
OTHER OBSTRUCTIONS OF CONCERN	

Coordinates according to DKTM3.
Levels according to DVR90.

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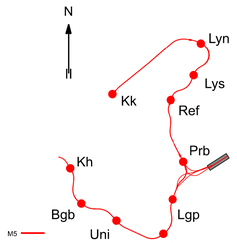

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Metroselskabet I/S
M5

Concept Design - Safeguarding Øresundsmetro Variant
General M5
Alignment - Plan & Profile
CMC Outer Track - Ch. 41+400 to 42+100

Scale:	As Indicated
Prepared by:	SASA
Checked by:	JESE
Approved by:	ALNO
Issue Date:	01.04.2024

MCOWI ARUP 5

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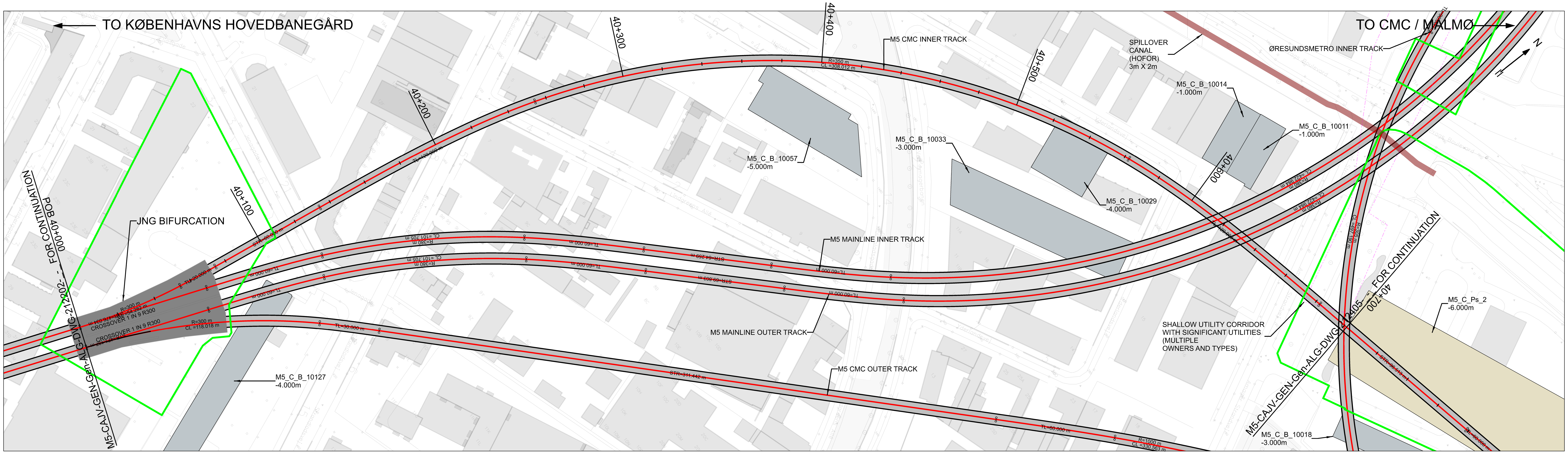

PLAN

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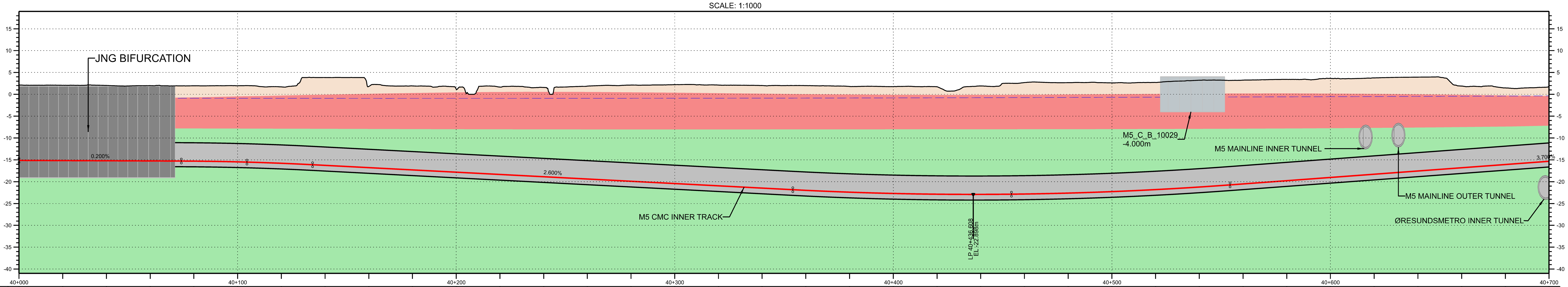

CHAINAGE	EXISTING GROUND LEVEL	PROPOSED RAIL LEVEL	SURFACE TO RAIL DEPTH
40+000	2.112	-15.122	-17.235
40+020	2.060	-15.162	-17.222
40+040	2.033	-15.202	-17.235
40+060	1.983	-15.242	-17.225
40+080	1.946	-15.289	-17.234
40+100	1.957	-15.455	-17.411
40+120	1.696	-15.780	-17.476
40+140	3.833	-16.260	-20.093
40+160	1.804	-16.780	-18.583
40+180	1.912	-17.300	-19.212
40+200	1.203	-17.820	-19.023
40+220	1.649	-18.340	-19.988
40+240	1.565	-18.860	-20.425
40+260	1.865	-19.380	-21.244
40+280	2.113	-19.900	-22.012
40+300	2.201	-20.420	-22.621
40+320	2.110	-20.940	-23.050
40+340	2.003	-21.460	-23.463
40+360	1.995	-21.974	-23.969
40+380	1.787	-22.394	-24.181
40+400	1.756	-22.687	-24.444
40+420	1.717	-22.855	-24.572
40+440	1.904	-22.897	-24.801
40+460	2.676	-22.812	-25.488
40+480	2.660	-22.602	-25.261
40+500	2.605	-22.265	-24.871
40+520	2.703	-21.803	-24.506
40+540	3.213	-21.215	-24.428
40+560	3.230	-20.506	-23.736
40+580	3.414	-19.766	-23.180
40+600	3.640	-19.026	-22.666
40+620	3.746	-18.286	-22.032
40+640	3.920	-17.546	-21.466
40+660	1.875	-16.806	-18.681
40+680	1.463	-16.066	-17.529
40+700	1.768	-15.326	-17.094

TRACK VERTICAL ALIGNMENT: L= 74.281m, G= -0.200% | L= 60.000m, Re= -2500m | L= 219.787m, G= -2.600% | L= 200.000m, Re= 3175m | L= 288.786m, G= +3.700%

TRACK HORIZONTAL ALIGNMENT: L= 54.282m, R= 300m | TL=20.000m | L= 60.000 m | TL=120.000m | L= 308.012m, R= 350m | TL=120.000m | L= 96.513 m

CANT ALIGNMENT: u= 0mm, aq= 0.64 m/s2 | u= 0mm, aq= 0.00 m/s2 | u= 120mm, aq= 0.63 m/s2

DESIGN SPEED: V = 50Km/h | V = 50Km/h | V = 80Km/h | V = 80Km/h | V = 80Km/h

LONGITUDINAL PROFILE

SCALE: H 1:1000 V 1:500

0 50 100m
SCALE: 1:1000

0 25 50m
SCALE: 1:500

FEATURE	SYMBOLOGY
GENERAL	
M5 ALIGNMENT	
M5 MAIN WORKSITE	
M5 SAFEGUARDED WORKSITE	
M5 PROPOSED STRUCTURES	
GEOLOGY	
GROUND SURFACE (DIGITAL TERRAIN MODEL)	
FILL	
GLACIAL AND GREENSAND DEPOSITS	
LIMESTONE	
MIXED FILL (LYNETTEHOLM ISLAND)	
PRIMARY AQUIFER LEVEL	
OBSTRUCTIONS	
BUILDING FOUNDATION	
UTILITIES OF CONCERN	
OTHER OBSTRUCTIONS OF CONCERN	

Coordinates according to DKTM3.
Levels according to DVR90.

