

Red Line Master Schedule

Version 10.7 Analysis

July. 2017

IDENTIFICATION

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Date	10.7.17	10.7.17	11.7.17

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1. EXECUTIVE SUMMARY


General

The report is presenting EMC analysis of the new schedule produced by NTA - version 10.7. The Work Breakdown Structure (WBS) is logical and provide good understanding of the total scope of the project. EMC examined the new schedule looking at the following issues:


- Project's execution status
- Probability of completion on time
- Risks to the timetable and budget
- The effects of past decisions
- Consistency with management decisions










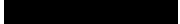
The major changes in the project execution and procurement strategy (i.e., SDAG split, Fit-Out split, TBM1st construction, canceling at-grade early operation), lead to the conclusion that the as result of these significant changes it is recommended that new Schedule will become the new baseline register.

Comparing the progress of works on site to the officially approved base line registered schedule 10.5 concludes that a lower rate of execution than planned for the stations' D-walls lead to extended construction of 11 months. The mitigation for the D-walls delay was set as a change in the construction sequence from stations' 1st to TBM 1st. Part of the mitigation was to consume Buffers and increased the execution rate. Based on the D-walls performance so far and experience in other projects around the world, EMC believe that the execution rate is too optimistic.

A decrease of 30% in CP Buffer Days (BD) lead to a situation where the buffers do not provide sufficient protection to the CP. 

The changes in project execution effected the Critical Path (CP) which changed from station only to TBM tunneling and station works. This has resulted in increasing risks, such that a small delay of TBM works may lead to delay in the end date of the stations. 

Conclusions

The report presents EMC analysis of the new schedule. [REDACTED]

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[REDACTED] and without Method Statement and commitment of the contractors. The mitigation plans introduced in the schedule are not yet finalized, for example expediting Rolling Stock deliveries are still under negotiation, similarly TBM 1st has not concluded the methodology for Cross Passages.

Taking all in to account EMC believe that Schedule 10.7 is not completed and in its current version (10.7a) cannot be approved as the new baseline register.

Recommendations

To set schedule 10.7 as the base line register after:

- [REDACTED]
- To complete the activities on the Critical Path that not detail in the schedule and it is EMC opinion that they are on the CP such as Cross Passage and roads development and traffic arrangements above stations.
- The total project Buffer Days, which are not sufficient should be increased. In order to calculate the buffer days required until the end of the project, NTA must to do a new risk analysis containing the risks due to the changes in the method of construction and procurement strategy, in the new analysis, NTA need to remove the risks that have already passed.

2. תקציר מנהלים – עברית

כללי

דוח הבקרה על לוי"ז 10.7 נערך במטרה לבחון עבור נציגי המדינה כיצד משקף עבורם (ומכאן חשיבותו הרבה) את:

- סטטוס ביצוע העבודות
- הסתברות לסיום במועד שנקבע
- סיכוני תקציב ולוי"ז
- השלכות של החלטות ושינויים שנתקבלו
- קונסיסטנטיות הניהול

ממצאים עיקריים

1. הלוי"ז נבדק לוגית ונמצא קונסיסטנטי, כאשר הוא משקף כיאות את שלבי העבודה ומדיניות הרכש, כולל השינויים העיקריים שנערכו לאחרונה והוכנסו ללוי"ז 10.7A
2. **יצוין כי חלק מהשינויים המוצגים בלוי"ז טרם אושרו רשמית על ידי נציגי המדינה ובעלי משמעות תקציבית, כגון:**
 - ביטול שלב ההפעלה המוקדמת
 - שינוי שיטת הביצוע למנהרות תחילה גם עבור קבלן הקטע המזרחי
 - שינוי מועדי אספקת הקרונות
 - הטמעת אסטרטגיית הרכש לעבודות הגמר.

3.

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4. ישנם איחורים כמעט בכל חבילות העבודה המוצגות בקובץ ה **NARRATIVES** שצורף ללוי"ז 10.7 בהשוואה לקובץ שהתקבל יחד עם לוי"ז 10.5. יצוין כי נת"ע רואה בלוי"ז כנייר עבודה של ה **PMC** בלבד ולכן מבחינתם השוואה ללוי"ז 10.5 היא לא רלוונטית, אלא ל-10.6 אשר לא אושר על ידי המדינה. לעומת זאת, חברת הבקרה רואה בלוי"ז מחויבות משוטפת של כל בעלי העניין בפרויקט ולכן נדרשת מחויבות מלאה שלהם ללוי"ז.

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7. הנתביב קריטי השתנה מתחנות בלבד לתחנות ו **TBM** ביחד בעקבות השינויים בשיטת הבניה. המשמעות היא:

- כל מכונות המנהור חייבות להיות מוצגות בנתביב הקריטי (מה שלא קיים היום) מאחר וכל עיכוב קטן בסיום עבודות המנהור יעכב את הסיום של התחנות מאחר ולא ניתן לחזור ולעבוד על התחנות ללא חילוץ כל מכונות המנהור שנמצאות מתחת לתחנה.
- בנתביב הקריטי לא מוצגות פעולות קריטיות כמו חיתוך עמודי ה **king pile**, עבודות החזרת הכביש למצבו הסופי והסדרי תנועה סופיים אשר בהעדרם ישנו סיכון ללוי"ז והתקציב.

- נידרש תיקון לרצף הפעולות בנתיב הקריטי כגון : עבודות החפירה בתחנות ביאליק ואבא הילל אשר על הנתיב הקריטי, מתחילות בסיום מכונת מנהור מספר #4 בעוד שבנתיב הקריטי מצוין מכונה מס #3 , המשמעות היא עיכוב סיום בתחנות הנ"ל של 3 חודשים בגלל הצורך להמתין לסיום העבודות וחילוץ מכונה #4.

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מסקנות

1. סטטוס ביצוע העבודות – עודכן הביצוע עד כה והשינויים באסטרטגיית הרכש ואף עודכנו נושאים שעדיין לא אושרו כמוזכר לעיל.

2. הסתברות לסיום במועד שנקבע וסיכוני תקציב ולו"ז - [Redacted]
 [Redacted]
 [Redacted]
 [Redacted]

3. [Redacted]
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4. [Redacted]
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המלצות

1. [Redacted]
 [Redacted]
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 [Redacted]

2. תיקון הלו"ז יהיה על בסיס הערות חברת הבקרה שעיקרן המפורטות בדו"ח זה.
 3. מצופה מנת"ע לבחון את הלו"ז החדש והסיכונים שבו ללו"ז ולתקציב בעזרת מודל הסיכונים ולחשב את ימי הבאפר הנצרכים עד לסיום הפרויקט והשינוי בהסתברות לסיום הפרויקט במועד ובתקציב המאושרים דהיינו לוי"ז 10.5.

4. [Redacted]
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3. VERSION 10.7 OVERVIEW

3.1. OBJECTIVES:

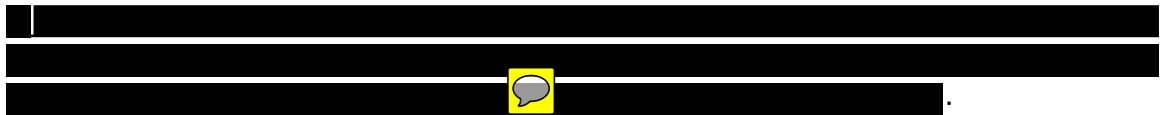
This report analyzes the new schedule produced by NTA (**version 10.7**), the importance of this report for the GOI is high, since the schedule reflects:

- Project's execution status
- Probability of completion on time
- Risks to the timetable and budget
- The effects of past decisions.
- Consistency of management decisions

In addition, all future decisions in the Steering Committee for the next project packages are influenced by the project's status and schedule.

EMC support GOI decision to periodically update the schedule base on the following review process:

1. Presenting existing project status and past performance.
2. Comparing future tasks of the project to the execution so far.
3. Updating mitigation plans required to meet the project completion date.



This report present EMC professional analysis whether the new schedule produced by NTA (**version 10.7**) meets the reasons above.

3.2. PRELIMINARY REMARKS:

Schedule version 10.7 has been issued in 30.3.17. EMC performed a quality and spot checking review of 10.7 version and provided NTA its preliminary report on 9.5.17.

An updated version 10.7a was send on 22.5.17 along with answers to EMC preliminary report. The changes between 10.7 compared to 10.7A are:

- Implementing the updated procurement strategy of the former SDAG tender, approved on 9.4.2017. 10.7 was built on the assumption of 3 separate tenders – S&TC, Track & Power and Communications & Controls. In the meeting stated above it was agreed to combine the Track & Power and Communications & Controls into one ‘Systems’ tender. 10.7A was modified to reflect the current approved procurement strategy.
- 10.7 showed a proposed option of early operations being held in At Grade East section. As early operations have not been decided, it had been removed for now from the master schedule.