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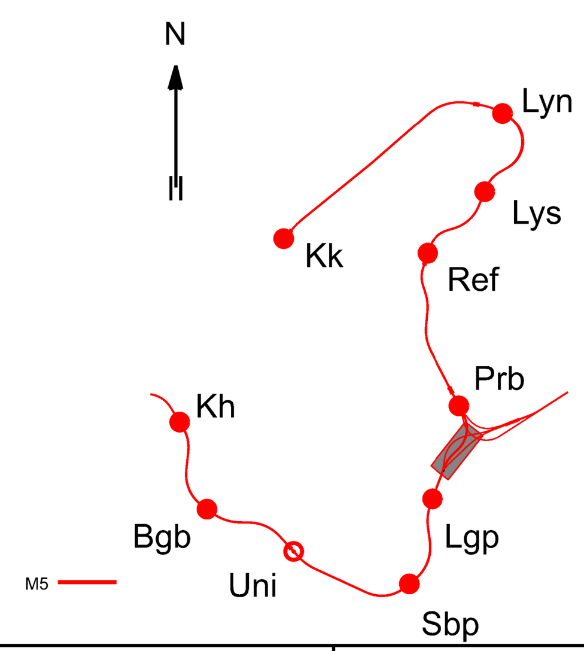

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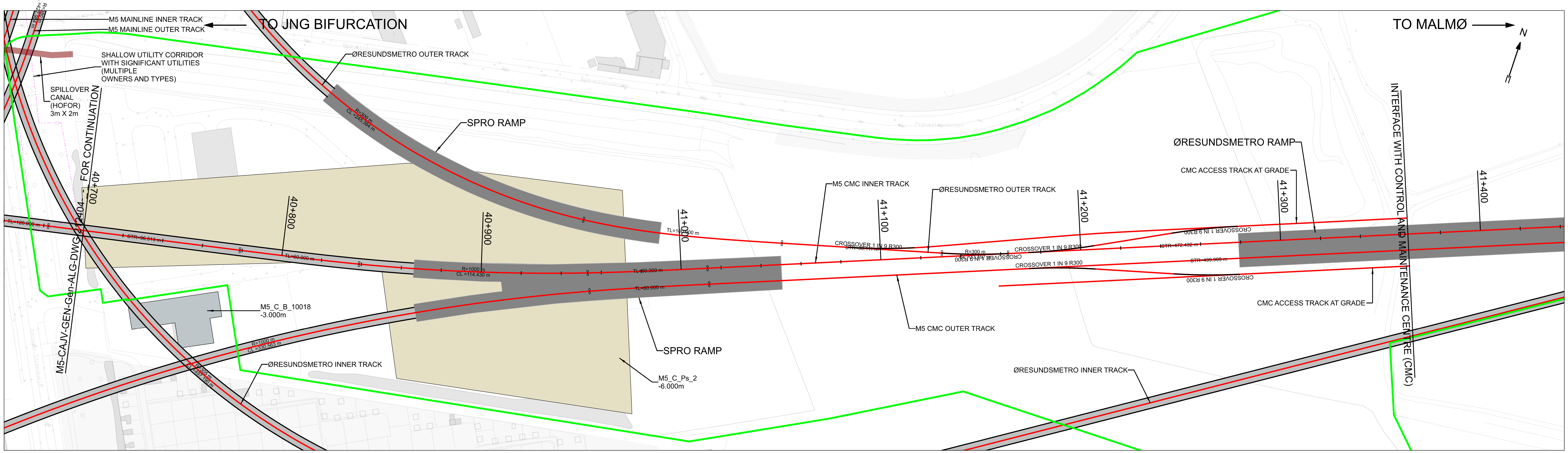
Metroselskabet I/S
M5

Concept Design - Safeguarding Øresundsmetro Variant
General M5
Alignment - Plan & Profile
CMC Inner Track - Ch. 40+000 to 40+700

Scale: As Indicated
Prepared by: SASA
Checked by: JESE
Approved by: ALNO
Issue Date: 01.04.2024

Document ID-No.: **M5-CAJV-GEN-Gen-ALG-DWG-212404-_-_**
Page: **1 of 1**
Revision: **1.0**



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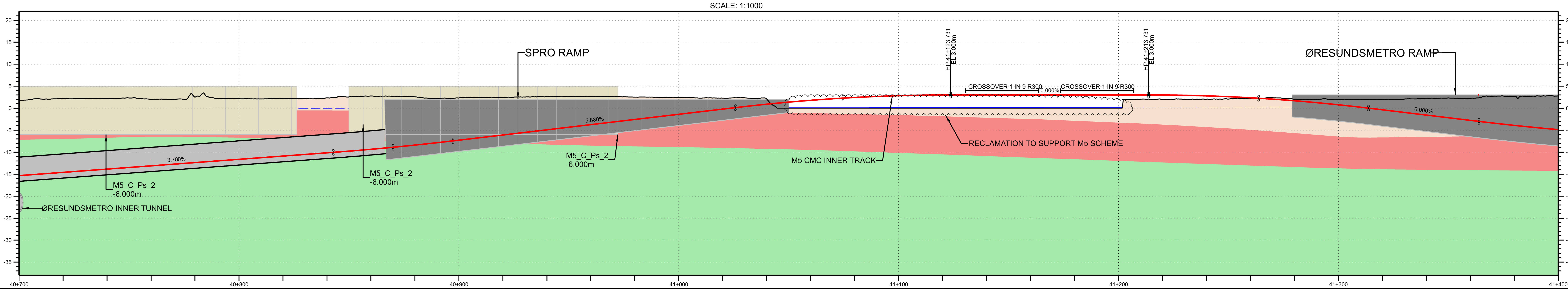

CHAINAGE	40+700	40+720	40+740	40+760	40+780	40+800	40+820	40+840	40+860	40+880	40+900	40+920
EXISTING GROUND LEVEL	1.768	2.183	2.195	2.017	2.519	2.121	2.179	2.301	2.771	2.564	2.317	2.390
PROPOSED RAIL LEVEL	-15.326	-14.586	-13.846	-13.106	-12.366	-11.626	-10.886	-10.146	-9.347	-8.390	-7.274	-6.098
SURFACE TO RAIL DEPTH	-17.094	-16.769	-16.041	-15.123	-14.885	-13.747	-13.065	-12.446	-12.118	-10.954	-9.592	-8.488

CHAINAGE	40+940	40+960	40+980	41+000	41+020	41+040	41+060	41+080	41+100	41+120	41+140	41+160
EXISTING GROUND LEVEL	2.633	2.683	2.509	2.455	2.283	2.101	0.002	0.002	0.003	0.003	0.003	0.003
PROPOSED RAIL LEVEL	-4.922	-3.746	-2.570	-1.394	-0.218	0.897	1.782	2.426	2.831	2.996	3.000	3.000
SURFACE TO RAIL DEPTH	-7.555	-6.429	-5.079	-3.849	-2.501	-1.204	1.780	2.425	2.828	2.992	2.997	2.997

CHAINAGE	41+180	41+200	41+220	41+240	41+260	41+280	41+300	41+320	41+340	41+360	41+380	41+400
EXISTING GROUND LEVEL	0.003	0.003	1.999	2.050	2.144	2.038	1.937	1.989	2.259	2.229	2.628	2.766
PROPOSED RAIL LEVEL	3.000	3.000	2.988	2.793	2.358	1.683	0.767	-0.376	-1.576	-2.776	-3.917	-4.877
SURFACE TO RAIL DEPTH	2.997	2.997	0.990	0.743	0.213	-0.356	-1.169	-2.365	-3.835	-5.005	-6.545	-7.643

TRACK VERTICAL ALIGNMENT: L= 288.786m G= +3.700% | L= 54.500m Re= 2500m | L= 128.377m G= +5.880% | L= 98.000m Re= -1667m | L= 90.000m G= +0.000% | L= 100.000m Re= -1667m | L= 50.157m G= -6.000% | L= 120.000m Re= 2182m

TRACK HORIZONTAL ALIGNMENT: L= 96.513 m | TL=60.000m | L= 114.430m R= 1000m | TL=60.000m | L= 472.432 m

CANT ALIGNMENT: u= 0mm aq= 0.00 m/s2 | u= 50mm aq= 0.44 m/s2 | u= 0mm aq= 0.00 m/s2

DESIGN SPEED: V = 100Km/h | V = 100Km/h | V = 100Km/h | V = 80Km/h | V = 80Km/h | V = 80Km/h

LONGITUDINAL PROFILE

SCALE: H 1:1000 V 1:500

0 50 100m
SCALE: 1:1000

0 25 50m
SCALE: 1:500

FEATURE	SYMBOLOGY
GENERAL	
M5 ALIGNMENT	
M5 MAIN WORKSITE	
M5 SAFEGUARDED WORKSITE	
M5 PROPOSED STRUCTURES	
GEOLOGY	
GROUND SURFACE (DIGITAL TERRAIN MODEL)	
FILL	
GLACIAL AND GREENSAND DEPOSITS	
LIMESTONE	
MIXED FILL (LYNETTEHOLM ISLAND)	
PRIMARY AQUIFER LEVEL	
OBSTRUCTIONS	
BUILDING FOUNDATION	
UTILITIES OF CONCERN	
OTHER OBSTRUCTIONS OF CONCERN	

Coordinates according to DKTM3.
Levels according to DVR90.

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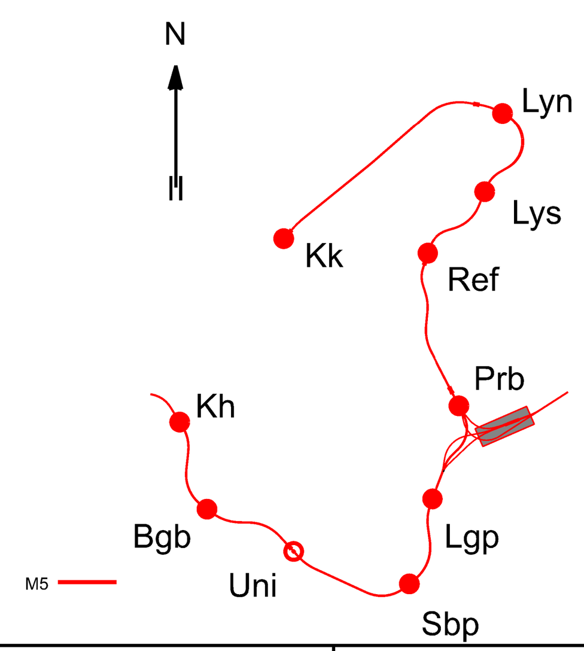
Revision	Date	Description	Prepared by	Checked by	Approved by
1.0	01.04.2024	First issue	SASA	JESE	ALNO



area reserved for QR codes

Metroselskabet I/S
M5

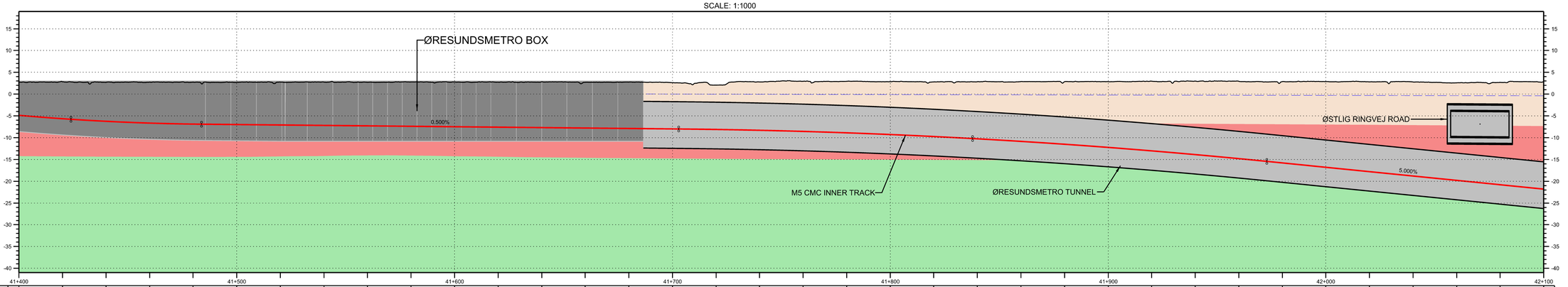
Concept Design - Safeguarding Øresundsmetro Variant
General M5
Alignment - Plan & Profile
CMC Inner Track - Ch. 40+700 to 41+400

Scale: As Indicated
Prepared by: SASA
Checked by: JESE
Approved by: ALNO
Issue Date: 01.04.2024

Document ID-No.: **M5-CAJV-GEN-Gen-ALG-DWG-212405-_-_**
Page: **1 of 1**
Revision: **1.0**