A second preliminary report sent to NTA on 8.6.17. To this version NTA sent their answer on 21.6.17.

The following is EMC final conclusions and report.

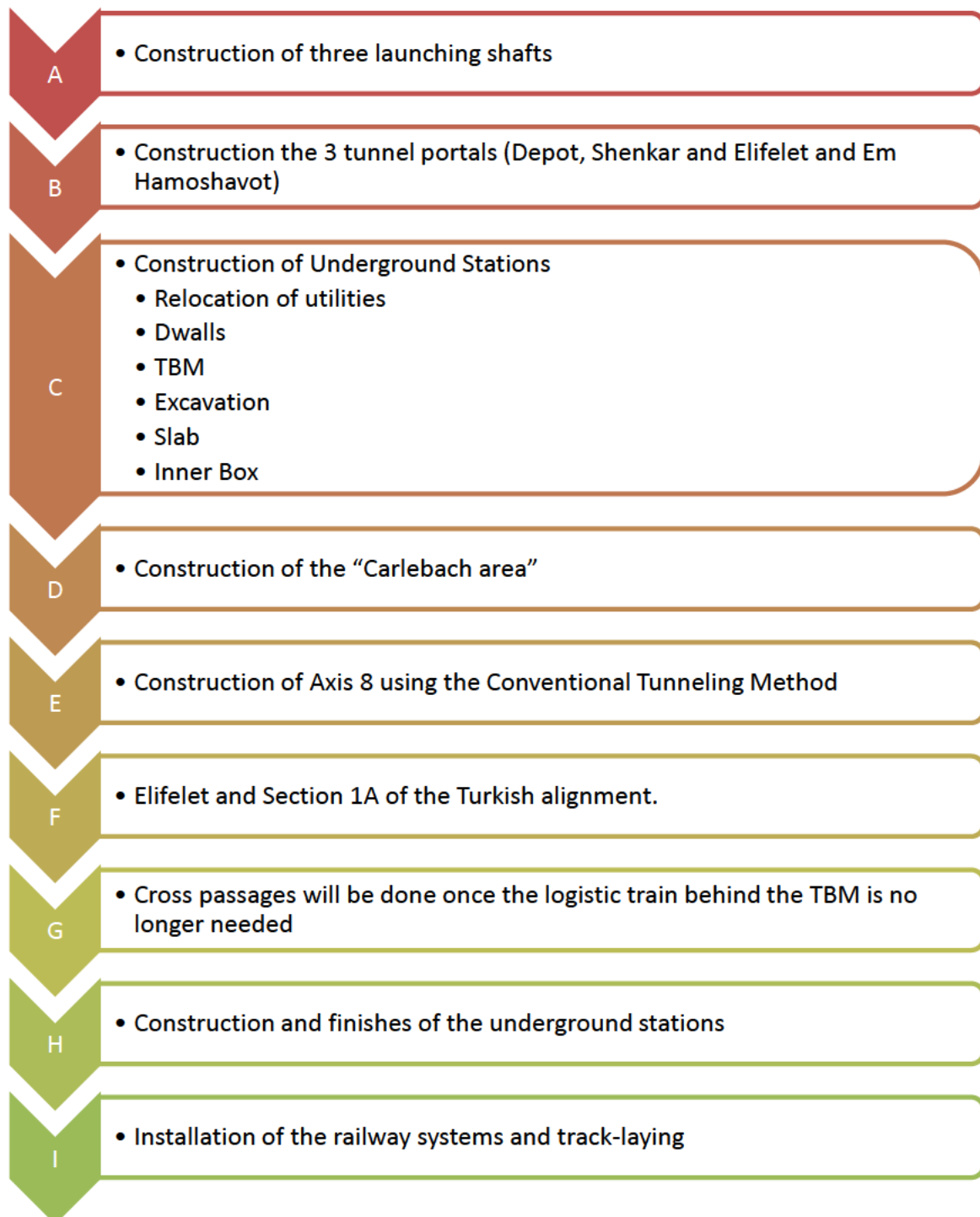
3.3. INPUT DATA

The table below summarizes the documentation requested and received from NTA, which is the basis of the EMC report:

Doc Name	Received /Requested	Status
Time Location Diagram (Tilos chart), version 10.7 March 2017.	Received 30.3.17	ok
Red Line Schedule Baseline (Primavera file - database), version 10.7	Received 30.3.17	ok
Red Line Schedule Baseline (Primavera file - database), version 10.7 - Top 3 critical path	Received 30.3.17	ok
Critical path (Primavera Gantt chart) - Official Longest Path	Received 30.3.17	ok
Version 10.7a		Received 22.5.17
Narratives	Requested in Hebrew 4.4.17 and then again in English in 19.4.17 for NTA request	Received 1.5.17
Method statement	19.4.17	Partially Received 26.4.17 – Allenby Excavation only 30.4.17 – Aba Hillel + Shaul Hamelech Excavation only
Detailed timetables for each contractor made by the local PMC	Requested in Hebrew 4.4.17 and then again in English in 19.4.17 for NTA request	Not Received - NTA's Response that Local PMC's schedule is an internal NTA document.
NTA response to D'Appolonia QA report	Requested in Hebrew 4.4.17 and then again in English in 19.4.17 for NTA request	Not Received because it's not yet finalized.
TBM Daily Progress Updates	Requested in 28.3.17 and received daily since 29.3.17	Ok
Weekly Station Progress Update	Requested on 2.4.17 and received since 30.4.17	Ok
NTA comment to the draft report		Ok

3.4. STAGES OF THE PROJECT

Following NTA narratives the project stages are:

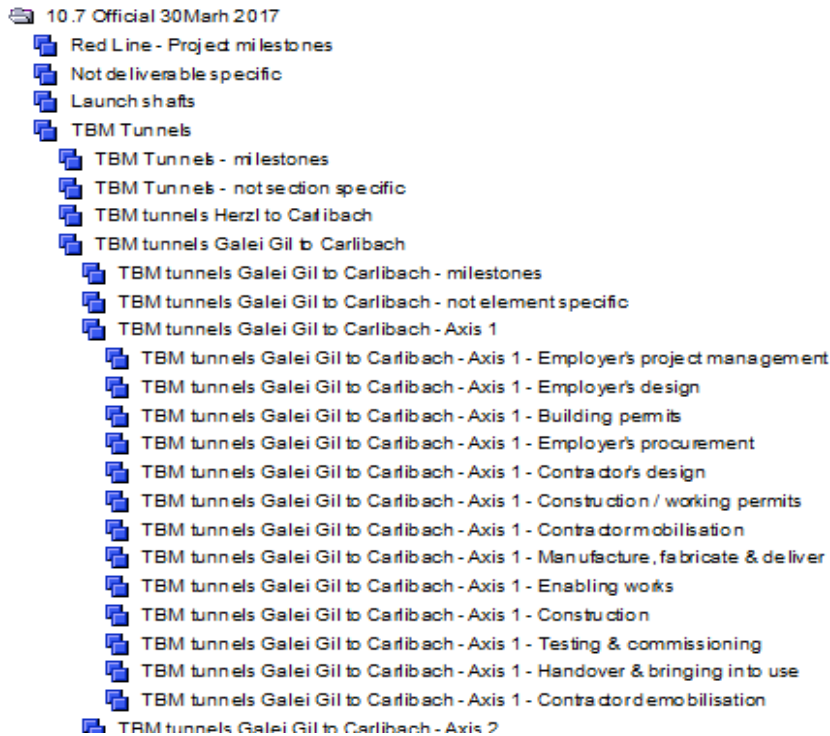


3.5. P6 INTEGRITY AND QUALITY:

Total activities: **4007**

The Works Break-down Structure (WBS) is logical and allow a well-structured understanding of the total scope of the project (including contractor's design and working permits).

Activity's codes are numerous and allow establishment of geographical filters or tender's filter and so on. Interface milestones are also identified.



- Only a default project calendar seems to be used for scheduling: 8h/d and 5/7d. Specified calendars may be created for specific tasks like TBM. In particular for TBM a normalized calendar is assumed to simulated 24*7 operation, however NTA normalized it to 1 unified calendar in order to simplify the critical path analysis.
- NTA need to integrate relevant vacation dates **Arab/** Christian /Chinese calendars.
- There's no baseline registered on the schedule, a first version of the schedule should be approved for future reference. This baseline becomes the benchmark against which project performance may be measured. This baseline should be in place before the execution of the project work. Although, NTA consider 10.6 as a baseline schedule, it is EMC view that only the 10.5 schedule can be used as a reference (base line register – ספא "דוח"), since this is the last approved schedule and is the current Contractor's contractual obligation.