PLAN

SCALE: 1:1000



	41+400	41+420	41+440	41+460	41+480	41+500	41+520	41+540	41+560	41+580	41+600	41+620	41+640	41+660	41+680	41+700	41+720	41+740	41+760	41+780	41+800	41+820	41+840	41+860	41+880	41+900	41+920	41+940	41+960	41+980	42+000	42+020	42+040	42+060	42+080	42+100
CHAINAGE																																				
EXISTING GROUND LEVEL	2.786	2.806	2.668	2.744	2.726	2.669	2.734	2.736	2.686	2.773	2.777	2.720	2.825	2.689	2.748	2.604	2.045	2.774	2.519	2.929	2.832	2.783	2.816	2.861	2.848	2.835	2.947	2.971	2.925	2.854	2.857	2.799	2.767	2.576	2.673	2.860
PROPOSED RAIL LEVEL	-4.877	-5.655	-6.249	-6.659	-6.887	-6.990	-7.090	-7.190	-7.290	-7.390	-7.490	-7.590	-7.690	-7.790	-7.890	-7.990	-8.114	-8.305	-8.562	-8.886	-9.276	-9.734	-10.257	-10.848	-11.505	-12.229	-13.019	-13.876	-14.800	-15.786	-16.786	-17.786	-18.786	-19.786	-20.786	-21.786
SURFACE TO RAIL DEPTH	-7.663	-8.461	-8.916	-9.403	-9.613	-9.659	-9.824	-9.926	-9.976	-10.163	-10.267	-10.310	-10.515	-10.479	-10.638	-10.594	-10.160	-11.079	-11.081	-11.815	-12.109	-12.516	-13.073	-13.709	-14.353	-15.064	-15.967	-16.848	-17.726	-18.640	-19.644	-20.585	-21.553	-22.363	-23.460	-24.647
TRACK VERTICAL ALIGNMENT	L= 120.000m Re= 2182m											L= 218.969m G= -0.500%												L= 270.000m Re= -6000m											L= 129.969m G= -5.000%	
TRACK HORIZONTAL ALIGNMENT	L= 472.432 m							TL=70.000m		L= 60.975m R= 650m				TL=70.000m													L= 416.181 m									
CANT ALIGNMENT										u= 125mm aq= 0.37 m/s2																	u= 0mm aq= 0.00 m/s2									
DESIGN SPEED	V = 100Km/h																									V = 120Km/h									

LONGITUDINAL PROFILE

SCALE: H 1:1000 V 1:500

0 50 100m

SCALE: 1:1000

0 25 50m

SCALE: 1:500

FEATURE	SYMBOLOGY
GENERAL	
M5 ALIGNMENT	
M5 MAIN WORKSITE	
M5 SAFEGUARDED WORKSITE	
M5 PROPOSED STRUCTURES	
GEOLOGY	
GROUND SURFACE (DIGITAL TERRAIN MODEL)	
FILL	
GLACIAL AND GREENSAND DEPOSITS	
LIMESTONE	
MIXED FILL (LYNETTEHOLM ISLAND)	
PRIMARY AQUIFER LEVEL	
OBSTRUCTIONS	
BUILDING FOUNDATION	
UTILITIES OF CONCERN	
OTHER OBSTRUCTIONS OF CONCERN	

Coordinates according to DKTM3.
Levels according to DVR90.

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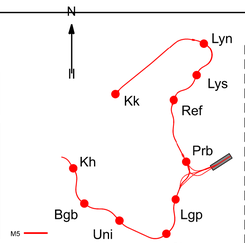
Revision	Date	Description	Prepared by	Checked by	Approved by
1.0	01.04.2024	First issue	SASA	JESE	ALNO



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Metroselskabet I/S
M5

Concept Design - Safeguarding Øresundsmetro Variant
General M5
Alignment - Plan & Profile
CMC Inner Track - Ch. 41+400 to 42+100

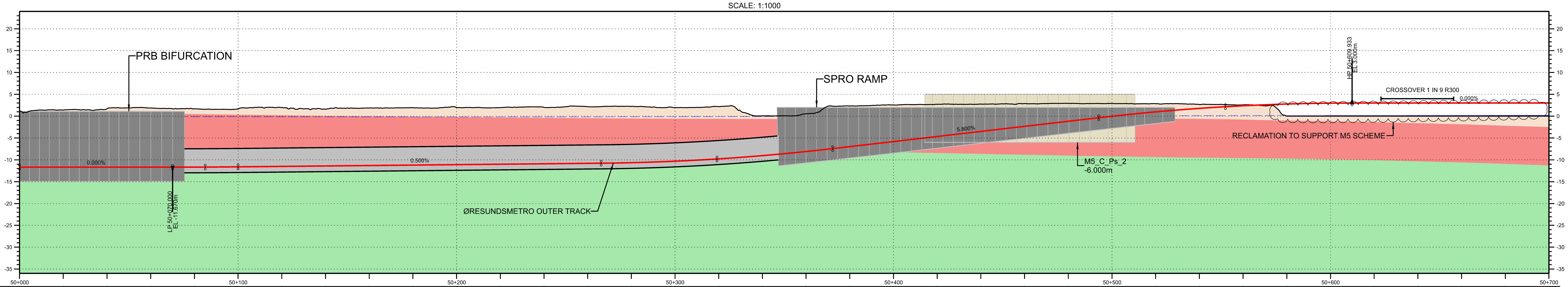
Scale:	As Indicated
Prepared by:	SASA
Checked by:	JESE
Approved by:	ALNO
Issue Date:	01.04.2024

COWI ARUP 5

Document ID-No.: **M5-CAJV-GEN-Gen-ALG-DWG-212406-_-_** Page: **1 of 1** Revision: **1.0**

PLAN

SCALE: 1:1000



CHAINAGE	50+000	50+020	50+040	50+060	50+080	50+100	50+120	50+140	50+160	50+180	50+200	50+220	50+240	50+260	50+280	50+300	50+320	50+340
EXISTING GROUND LEVEL	1.220	1.392	1.682	1.865	1.671	1.626	1.970	1.577	1.859	1.940	1.987	1.953	1.997	2.172	2.238	1.963	2.196	0.067
PROPOSED RAIL LEVEL	-11.670	-11.670	-11.670	-11.670	-11.662	-11.595	-11.495	-11.395	-11.295	-11.195	-11.095	-10.995	-10.895	-10.795	-10.647	-10.309	-9.771	-9.033
SURFACE TO RAIL DEPTH	-12.890	-13.062	-13.352	-13.535	-13.332	-13.221	-13.465	-12.972	-13.154	-13.135	-13.082	-12.948	-12.892	-12.967	-12.885	-12.272	-11.967	-9.100

CHAINAGE	50+360	50+380	50+400	50+420	50+440	50+460	50+480	50+500	50+520	50+540	50+560	50+580	50+600	50+620	50+640	50+660	50+680	50+700
EXISTING GROUND LEVEL	0.546	2.324	2.558	2.711	2.773	2.884	2.919	2.895	2.860	2.665	2.585	0.002	0.002	0.002	0.003	0.003	0.003	0.003
PROPOSED RAIL LEVEL	-8.095	-6.972	-5.812	-4.652	-3.492	-2.332	-1.172	-0.021	0.978	1.777	2.377	2.776	2.975	3.000	3.000	3.000	3.000	3.000
SURFACE TO RAIL DEPTH	-8.640	-9.296	-8.370	-7.363	-6.266	-5.216	-4.091	-2.917	-1.882	-0.887	-0.209	2.774	2.974	2.998	2.997	2.997	2.997	2.997

TRACK VERTICAL ALIGNMENT: L= 70.000m G= +0.000% | L= 30.000m Re= 6000m | L= 166.190m G= +0.500% | L= 105.999m Re= 2000m | L= 121.745m G= +5.800% | L= 116.000m Re= -2000m | L= 93.308m G= +0.000%

TRACK HORIZONTAL ALIGNMENT: L= 50.000m R= 300m | TL=20.000m | L= 74.549 m | TL=100.000m | L= 245.384m R= 300m | TL=100.000m | L= 80.111 m | L= 33.197m R= 300m

CANT ALIGNMENT: u= 0mm aq= 0.64 m/s2 | u= 0mm aq= 0.00 m/s2 | u= 95mm aq= 0.64 m/s2 | u= 0mm aq= 0.00 m/s2 | u= 0mm aq= 0.64 m/s2

DESIGN SPEED: V = 50Km/h | V = 50Km/h | V = 70Km/h | V = 70Km/h | V = 70Km/h | V = 50Km/h

LONGITUDINAL PROFILE

SCALE: H 1:1000 V 1:500

0 50 100m
SCALE: 1:1000

0 25 50m
SCALE: 1:500

FEATURE	SYMBOLOGY
GENERAL	
M5 ALIGNMENT	
M5 MAIN WORKSITE	
M5 SAFEGUARDED WORKSITE	
M5 PROPOSED STRUCTURES	
GEOLOGY	
GROUND SURFACE (DIGITAL TERRAIN MODEL)	
FILL	
GLACIAL AND GREENSAND DEPOSITS	
LIMESTONE	
MIXED FILL (LYNETTEHOLM ISLAND)	
PRIMARY AQUIFER LEVEL	
OBSTRUCTIONS	
BUILDING FOUNDATION	
UTILITIES OF CONCERN	
OTHER OBSTRUCTIONS OF CONCERN	

Coordinates according to DKTM3.
Levels according to DVR90.

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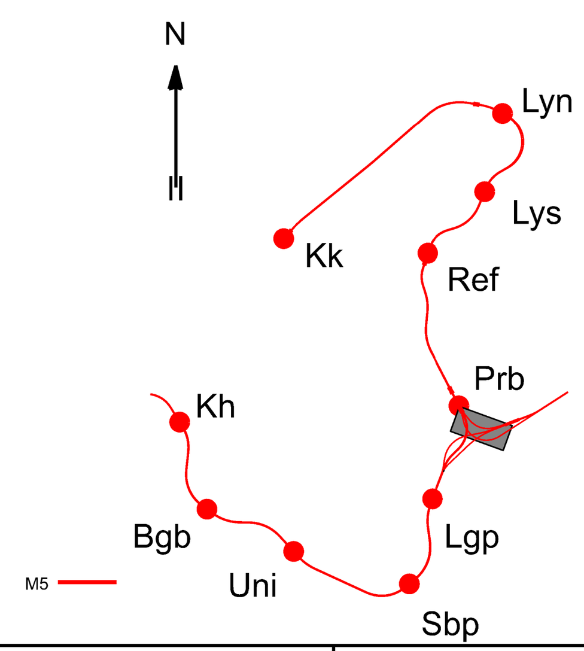
Revision	Date	Description	Prepared by	Checked by	Approved by
1.0	01.04.2024	First issue	SASA	JESE	ALNO



area reserved for QR codes

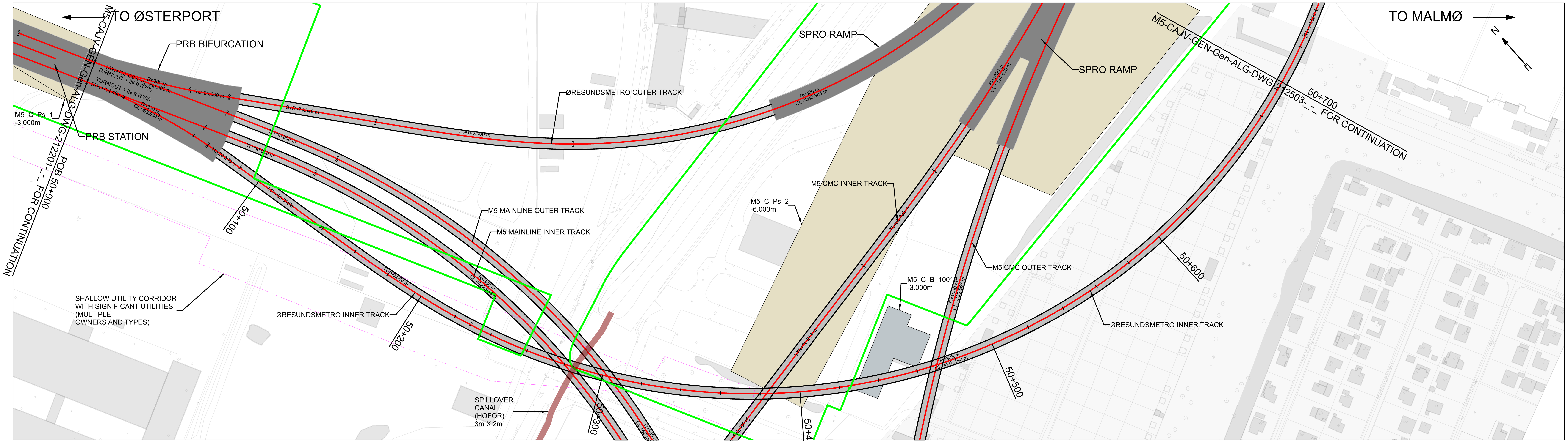
Metroselskabet I/S
M5

Concept Design - Safeguarding Øresundsmetro Variant
General M5
Alignment - Plan & Profile
Øresundsmetro Outer Track - Ch. 50+000 to 50+700

Scale: As Indicated
Prepared by: SASA
Checked by: JESE
Approved by: ALNO
Issue Date: 01.04.2024

COWI MARUP 5

Document ID-No.: M5-CAJV-GEN-Gen-ALG-DWG-212501-_-_
Page: 1 of 1
Revision: 1.0



PLAN

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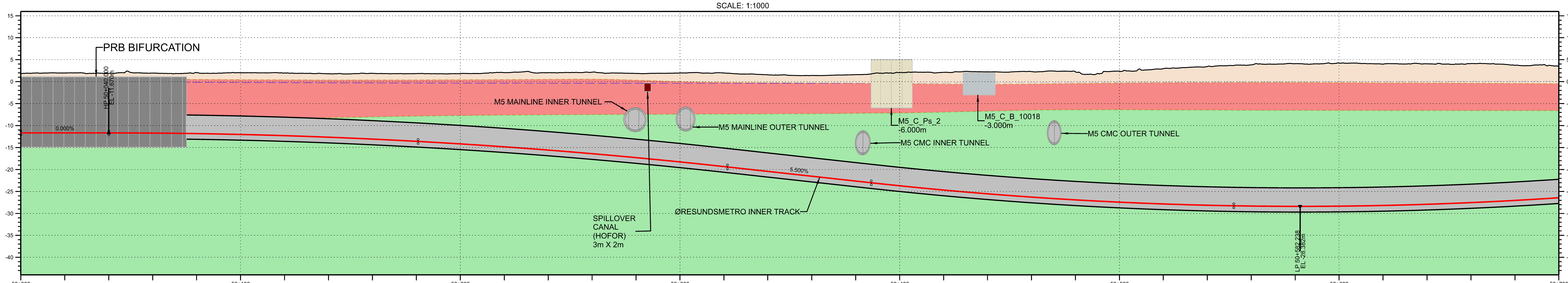

CHAINAGE	50+000	50+020	50+040	50+060	50+080	50+100	50+120	50+140	50+160	50+180	50+200	50+220	50+240	50+260	50+280	50+300	50+320	50+340
EXISTING GROUND LEVEL	1.791	1.958	1.869	1.941	2.027	1.968	1.978	1.781	1.885	1.831	1.817	2.049	2.039	2.145	1.849	1.952	1.963	1.542
PROPOSED RAIL LEVEL	-11.670	-11.670	-11.670	-11.709	-11.826	-12.022	-12.295	-12.647	-13.076	-13.584	-14.170	-14.834	-15.576	-16.397	-17.295	-18.272	-19.326	-20.426
SURFACE TO RAIL DEPTH	-13.461	-13.628	-13.539	-13.650	-13.854	-13.989	-14.273	-14.427	-14.961	-15.415	-15.987	-16.883	-17.615	-18.542	-19.144	-20.224	-21.290	-21.968