3.6. COMPARISON 10.5 VS 10.7

At the beginning of the analysis EMC examined the main changes between the last official schedule approved by GOI – Schedule 10.5.



The following table summarize the main differences between schedule version 10.5 and 10.7, which are:

	10.5	10.7
PTO (Without Carlibach)	Oct 2021	Oct 2021
Early operation	Sep 2020 (AG South)	Apr 2021 (AG East) Early operations omitted in 10.7A schedule.
Construction method	Station 1 st	TBM 1 st
SDAG	One tender NTP May 2017	Infra1 NTP June 2017 STC NTP Jan 2018 Systems NTP May 2018
O&M	NTP Sep 2016	NTP Sep 2017
FIT OUT	1 Contractor to all activities	Contractors for finishing Contractor for Lifts & Escalators Contractor for HVAC & TVS Supplier for the Procurement only.
RS	First 3 LRVs – May 2018 Last Vehicle - July 2021	First 3 LRVs – Dec 19 Last Vehicle - October 2021
End D-Walls (Without Carlibach)	April 2017	March 2018

TBM'S	Completion of boring - March 2019	Completion of boring -July 2019
	Completion of sub invert in all tunnels -June 2019	Completion of sub invert in all tunnels - June 2019
Chamber 5/8 to Chamber 2/8	NATM – 35 Month from April 2016	CTM – 23 Month from July 2017
Turkish Alignment	Total duration for construction 31 months	Total duration for construction 25 months
Critical Path	Station	TBM + Station
Tenders	TA, SDAG, FIT OUT, O&M, RS, AG	INFRA1, INFRA2 (S&TC& Systems), FIT OUT (Fit-Out, Lifts & Escalators, HVAC & TVS), O&M
Total Buffers Days (BD) that remains (BD are in parallel)	4781 Days (1064 BD that protect the critical path)	3230 Days (746 BD that protect the critical path)
Testing & commissioning	9 Month	7 Month
Overlapping between activities such as concrete works and fit out also has been changed		

The major changes in the project procurement strategy (i.e., SDAG, Fit-Out, TBM1st, no early operation), lead to the conclusion that the best solution is that new Schedule will become the new baseline register.

Therefore, it is expected in each new Schedule report that NTA would calculate the new probability for project conclusion on time, which is based on the remaining buffers and risks. It is EMC estimation that based on the present project status and as result of the changes in the project construction and procurement strategy (TBM1st, SDAG split, Fit-Out split etc.) this probability has decreased between Schedule 10.5 to Schedule 10.7.

3.7. PROJECT PROGRESS JUNE 2015 / APRIL 2017

It is important to analyze the working progress on the RED LINE project, specifically, to compare what has been planned and what has been executed. This shall reflect what has really been done between June 2015 when the project has been launched according to schedule 10.5 and April 2017 when schedule 10.7 was published.

ENGINEERING

TBM

Following changes of construction method from Station 1st to TBM 1st, the TBM's launched earlier than planned on Schedule 10.5 as detailed below:

TBM#6 launched from Galei Gill on 19-Feb-17, 4 months earlier than planned. It has constructed 175 rings (= 264 l.m.) until 5-Apr-17, that is a boring rate of 5.9m/per day compared to 5.4 meters per day as planned in 10.7. The TBM availability during that drive included 21-day stoppage. It is noted that for this stretch the TBM passed with care under ISR railway line, Ayalon Highway and Ayalon river.

TBM#5 launched from Galei Gill on 3-Apr-17 (also 4 months earlier than initially planned) and as of the end of April has constructed 98 rings (= 147 l.m.). Average tunneling advance rate was 4.9 meters per day compared to 3.7 meters per day as planned in 10.7. It is noted that for this stretch, TBM#5 also passed with care under ISR railway line and Ayalon river. TBM#5 has made a much faster progress than planned for crossing of the Ayalon Highway and the railway, since supporting piles of the Ayalon canal were not encountered to slow down the progress.

Almost 95% of tunneling are planned to be completed earlier than in 10.5, though EMC believe the basic assumption about the rate of progress are too optimistic. As result the impact that TBM 1st has on the stations is significant. The TBMs, due to TBM 1st create the constraints for the stations construction sequence which delay the station excavation & concreting works progress. Due to the earlier passage at the stations, the continuity of works will stop until the TBM will finish its drive at the last station and will be taken out of the tunnel. EMC believe that all TBMs are now part of the critical path rather than as shown by NTA in the "**top 3 critical paths.pdf**" that only TBM 3# in the critical path.

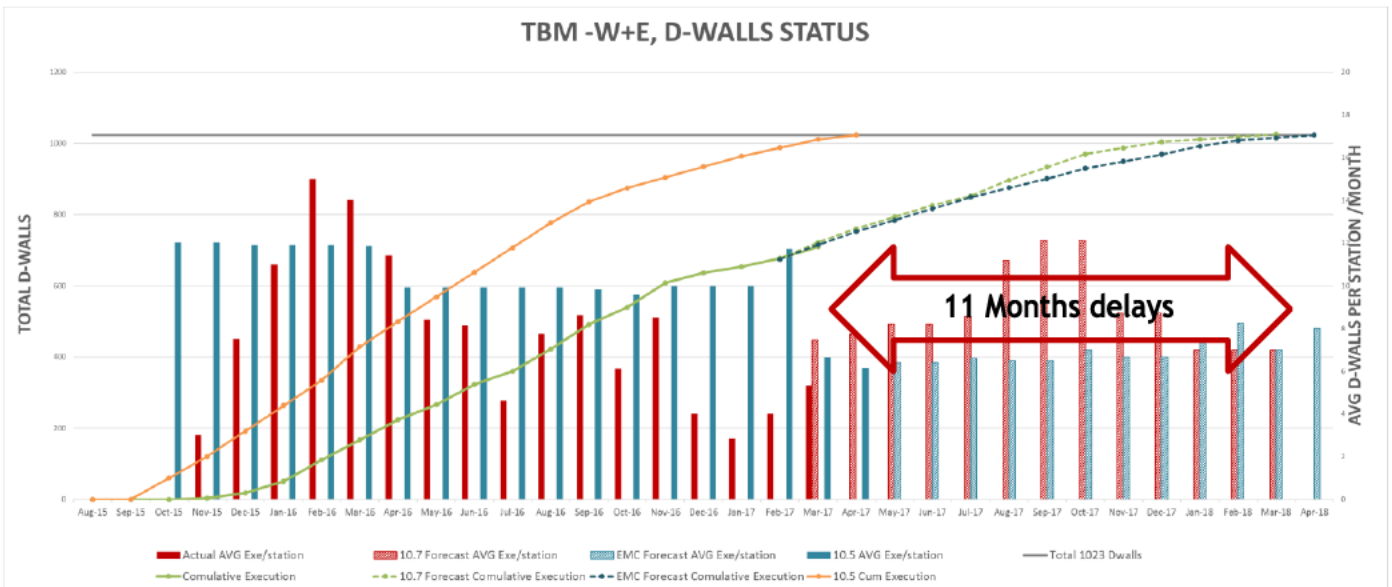
The narrative report does not describe the assumptions of TBM construction (e.g. where TBMs have to stop, rate of progress within and outside of a station, how the average advancement rates used or how they were derived). EMC can comment that compare to other projects learning curve experience the rates achieved by the two TBMs so far are considered reasonable.

STATION



The graph below shows the change made in the D-walls execution between sch 10.5 according to which the contractors (TBM W and TBM E) has planned their progress and the 10.7 schedule and EMC forecast.

The graph follows the execution of the D-walls from the beginning of the works. A lower rate of execution than planned can be seen throughout most of the months. As a result, the execution period is extended by 11 months (from April 2017 to March 2018). Additionally, the graph reflects low execution rate in the past months (Dec 2016 - Jun-Feb 2017).

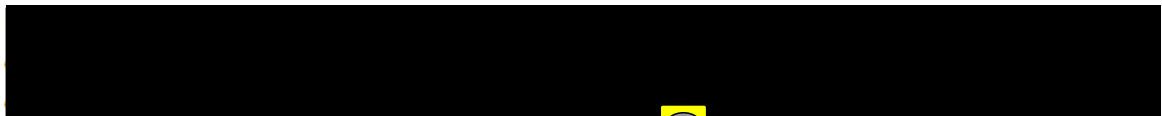


Since the D-wall construction activity is a main task in the stage C of the project, any execution delay may delay the end date of the project. The mitigation for the D-walls delay was to change the construction sequence to TBM 1st, it consumed Buffers and increased the execution rate.

The chart below describes D-walls progress for each station (excluding Carlibach) till the end of June 2017.