CHAINAGE	50+360	50+380	50+400	50+420	50+440	50+460	50+480	50+500	50+520	50+540	50+560	50+580	50+600	50+620	50+640	50+660	50+680	50+700
EXISTING GROUND LEVEL	1.402	1.579	2.053	2.110	2.225	2.275	2.218	2.378	2.959	3.424	3.810	4.087	4.210	3.978	4.035	4.105	3.719	3.501
PROPOSED RAIL LEVEL	-21.526	-22.626	-23.702	-24.673	-25.531	-26.277	-26.909	-27.429	-27.836	-28.131	-28.312	-28.381	-28.338	-28.181	-27.912	-27.530	-27.035	-26.428
SURFACE TO RAIL DEPTH	-22.928	-24.205	-25.756	-26.783	-27.756	-28.552	-29.128	-29.807	-30.795	-31.555	-32.123	-32.468	-32.548	-32.159	-31.947	-31.635	-30.754	-29.929

TRACK VERTICAL ALIGNMENT: L= 40.000m, G= +0.000% | L= 281.600m, Re= -5120m | L= 65.476m, G= -5.500% | L= 330.000m, Re= 3548m

TRACK HORIZONTAL ALIGNMENT: L= 68.534m, R= 300m | TL=20.000m | L= 50.315 m | TL=90.000m | L= 497.190m, R= 305m

CANT ALIGNMENT: u= 0mm, aq= 0.64 m/s2 | u= 0mm, aq= 0.00 m/s2 | u= 150mm, aq= 0.64 m/s2

DESIGN SPEED: V = 50Km/h | V = 50Km/h | V = 80Km/h | V = 80Km/h | V = 80Km/h

LONGITUDINAL PROFILE

SCALE: H 1:1000 V 1:500

0 50 100m
SCALE: 1:1000

0 25 50m
SCALE: 1:500

FEATURE	SYMBOLOGY
GENERAL	
M5 ALIGNMENT	
M5 MAIN WORKSITE	
M5 SAFEGUARDED WORKSITE	
M5 PROPOSED STRUCTURES	
GEOLOGY	
GROUND SURFACE (DIGITAL TERRAIN MODEL)	
FILL	
GLACIAL AND GREENSAND DEPOSITS	
LIMESTONE	
MIXED FILL (LYNETTEHOLM ISLAND)	
PRIMARY AQUIFER LEVEL	
OBSTRUCTIONS	
BUILDING FOUNDATION	
UTILITIES OF CONCERN	
OTHER OBSTRUCTIONS OF CONCERN	

Coordinates according to DKTM3.
Levels according to DVR90.

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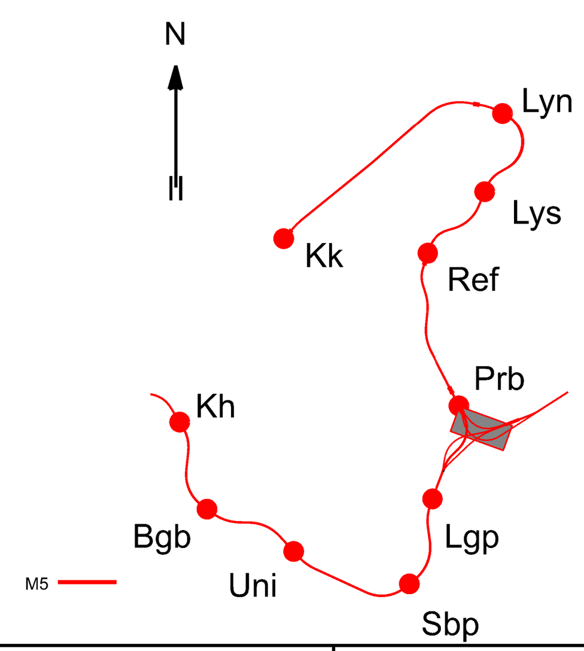
Revision	Date	Description	Prepared by	Checked by	Approved by
1.0	01.04.2024	First issue	SASA	JESE	ALNO



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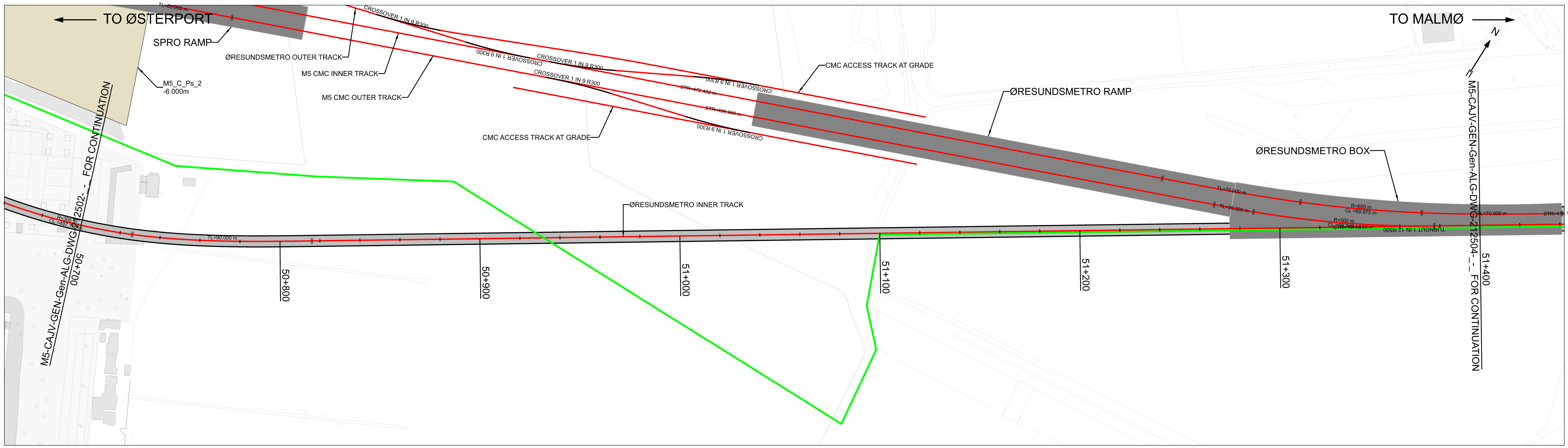
Metroselskabet I/S
M5

Concept Design - Safeguarding Øresundsmetro Variant
General M5
Alignment - Plan & Profile
Øresundsmetro Inner Track - Ch. 50+700 to 51+400

Scale: As Indicated
Prepared by: SASA
Checked by: JESE
Approved by: ALNO
Issue Date: 01.04.2024

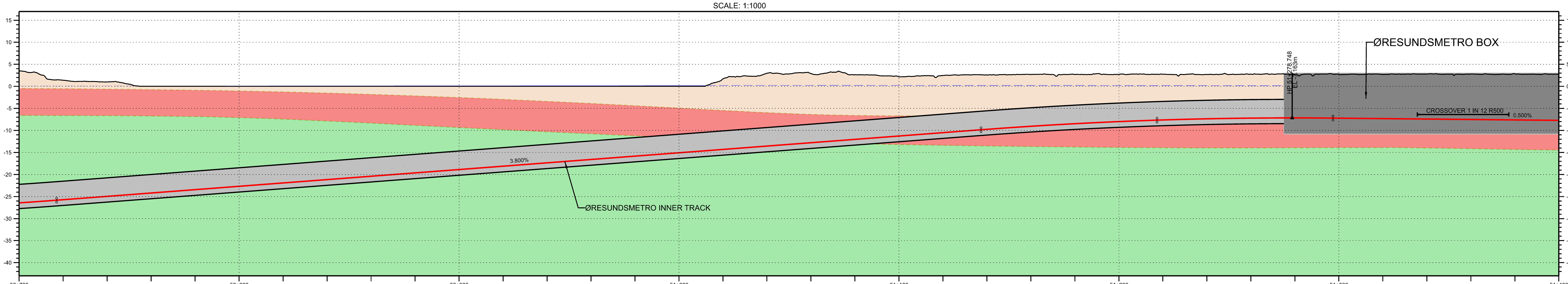
COWI ARUP 5

Document ID-No.: M5-CAJV-GEN-Gen-ALG-DWG-212502-_-_
Page: 1 of 1
Revision: 1.0



PLAN

SCALE: 1:1000



CHAINAGE	EXISTING GROUND LEVEL	PROPOSED RAIL LEVEL	SURFACE TO RAIL DEPTH
50+700	3.501	-26.428	-29.929
50+720	1.379	-25.709	-27.088
50+740	0.990	-24.949	-25.939
50+760	0.003	-24.189	-24.192
50+780	0.003	-23.429	-23.432
50+800	0.000	-22.669	-22.669
50+820	0.000	-21.909	-21.909
50+840	0.000	-21.149	-21.149
50+860	0.000	-20.389	-20.389
50+880	0.000	-19.629	-19.629
50+900	0.000	-18.869	-18.869
50+920	0.000	-18.109	-18.109
50+940	0.000	-17.349	-17.349
50+960	0.000	-16.589	-16.589
50+980	0.004	-15.829	-15.833
51+000	0.004	-15.069	-15.073
51+020	1.694	-14.309	-16.003
51+040	2.955	-13.549	-16.504
51+060	2.897	-12.789	-15.686
51+080	2.612	-12.029	-14.641
51+100	2.163	-11.269	-13.433
51+120	2.451	-10.509	-12.960
51+140	2.574	-9.750	-12.324
51+160	2.683	-9.058	-11.741
51+180	2.693	-8.473	-11.166
51+200	2.657	-7.996	-10.654
51+220	2.759	-7.627	-10.386
51+240	2.667	-7.365	-10.032
51+260	2.750	-7.210	-9.961
51+280	2.747	-7.163	-9.911
51+300	2.741	-7.223	-9.964
51+320	2.680	-7.323	-10.003
51+340	2.769	-7.423	-10.192
51+360	2.793	-7.523	-10.316
51+380	2.826	-7.623	-10.449

TRACK VERTICAL ALIGNMENT: L= 330.000m, Re= 3548m; L= 420.277m, G= +3.800%; L= 160.000m, Re= -3721m; L= 161.573m, G= -0.500%

TRACK HORIZONTAL ALIGNMENT: L= 497.190m, R= 305m; TL=90.000m; L= 1041.189 m

CANT ALIGNMENT: u= 0mm, aq= 0.00 m/s2

DESIGN SPEED: V = 80Km/h; V = 80Km/h; V = 80Km/h; V = 120Km/h; V = 120Km/h; V = 120Km/h

LONGITUDINAL PROFILE

SCALE: H 1:1000 V 1:500

0 50 100m
SCALE: 1:1000

0 25 50m
SCALE: 1:500

FEATURE	SYMBOLOGY
GENERAL	
M5 ALIGNMENT	
M5 MAIN WORKSITE	
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Coordinates according to DKTM3.
Levels according to DVR90.

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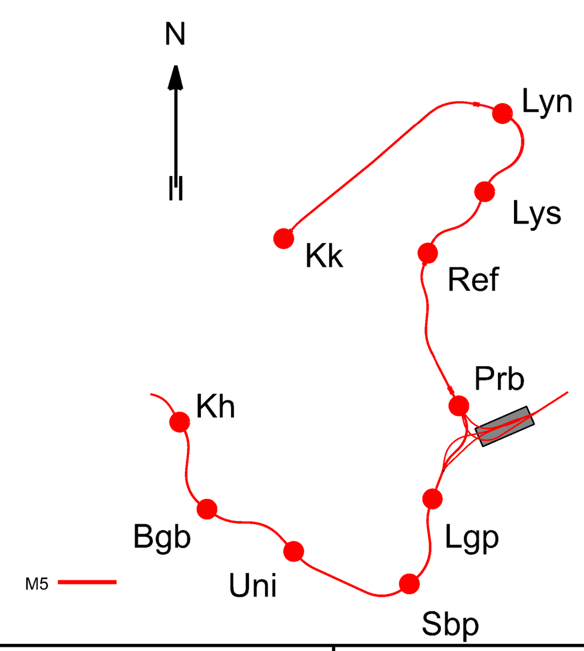
1.0	01.04.2024	First issue	SASA	JESE	ALNO



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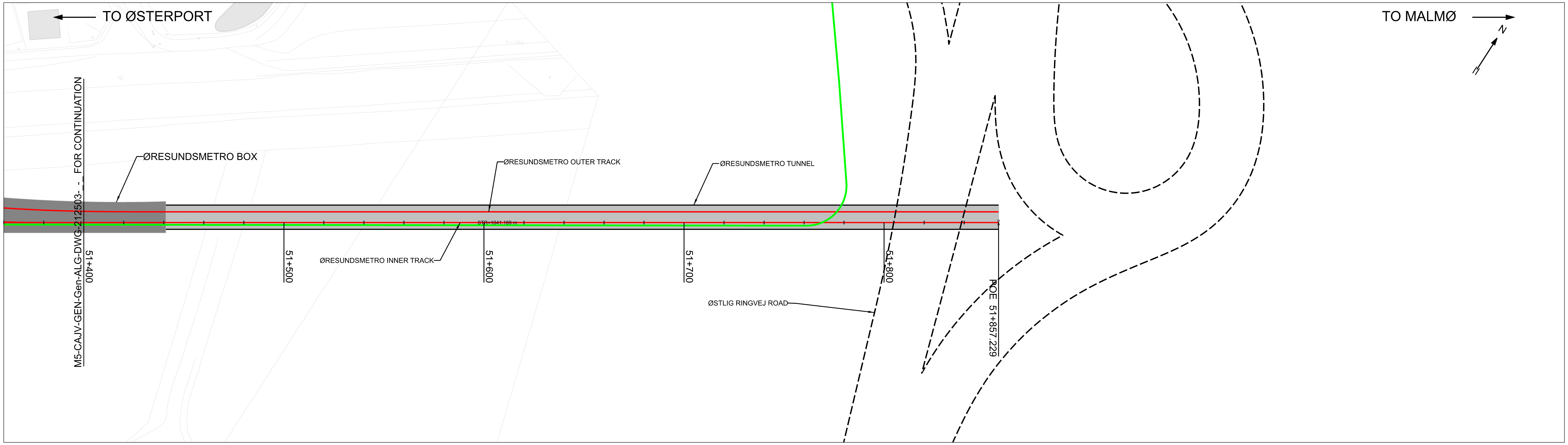
Metroselskabet I/S
M5