Station	D-walls Completed	Total D-walls	Remained D-walls
Allenby	116	116	0
Yehudit	96	104	-8
Shaul Hamelech	67	112	-45
Arlozorof	152	152	0
Abba Hillel	112	112	0
Bialik	110	110	0
Aharonovich	74	145	-71
Ben Gurion	90	172	-82
Total	817	1023	-206

Based on the performance so far in the D-walls execution and experience in other projects



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- [Redacted]

- [Redacted]

- [Redacted]

- [Redacted]

- [Redacted]

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[REDACTED]




[REDACTED]

[REDACTED]

CRITICAL PATH (CP)

Review of the Critical Path (CP) shows that it changed from **station only** as was in 10.5 Schedule to **TBM tunneling and station works**. NTA shown the "*top 3 critical paths.pdf*" that only TBM 3# in the critical path. It is EMC opinion that That it is not correct to show only TBM 3# in the critical path instead of all the TBMs because for example:

TBM 4# finish after TBM 3#, in light of that the excavation works in the critical station bialik and aba hillel can't start as mention in the 10.7 schedule for the reason that the works can start just after demolishing TBM 4#, 

One more example to demonstrate the importance of putting all the TBMs in the critical path is, that a small delay of the TBM works may lead to a delay in all the stations on the TBM section of the line. For example, If TBM#6 need to stop for a longer period before Shaul Hamelech, it affects the works of all underground stations between Arlozerof and Carlibach. and will put Arlosorof station on the critical path.

Further review of the schedule shows that stations' works such as roads development and traffic arrangements above stations, demolishing the king pile and architectural finishing are not included. EMC believe that these works are on the critical path, because they are effecting the availability of stations' entrance to the beginning of Fit-Out works.

EMC conclusion is that NTA must provide to GOI a new and update CP and buffer list.

TENDERS

SDAG

NTP was expected in summer 2016 for commencement of the Systems design and to secure critical interfaces with other packages such as depot and rolling stock. SDAG tender process has been canceled and a new procurement and packaging strategy was accepted by the GOI, the new procurement is:

Infra 1 – All the civil works

Infra 2 - Those will be two tenders, one is S&TC and the other is a Systems tender, when the Systems contractor shall be the leading contractor responsible for all systems integration in the project.

All the delays in this Tender are very critical to the Red Line Project.

FIT OUT

Station/Fit-Out design completed to allow fit out tender as a DBB and to secure interfaces with CW packages (inner box) and SDAG. A new approach in matter of structural design and functionality was introduced by PMC in early 2016. Thus, NTA proposed moving from DBB to DB tender. On Q4 2016, NTA changed again the tender strategy proposing splitting the works to several DBB tenders. Therefore, Fit Out Tender was not published in 2016.

In January 2017 NTA presented to EMC a new procurement strategy for the FIT-OUT Tender, however in the 10.7 Schedule and Narrative Report it is not presented in detail how the different contracts will be sequenced, coordinated and managed (e.g. as concreting works will pause for fit-Out, SDAG and then be resumed).

The new strategy is to split the tender into several work packages:

- Finishing works at stations
- Procurement of Lifts & Escalators
- Procurement of HVAC & TVS
- Procurement of other materials

No timetable has yet been provided regarding the change in the FO strategy. Only after the updated schedule will be transferred – EMC will be able to express its opinion regarding to it.

O&M

The Tender PQ stage was cancelled and the thresholds were changed to lure international competitors. However, the antitrust commissioner questioned the participation of Egged,

the local Monopole in bus transit, and Dan the local operator of most bus lines in Tel Aviv. As result, the tender process was delayed. NTA is doing every effort to be able to give the NTP at the end of September 2017, which will give the contractor sufficient time to meet the schedule.

Comment: The new procurement strategy of the SDAG and Fit-Out tenders, and the cancelation of early operation were not detailed in schedule 10.7 and were only somewhat presented in the updated version 10.7a.

4. VERSION 10.7 ANALYSIS

In this chapter, EMC present an analysis of checking the correlation between the contractor's method statement and the planning proposed in the new timetable.

A full correlation between the contractors and NTA should ensure that the project completion date can be timely achieved as planned.

4.1. METHOD STATEMENT (MS)

To facilitate the review of 10.7 schedule, EMC requested NTA to provide the CW contractors' method statements. This documentation is necessary to calculate activities' durations among which to appreciate the impact of the change from "Station 1st" to "TBM 1st", in identification of risks and the planning of the contractors in order to meet schedule. NTA's response that 10.7 schedule was built according to information received from multiple sources such as analysis of up to date progress and from the experience of PMC and local PMCs, and not directly from contractor's method statements, However, references and details of these projects used by NTA were not provided to compare similarity of conditions and complexity.

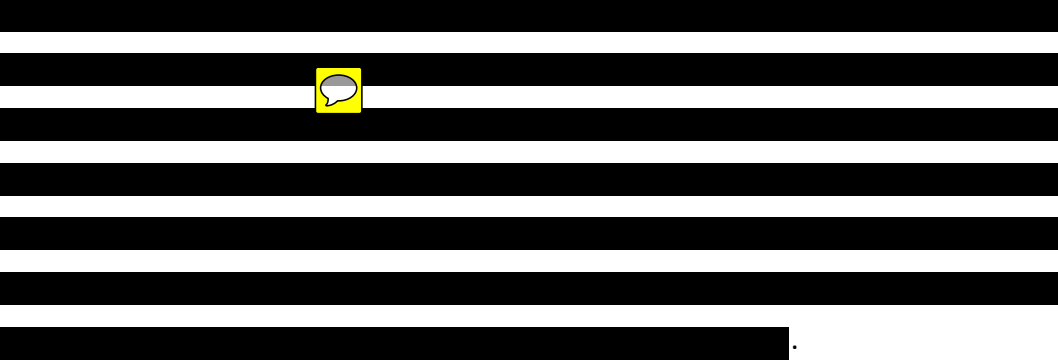
It is highlighted that the Method Statements should describe how the construction activities will be executed in a safe a timely manner and prescribe mitigation measures in case of identified risks being encountered.

NTA's response explains why the EMC finds that Schedule 10.7V and the various Method Statement are not fully coordinated.

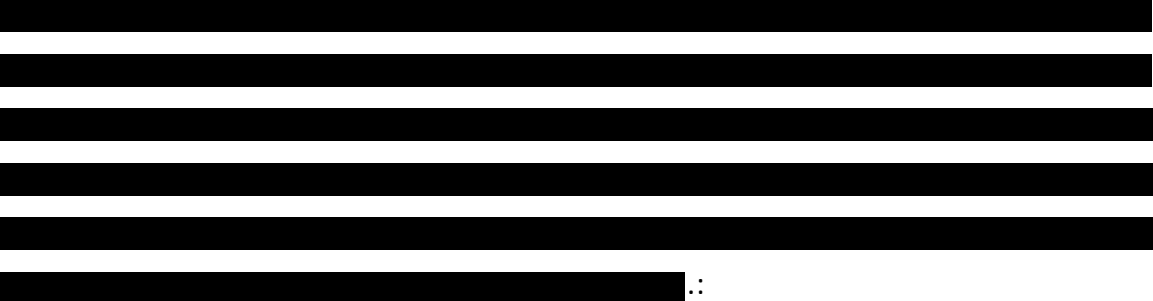
The Method Statements do not present the critical excavation stages that affect durations. EMC opinion considers the following points to present risk for bottlenecks which will slow down production:

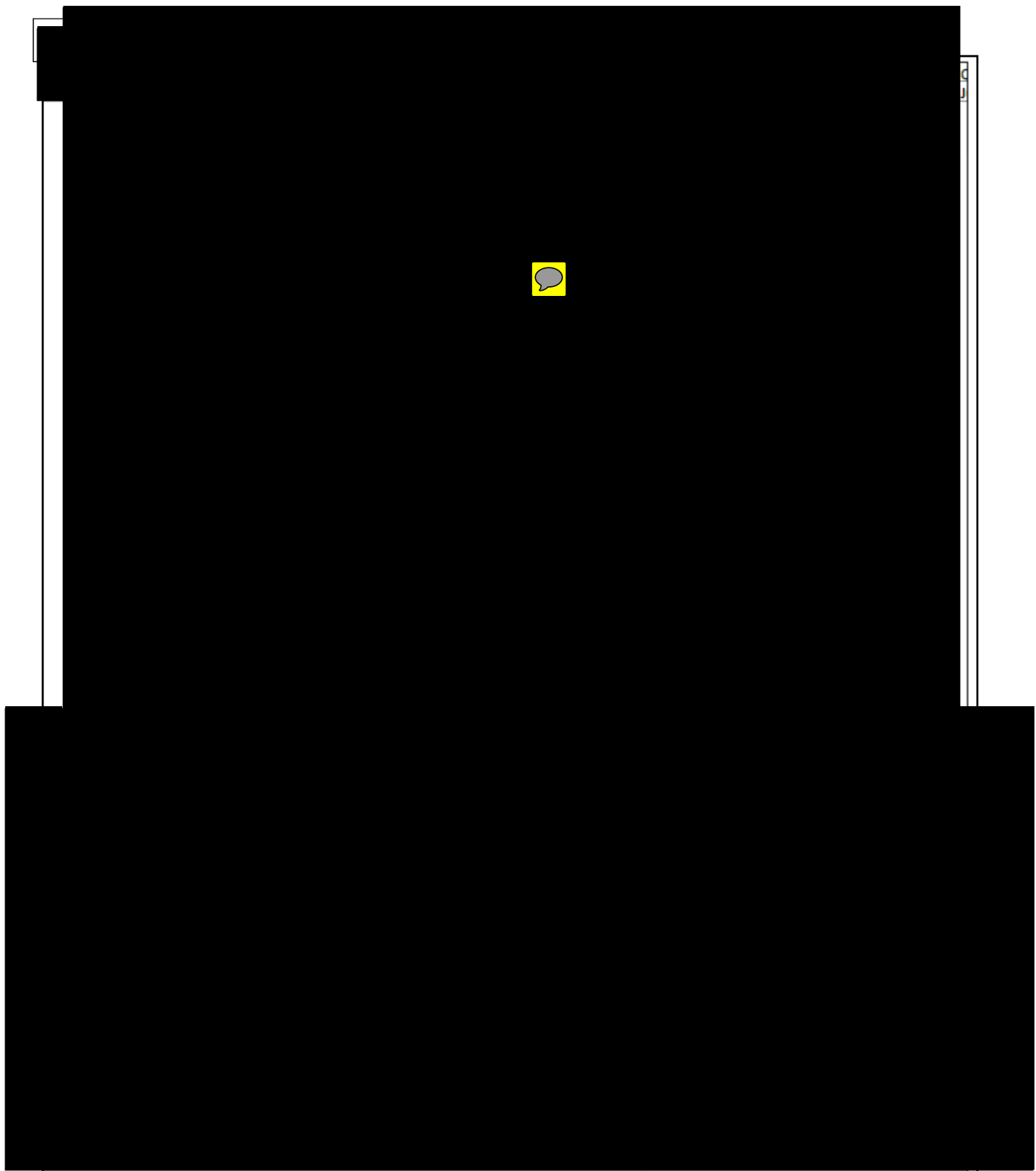
- Method statements received to date do not present how the stations will be excavated with the TBM tunnel in place, as the TBM 1st will require staging of the works accordingly. Similar applies for the station box concreting works, as the base slab will no longer receive the TBMs.
- Some excavation Method Statements are still pending approval Although NTA Had to approve them 56 days before the start of implementation. There are

discrepancies in the Tasks durations between the 10.7 and those presented in the various MSs. For example:

- Excavation works Allenby station MS shows 11 months; 10.7 shows 8 months.
- Similar also applies for Aba Hillel and Shaul Hamelech box excavation MS.
- 
- When/how the spoil conveyor and its support frame are installed & the staging to allow excavation under it. No mention for the installation and extension of the staircase either.
- The progress is highly restricted by the clam's single point of access from the top to provide at each excavation stage a start points for the excavators. Also, confusion with where the ramp is.

Additionally, NTA has not approved the excavation Method Statement (MS) and other future activities, such as Inner Box, Cross Passage, roads development and traffic arrangements above stations. Without Method Statement and a clear understanding of how these activities can be achieved as planned, there is risk on project completion date, to emphasize the importance of the MS we take one task:

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4.2. NARRATIVES

EMC received the PMC narratives.

The PMC's narrative was found reasonable, though no significant information was given as added value except to the changes and delays in all the significant packages in the project comparing 10.5 Sch (shown in the table above). The narrative presents the project status, construction sequence and different changes that were made between versions 10.6 and 10.7, as 10.6 is the baseline that NTA refer to.

4.3. Conclusions and Recommendations (with NTA response)

The report presents EMC analysis of the new schedule. The project status is updated and show delays in construction execution and tender time-table. This has result in a mitigation plan and change in the procurement strategy. Not all critical future tasks, such as King Piles, Cross Passages, roads development and traffic arrangements above stations are detailed. [REDACTED]

[REDACTED] The mitigation plan  introduced in the schedule are not yet finalized, for example expediting Rolling Stock deliveries are still under negotiation, similarly TBM 1st has not concluded the methodology for Cross Passages.


NTA's Response – It is not clear why EMC believes that activities such as landscaping or King Piles are Critical and need to be given special attention in the master schedule. Regarding the method statement, as explained in numerous comments above, the master schedule is built based on best information in hand. We will never have all method statements for future activities and therefore assumptions must be made.

Taking all in to account EMC believe that Schedule 10.7 is not complete and in its current version (10.7a) cannot be approved as the new baseline register.

[REDACTED] 
[REDACTED]
[REDACTED]
[REDACTED]

EMC recommendations are:

Complete and update Sch 10.7 according to EMC main comments, including:

[REDACTED]
[REDACTED]
[REDACTED] 
[REDACTED]
[REDACTED]
[REDACTED]

Furthermore, regarding future rates of Inner Box construction and the commitment of the contractors:

1. Generally, 10.7 master schedule is aligned with the durations for the Inner Box activities in the contractors' baselines.
2. In several stations, 10.7 even allows a longer duration for Inner Box construction than the durations in the contractors' schedule.
3. The contractor is committed to the contractual milestones set in each contract, which are earlier than the completion dates provided in 10.7. In cases the contractors is already experiencing delays, they are responsible to accelerate works and meet their contractual milestones.





Complete the Method Statement for activities on the Critical Path, such as Inner Box, Cross passages and landscaping.

NTA's response – Method Statements are required according to the contract only 56 prior of commencement of the activity. If NTA were to plan and schedule the project based solely on method statements, it would only have been possible to plan the only next year at best. A master schedule does not and can not be based only on method statements. in order to produce a master schedule for a mega project planning over 5 years ahead, one has to use the best information in hand, along with the experience of professionals who have managed or designed similar projects in the past, and produce assumptions that will eventually form the schedule.

The schedule should be officially accepted by all stakeholders, and after approval, NTA should declare schedule 10.7 as the base line register.

Appendices



4.4. ISSUES RAISED by EMC

Issue raised by EMC	Answers by NTA	EMC Response/Recommendation
<p>To review the 10.7 schedule EMC need to see all the current contractors' narratives demonstrating the contractors' commitment to 10.7.</p>		<p>The schedule is not detailing the mitigation plans. The risk register should be updated to present TBM (East JV+West Stations' contractor) changes (TBM1st) and contractor's commitments should be identified.</p>
<p>We would like to clarify how the average rate of concrete casting performance of 80-100 cubic meters per day is calculated within the space available within the stations</p>	<p>This is an average rate based on our experience from similar projects in similar conditions. The duration of inner box construction was indicated to the contractors, and the contractor has submitted a rate of 200 m3/day for the floor, 50 m3/day for the walls and 100 m3/day for ceiling. This rate supports the rates of 10.7.</p>	
<p>What are the provisions to supply and install heavy MEP equipment after roof slab casting? (Are there temporary openings in the roof slab?)</p>	<p>Access to the station will be possible through the ventilation openings located at both ends of the stations, the final construction of the ventilation openings will be carried out at the final stage after the introduction of the HVAC systems.</p>	<p>Noted</p>
<p>When will the King Piles be removed and what does this mean for traffic arrangements?</p>	<p>The columns should remain until the completion of the construction of the inner box as part of the internal support until the end of casting the ceiling. Dismantling of the king piles will be during the removal of the deck with the last traffic arrangement.</p>	<p>The King Piles though are temporary structures have a major effect on the work sequence in the station and should be introduced in the schedule and the impact of their removal on other tasks should be detailed.</p>
<p>According to the approved timetable the entrances are finished before the roof slab casting, while at 10.7 they are finished 8 months after casting the slab, how they enter the station?</p>	<p>Access through the openings shall still be possible during the construction of the entrances.</p>	<p>Noted. To be followed up in the updated schedule.</p>
<p>The sequence of concreting slab is related to constraints imposed by the platform slab (ST1650) and shoring for the heavy roof slab (ST1710)</p>	<p>A casting sequence has been assumed for 10.7, however the sequence may change according to contractor's methods that have not been produced yet. Furthermore, the design of the inner box is yet to be finalized.</p>	<p>The potential propping (scaffolding) required for concreting of the upper slabs down to the base slab may restrict the construction of the platform slabs and will impact the schedule. The sequence of works need to comply with the Design assumptions in order to ensure no impact to the Schedule.</p>