Concept Design - Safeguarding Øresundsmetro Variant
General M5
Alignment - Plan & Profile
Øresundsmetro Inner Track - Ch. 51+400 to 52+100

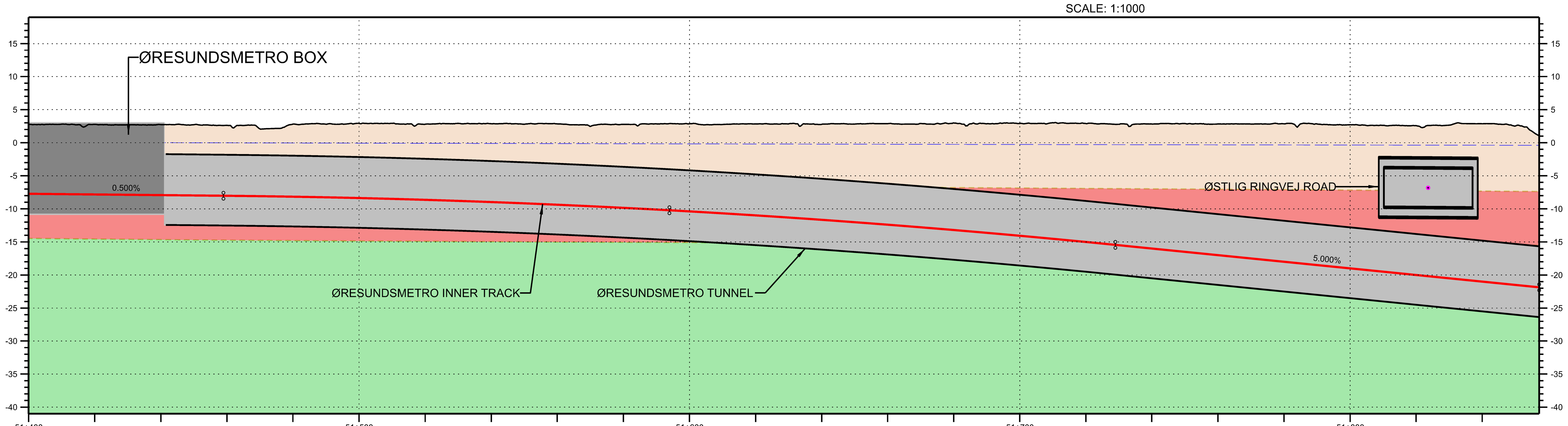
Scale: As Indicated
Prepared by: SASA
Checked by: JESE
Approved by: ALNO
Issue Date: 01.04.2024

Document ID-No.: **M5-CAJV-GEN-Gen-ALG-DWG-212503-_-_**
Page: **1 of 1**
Revision: **1.0**



PLAN

SCALE: 1:1000



CHAINAGE	51+400	51+420	51+440	51+460	51+480	51+500	51+520	51+540	51+560	51+580	51+600	51+620	51+640	51+660	51+680	51+700	51+720	51+740	51+760	51+780	51+800	51+820	51+840
EXISTING GROUND LEVEL	2.762	2.769	2.735	2.624	2.805	2.926	2.793	2.865	2.847	2.775	2.872	2.841	2.778	2.878	2.976	2.914	2.894	2.826	2.830	2.858	2.715	2.580	2.866
PROPOSED RAIL LEVEL	-7.723	-7.823	-7.923	-8.023	-8.160	-8.364	-8.634	-8.971	-9.374	-9.844	-10.381	-10.985	-11.655	-12.392	-13.196	-14.066	-15.003	-15.996	-16.996	-17.996	-18.996	-19.996	-20.996
SURFACE TO RAIL DEPTH	-10.485	-10.592	-10.658	-10.647	-10.965	-11.290	-11.426	-11.836	-12.221	-12.620	-13.254	-13.826	-14.433	-15.270	-16.172	-16.980	-17.897	-18.822	-19.826	-20.854	-21.712	-22.576	-23.863
TRACK VERTICAL ALIGNMENT	L= 161.573m G= -0.500%										L= 270.000m Re= -6000m										L= 128.303m G= -5.000%		
TRACK HORIZONTAL ALIGNMENT													L= 1041.189 m										
CANT ALIGNMENT																							
DESIGN SPEED	V = Profile Annotation.Speed place holder											V = Profile Annotation.Speed place holder											V = Profile Annotation.Speed place holder

LONGITUDINAL PROFILE

SCALE: H 1:1000 V 1:500

0 50 100m

SCALE: 1:1000

0 25 50m

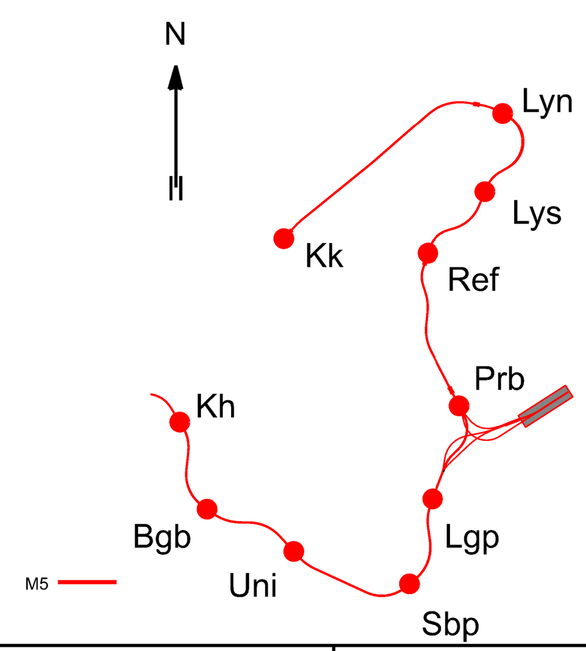
SCALE: 1:500

FEATURE	SYMBOLOGY
GENERAL	
M5 ALIGNMENT	
M5 MAIN WORKSITE	
M5 SAFEGUARDED WORKSITE	
M5 PROPOSED STRUCTURES	
GEOLOGY	
GROUND SURFACE (DIGITAL TERRAIN MODEL)	
FILL	
GLACIAL AND GREENSAND DEPOSITS	
LIMESTONE	
MIXED FILL (LYNETTEHOLM ISLAND)	
PRIMARY AQUIFER LEVEL	
OBSTRUCTIONS	
BUILDING FOUNDATION	
UTILITIES OF CONCERN	
OTHER OBSTRUCTIONS OF CONCERN	

Coordinates according to DKTM3.
Levels according to DVR90.

This drawing has been printed from PDF-format - the scale cannot be expected to be correct.

1.0	01.04.2024	First issue	SASA	JESE	ALNO
Revision	Date	Description	Prepared by	Checked by	Approved by



area reserved for QR codes

Metroselskabet I/S
M5

Concept Design - Safeguarding Øresundsmetro Variant
General M5
Alignment - Plan & Profile
Øresundsmetro Inner Track - Ch. 52+100 to 52+800

Scale: As Indicated
Prepared by: SASA
Checked by: JESE
Approved by: ALNO
Issue Date: 01.04.2024

Document ID-No.: **M5-CAJV-GEN-Gen-ALG-DWG-212504-_-_**
Page: **1 of 1**
Revision: **1.0**