<p>The sequence of cross passage construction and TBM retrieval through bored tunnel</p>	<p>Explained in the narrative</p>	<p>Two different construction sequences are presented in the narrative (CP construction during and after TBM tunnel completion). Cross passage design and method statement status is understood not finalized. The relevant requirements need to be reflected in the schedule and impact to TBM tunneling, Cross Passage Construction, TBM dismantling, 1st stage concrete etc.</p>
<p>Fit Out activities must complete before trial running – no public allowed before station's PTO (Tofes 4)</p>	<p>Completion of all Fit-Out activities are preferable but not essential before trial running.</p>	<p>Details of fit-out works that can be executed during trial running need to be presented.</p>
<p>Potential delay risks from the cross passage (CP) construction is not thoroughly addressed: Reduced progress rates due to concurrent TBM tunneling; CP spoil and incoming material logistics through the overcrowded Galei Gill shaft; etc.); Risk from delayed TBM removal from within the tunnel; Risk delaying the 1st stage concrete and H.O. to SDAG; Risk delaying the stations until tunnel section within the stations can be safely demolished.</p>	<p>These risks are thoroughly addressed in the project's risk register.</p>	<p>EMC has no visibility over how the risks are managed.</p>
<p>Design Status is not discussed for the Cross passages & TBM tunnels interfaces (CW, systems, S&TC)</p>	<p>CP design is still being finalized. TBM Tunnel interfaces - TBM tunnels shall be handed over from Civils contractor to Systems contractor upon completion of boring and 1st stage concrete works. Systems contractor shall then act as the lead contractor, and shall provide access to S&TC contractor.</p>	<p>The relevant requirements need to be reflected in the schedule and impact to TBM tunneling, Cross Passage Construction, TBM dismantling, 1st stage concrete etc.</p>
<p>Construction: TBM tunnels: It is not explained if TBMs 3,4,5,6 shields are left in and if the last permanent tunnel section is constructed in-situ or alternatively how the erection of segment will be done if the shield enters the station box without face pressure.</p>	<p>This issue has not been finalized yet.</p>	<p>Noted.</p>
<p>Construction Stage C: Completion of D-wall construction prior to TBM arrival is not always possible (eg Shaul Hamelech). Stage C to include construction of tension piles and temporary pumping wells.</p>	<p>The completion of all the D-wall construction is indeed not possible in Shaul Hamelech before TBM arrival, however in order to have the TBM go through the station, not all D-walls are necessary, but only the head walls. Tension piles and pumping wells are considered part of D-wall & piles activity and are not addressed in the Master Schedule's level of detail.</p>	<p>Noted</p>

<p>Construction Stage G (CP construction) considers the 1st TBMs have completed boring to Carlebach and Ben Gurion respectively, disassembled and the logistics is removed. This is not reflected in the schedule (TBMs dismantling starts after each 1st cross passage construction commences). 1st stage concrete also to be in alignment with the CP construction.</p>	<p>The construction of the CPs can be done during or after completion of tunneling.</p>	<p>Since decision is still pending it is not understood why the most conservative assumption is not reflected in the schedule.</p>
<p>Stated 1st stage concrete rate of 20m/d in the narrative report is not in line with the schedule progress (presented as much higher).</p>	<p>The rate of 20 m/day refers to the rate used for post-TBM works after TBM contractor is done and not for 1st stage concrete, which is indeed in a higher rate.</p>	<p>Noted</p>
<p>The assumption of 300m welded rail installation is not applicable for the small track curve radii. Longer construction durations may apply (more in place welding activities). Points and crossovers will also have increased installation time and it is unknown if considered.</p>	<p>The assumption is for the average rates of rail installation and are considered reasonable.</p>	<p>Noted</p>
<p>[Redacted]</p>	<p>[Redacted]</p>	<p>[Redacted]</p>
<p>The delay potential of antiquities found during station excavation is not discussed and how this risk has been mitigated in planning.</p>	<p>This risk is addressed in the risk register, and considered to be with a very low probability.</p>	<p>EMC has no visibility over how the risks are managed.</p>
<p>Surface final reinstatement and city integration is not described as a discrete activity and if it forms a separate Contract.</p>	<p>There is such an activity under both TBMW and TBME sections named "Street Landscaping". However, the execution is not really linked to the general schedule, as it does not influence or is influenced by other activities. Furthermore, the details of the execution and the procurement strategy is yet to be finalized.</p>	<p>Noted.</p>
<p>What are the milestones for O&M, Systems and FO contractors (Design, interfaces)</p>	<p>All in the appropriate schedule WBS</p>	<p>Accepted</p>
<p>Review the Tilos Ben Gurion, Aharonovitz, and Yehudit are also on critical path. At grade south may also be on critical path given the fact that the links between track bed / track laying / Track surfacing aren't clearly explained and scheduled in P6 and not well specified on Tilos view. (Track laying before track bed, track surfacing not shown, and so on).</p>	<p>Please refer to the top 3 float paths schedule supplied as part of the 10.7 submittal.</p>	<p>The critical path received do not include track works and AG sections. The response is not justified.</p>

<p>Why doing TBM 1st in the East side, risking Aba Hillel & Bialik station progress</p>	<p>TBM First methodology generally prolongs the execution of the stations progress, however it does not impose a substantially higher risk to the stations. On the other hand, the risk of delays caused by station delays to the TBM drive using station first is considered to be higher. TBM first for TBMs 3 and 4 was preferred in order to reduce the level of risk and achieve quicker access to the systems contractor in the tunnels. However, the addendum for TBM First allows NTA to decide whether to go TBM First or Station First during excavation, and take the real-time decision according to the relevant station's progress.</p>	<p>Noted.</p>
<p>According to the optimistic task durations EMC concern is that Buffers are not enough</p>	<p>Please refer to the near critical buffer analysis supplied as part of the 10.7 submittal.</p>	<p>Not accepted.</p>
<p>What is the critical path without Carlilbach station? Why the TBM not part of the critical path?</p>	<p>Please refer to the top 3 float paths schedule supplied as part of the 10.7 submittal</p>	<p>The critical paths presented do not seem logical. For example, TBM #3-Bialik-Aba Hillel is presented as one of the critical paths, although TBM 4 finishes later than TBM 3 and excavation in these stations can only be completed after TBM 4 completion. Similar applies to the East package.</p>
<p>Did the RS contractor approve the new rate of the LRV's deliveries?</p>	<p>Negotiations with RS contractor regarding the modifications of the schedule is currently in negotiations</p>	<p>Noted.</p>
<p>We would like to receive NTA's response to the D'Appolonia report, and in particular regarding the reported discrepancy in quantities in the BOQ</p>	<p>It was not received because D'appolonia's report hasn't been finalized yet, and therefore obviously the comments for the report haven't been finalized either.</p>	<p>Pending item</p>
<p>Please also present in the P6 the preparation/assembly works of the Rolling Stock in the Depot</p>	<p>Noted. However, negotiation regarding updated RS schedule are ongoing with contractor, and therefore the update shall be updated once finalized.</p>	<p>Until negotiation feedback is available, reasonable assumptions need to be made in P6.</p>
<p>There is no baseline registered. NTA consider Schedule 10.6 as such, while EMC view that it is Schedule 10.5, which is the official approved schedule by both GOI and contractors.</p>	<p>10.5 was formulated in October 2015. 10.7 was issued in March 2017, almost 1.5 years later, and a lot have happened since. In between, 10.6 was issued in August 2016, and this is the schedule NTA has been working with until the issue of 10.7. Thus, the comparison between 10.7 to 10.5 is not relevant and does not reflect changes made in 10.7.</p>	<p>10.5 is the basis of the Civil Contractors' milestones & obligations. Therefore 10.7 needs to relate to the previously approved 10.5 schedule.</p>
<p>EMC analyzed Schedule 10.7 in comparison to the progress of works on site and the officially approved base line registered 10.5. This analysis concludes that a lower rate of execution than planned lead to extended construction of 11 months</p>	<p>It is not clear what they described delay of 11 months refers to</p> <p>TBM First construction sequence indeed prolongs in some cases the total duration of the Station Boxes construction, however the early launch of TBMs is also getting the tunneling activities to end earlier. Therefore, the statement in this sentence is only one side of coin.</p>	<p>Noted, the wording will be corrected the delay is in the D-walls execution as showed in 10.7 sch</p> <p>It seems that the tunneling advance rates as of today do not seem too much 10.7 expectation. EMC concern remains.</p>

		
<p>The Critical Path (CP) changed from station only to TBM tunneling and station works, which create risk that a small delay of TBM works lead to delay in stations, while street level works were omitted.</p>	<p>The TBMs were in the critical path also in the station 1st scenario. Previously TBM5&6 were in the critical path and now TBM3&4 are. The purpose of the TBM 1ST was to neutralize as much as possible the link between the tunnels & the stations and to commence the tunnels works as soon as possible. The critical paths are activities with 30 days or less of total float.</p> <p>Also, the comment regarding the street level works is unclear, since (1) it appears and has activities in Primavera and (2) it is nowhere near the critical path as it does not have any effect on revenue operations.</p>	<p>The file that supplied to EMC with top 3 float paths schedule as part of the 10.7 show TBM 3# only in the critical path. There is no reference to the east TBM that finish after. Additionally, TBM 4# finish after TBM 3# therefor it is unclear why 3# is critical?</p> <p>The intention was for the chain of tasks after casting the station roof slab such as backfill soil, relocate utilities, dismantling temporary deck ... EMC opinion these tasks prevent the access to the FO contractor into the technical rooms</p>
<p>The new procurement strategy of the SDAG and Fit-Out tenders and changes in early operation were not aligned and detailed in the schedule 10.7 and were only partly corrected in 10.7a.</p>	<p>NTA's response – The new procurement strategy for Fit Out was implemented in full already in version 10.7. The new procurement strategy for SDAG and the cancellation of early operations were implemented in 10.7A. It is not clear why EMC states it was only partially implemented. In any case, for SDAG split, since the change was between two tenders in 10.7 (1) C&C and (2) T&P combined into one "Systems" tender with the same dates and same activities it does not have any impact on the schedule.</p>	<p>Noted</p>
<p>NTA has not approved the excavation Method Statement (MS) and other future activities, such as Inner Box, Cross Passage and landscaping MS is missing. Without Method Statement and a clear understanding of how these activities can be achieved as planned, there is risk on project completion date.</p>	<p>NTA's Response - The contractor is required to submit MS only 56 days prior to construction. Therefore, there is obviously no way to produce a master schedule 5 years ahead based on approved method statements. In order to build a master schedule assumptions are made based on various sources of information and according to the best knowledge in hand to the certain point in time.</p>	<p>It is EMC understanding that a clear Construction Methodology Plan is agreed between NTA and the ongoing Contracts and therefore works sequence can be detailed in the Schedule.</p>

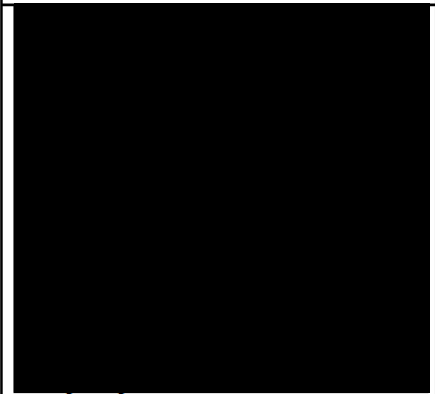


<p>Not all critical future tasks, such as King Piles, Cross Passages, Landscaping are detailed.</p>	<p>NTA's Response – It is not clear why EMC believes that activities such as landscaping or King Piles are Critical and need to be given special attention in the master schedule. The master schedule is a high level plan, and it cannot include every single activity (such as King Piles).</p>	<p>These activities have impact over the sequencing of works and need to be reflected in the schedule.</p>
<p>[Redacted]</p>	<p>[Redacted]</p>	<p>See above relevant comments.</p>
<p>Taking all in to account EMC believe that Schedule 10.7 is not completed and in its current version (10.7a) cannot be approved as the new baseline register.</p>	<p>NTA's Response – If NTA was to wait for all information to be in hand before approving a schedule, NTA would not be able to approve any schedule until the end of the project. 10.7A schedule is based on the best information in hand to this point in time and it is NTA's opinion that it reflects the project's schedule as foreseen today and that it should be approved as is.</p>	<p>The EMC believes that the "base line" of the project (10.5 Ver) as it was approved by the client. All other updates should be compared to that "base line" and could be called "update no__ to time table". NTA respond has nothing to do with the issue raised by EMC.</p>
<p>[Redacted]</p>	<p>[Redacted]</p>	<p>[Redacted]</p>

<p>The total project Buffer Days are not sufficient and should be increased in accordance to the changes in procurement strategy.</p>	<p>NTA's response – This sort of statement is correct for a project in its early stages, however for a project in this stage it is irrelevant. In this progressed stage of the project some of the buffers were naturally consumed and some not. NTA will manage with the current buffers left in the project in order to meet opening date</p>	<p>Not accepted. The project is still in his early stages! Just one task was start and still not finish with 1 month delay. All the critical tenders are still in process.</p>
<p>EMC request the detailed timetables for each contractor made by the local PMC</p>	<p>NTA's Response – Local PMC's schedule is an internal NTA document. 10.7 is the official schedule prepared by PMC for NTA and this is the relevant schedule for review</p>	<p>The local PMC is more close to the executions' problems/risks and the PMC believes that his opinion towards rate of performance is very important to better understanding of the 10.7 context.</p>
<p>EMC view that only the 10.5 schedule can be used as a reference (base line register – רישום בסיסי), since this is the last approved schedule and is the current Contractor's contractual obligation.</p>	<p>Thus, the comparison between 10.7 to 10.5 is not relevant and does not reflect changes made in 10.7. Furthermore, 10.5 does not reflect and is not the basis for the contractors' contractual obligations. 10.5 includes, just like 10.7, predictions that were made based on the best knowledge in hand at that time.</p>	<p>see above 48#</p>
<p>RS -Last Vehicle - October 2021</p>	<p>NTA's Response – First 3 LRVs not Correct – Arrival at Depot of LRVs 1,2,3 (activity ID A4420) – 10.5 May 2018 (correct); 10.7 September 2019.</p>	<p>not correct -Pls see again task A4420</p>
<p>TBM'S Completion of sub invert in all tunnels- June 2019</p>	<p>NTA's Response - The data is correct, however it shows the wrong picture. All tunneling except for Shenkar-Chamber section (~95%) are planned to be completed significantly earlier than in 10.5. completion of TBM5+6 are almost a year earlier. Showing a delay in TBM boring in the project is just wrong.</p>	<p>Noted.</p>
<p>, TBM#5 also passed with care under ISR railway line and Ayalon river. However, a continuous settlement of the rails, in particular the middle track has breached the safety trigger limits. The cause of this movement is not yet identified and mitigated. This is still in focus by all parties. TBM#5 has made a much faster progress than planned for crossing of the Ayalon Highway and the railway, since supporting piles of the Ayalon canal were not encountered to slow down the progress.</p>	<p>The settlement described in EMC's comments above are within the expected and designed range of settlements. The issue is being monitored and managed, and it is not considered an issue for concern. We request to remove this sentence from the report because by including it in a comment on the Master Schedule it appears to be a major issue when in fact, as explained, it is not.</p>	<p>It seems that presently the settlement has stabilized and therefore no longer considered a direct threat, although design limits have been exceeded.</p>
<p>. Due to the earlier passage at the stations, the continuity of works will stop until the TBM will finish its drive at the last station and will be taken out of the tunnel. EMC believe that TBMs are now part of the critical path.</p>	<p>1. TBMs were in 10.5 and still are in 10.7 on the critical path, so the point raised by EMC is not clear.</p>	<p>see above relevant comments.</p>
	<p>2. NTA believe that the rates used for TBM drive are very reasonable, and progress made so far supports this assumption.</p>	<p>Noted</p>
<p>The narrative report does not describe the assumptions of TBM construction (e.g. where TBMs have to stop, rate of progress within and outside of a station, how the average advancement rates used or how they were derived).</p>	<p>NTA's Response - The schedule indicates the average rates and the dates in which they are planned to reach the stations, so it is not clear what information is missing.</p>	<p>There is no explanation in the narrative of how the average rates were determined.</p>

<p>Project Buffer: A unique and single buffer to be used to protect the project deadline in case of global failure on the critical path, which is now existing between packages as a handover time and not at the end of the critical path.</p>	<p>NTA's response – This sort of statement is correct for a project in its early stages, however for a project in this stage it is irrelevant. In this progressed stage of the project some of the buffers were naturally consumed and some not. NTA will manage with the current buffers left in the project in order to meet opening date.</p>	<p>Not accepted. The project is still in his early stages! Just one task was start and still not finish with 11 month delay. All the critical tenders are still in process.</p>
<p>Feeding Buffer: Multiple buffers to protect the main parts of the CP for example a buffer between the utilities diversion and the start of station excavation, which exist in the schedule.</p>	<p>NTA's response – We do have such buffers in the handover points between the contractors. It was decided and approved based on Egis suggestion and PB analysis and running of Monte Carlo and implemented from v10.2 dated October 2013. Originally it was 6 months buffer. Part of it was consumed.</p>	<p>Not correct, The main handover buffers that in the sch are not the feeding buffers. Those buffer are the project buffer that split between the main packages.</p>
<p>Further review of the schedule shows that stations' works such as landscaping, final roads alignment and architectural finishing are not included. EMC believe that these works are on the critical path, because they are effecting the availability of stations' entrance to the beginning of Fit-Out works.</p>	<p>NTA's response – The activities mentioned above are not on the critical path.</p>	<p>see above relevant comments.</p>
<p>Review of the Critical Path (CP) shows that it changed from station only as was in 10.5 Schedule to TBM tunneling and station works. This create a risk that a small delay of the TBM works may lead to a delay in all the stations on the TBM section of the line. For example, If TBM#6 need to stop for a longer period before Shaul Hamelech, it affects the works of all underground stations between Arlozerof and Carlibach. and will put Arlosorof station on the critical path</p>	<p>NTA's response – The TBMs were in the critical path also in the station 1st scenario. Previously TBM5&6 were in the critical path and now TBM3&4 are. The purpose of the TBM 1ST was to neutralize as much as possible the link between the tunnels & the stations and to commence the tunnels works as soon as possible. Arlosorof station is not on the critical path according to 10.7.</p>	<p>see above relevant comments.</p>
<p>14 Days Buffer Provision Task B1690 "Handover TBM 5-6 to SDAG - Galei Gil to Carlibach - Axes 1 & 2 (inc. GG)": this task is not shown in the Buffers list of the 10.7 Narrative Report although it is protecting the CP.</p>	<p>NTA's response – The narrative indicates only the buffers which were consumed! Not necessity the ones on the critical path.</p>	<p>Noted</p>
<p>During the 24 months of project works almost 50% of the buffers days were already used. EMC opinion is that the present available BD is not sufficient and should be increased to at least 10% of the remaining works, which can be computed as approximately XX% increase in project BD. Those additional BD should be put as a separate Project Buffer at the end of the construction works.</p>	<p>NTA's response – Not accurate, ~30% of the buffers were consumed and not 50% as stated by EMC. Please refer to the table under "3.6 – COMPARISON 10.5 VS 10.7"</p>	<p>Noted, the wording will be corrected</p>
<p>Method statements received to date do not present how the stations will be excavated with the TBM tunnel in place, as the TBM 1st will require staging of the</p>	<p>1. The method in which the excavation will be performed after tunneling can be found in the technical report he provided for TB First.</p>	<p>Noted.</p>

works accordingly. Similar applies for the station box concreting works, as the base slab will no longer receive the TBMs.	2. As mentioned before, method statements need to be submitted 56 before actual works commence. The excavation stage that deals with the dismantling of the tunnel lining in further ahead in the plan.	see above relevant comments.
When/how the spoil conveyor and its support frame are installed & the staging to allow excavation under it. No mention for the installation and extension of the staircase either.	NTA's response – the engineer requires MS for all activities deemed necessary by the engineer. This does not mean that every small activity has a MS. Installation of spoil conveyors will be covered by a separate safe work MS and risk assessment.	Accepted provided that relevant temporary works durations are considered in the excavation rates. However, the excavation rates presented see too optimistic as commented above.
The progress is highly restricted by the clam's single point of access from the top to provide at each excavation stage a start point for the excavators. Also, confusion with where the ramp is.	NTA's response – noted, although taken into consideration in the overall duration. Not clear what EMC's confusion is regarding the ramp.	As above.
For Allenby station MS tentative program is in 6 months delay whilst theoretically the 3rd strut stage should have been reached.	NTA's response – there is no delay in Allenby compared to 10.7 program.	The comparison should be with 10.5 sch and not 10.7
These mitigation plans are still under negotiations with the contractors, so obviously, no contractors' commitment yet.	1. The contractor is committed to the contractual milestones set in each contract, which are earlier than the completion dates provided in 10.7. In cases the contractors is already experiencing delays, they are responsible to accelerate works and meet their contractual milestones.	At least the relevant contractors should agree.
Increase the total project Buffer Days – which are not sufficient and should be increased in accordance to the changes in procurement strategy to at least 10% of the duration of the remaining activities on the critical path.	1. This is a very general comment, without any real methodology or basis standing behind it, and seem to be based on gut feelings.	In order to calculate the buffer days required until the end of the project, NTA must to do a new risk analysis containing the risks due to the changes in the method of construction and procurement strategy, in the new analysis, NTA need to remove the risks that have already passed. The determination of NTA that the red line project is in advanced stages not accepted by EMC for the following reasons: • A year and a half from the start of the project the first construction stage in the project (D-walls) is not finish yet and in 11-month delay • The main Tenders are not published yet and in a major delay
	2. This sort of statement could be correct for a project in its early stages, however for a project in this stage it is irrelevant. In this progressed stage of the project some of the buffers were naturally consumed and some not. NTA will manage with the current buffers left in the project in order to meet opening date.	
[REDACTED]	NTA's response – NTA agrees that 10.7 should become the new baseline for the project. [REDACTED]	[REDACTED]

		
	We believe that this is a reasonable rate.	Noted.
(b) Herzl to Carlibach (drive 8 & 7) and Galei Gil to Carlibach (drive 6 & 5) - Construction of sub-invert: Dismantling of TBM starts one day before 1 st stage concrete to tunnels. TBM retrieval through the tunnel (2months) and removal/cleaning of temporary services in tunnel are not considered. 1 st stage delay two months.	The construction for Sub-invert in TBM 7-8 axes is driven by: 1. Dismantling of TBM8, starting after the completion of dismantling. 2. Starting with the beginning of TBM7 dismantling, which is possible since it will be dismantled in Carlebach shaft and not back from Herzl shaft.	Noted.
(a) Particular activities & durations for D-wall panels construction for the TBM #6 break-in/out headwalls are not presented. (64+64 No. D-walls equally divided as before and after TBM arrival).	The split of the 2 stages in Primavera was made before TBM first and therefore assumed half to be done in each stage. The number of D-walls in the activity's name was indeed not adjusted, however the duration is according to before and after TBM crossing the station.	Noted
(b)The activity of pumping wells and tension piles construction in the TBM#6 axis is not clearly presented.	Pumping wells are continuous activities throughout the excavation period. It is an internal time within the excavation. Tension piles are consistent with the D-wall activity.	Noted.
TBM#8 is launched 1 day later (17-Oct-17). Activities in the adjacent tunnel eye and the #8 frame may conflict resulting to delay.	There are almost 3 months between the launches of TBM8 and TBM7, allowing sufficient time to accommodate confictions with TBM8 working simultaneously. TBM6 and 5 were launched in a less than 2 month difference so we are confident that it is sufficient time.	Noted.
(a) It is not understood what CP16 and 16A are (presented to be in the same location Ch.20+197). Is it approached by the two TBM tunnels at different timings?	The description in Primavera is not correct. They are 2 different CPs, so of course not on the exact same chainage. The wrong description does not effect the schedule.	Noted.
(b) further to (a), how is it planned to implement grouting to 16A at the same time that construction is already started at CP16?	As stated above, the two CPs are not in the same location, so grouting can be done in one while constructing the other. The grouting in these CPs is done from within the tunnel.	Noted.
(c) Two different chainages are shown for CP the locations. Please confirm correct chainage positions.	All CP chainage locations to be amended. However, this does not effect the schedule.	Noted.
For a few sections, namely between Yoseftal and Balfour, track laying seems to be done before track bed. (Tilos view). As a whole, Track laying is not detailed in P6, and the links between track bed / track laying / Track surfacing aren't clearly explained and scheduled. The phasing and construction method should be explained.	This is a level of effort activity that represents in a broad brush the track laying activity. The contractor (once awarded) will be able to choose where to start according to access given.	Need to fix the P6 file

<p>NTA published a tender for the detailed design 4/4/17 meaning no start of infra 1 works of AG east possible in Feb 2018</p>	<p>The tender of detailed design is planned to be awarded early June, leaving 6 months for design of the first section. The construction shall be carried out by framework contractors, so procurement period should be short and therefore February is possible.</p>	<p>Noted</p>
		
<p>Activities related to the cross-passage construction mobilization/demobilization, such as installation of temporary works, ramps, services etc., and related delays to the TBM due to cross passage construction, are not presented.</p>	<p>The schedule is a high level Master Schedule that does not go into this kind of breakdown. The overall duration is sufficient to accommodate sub-activities.</p>	<p>As above.</p>
<p>H.O. to SDAG unclear if done for both axes of a tunnel stretch at the same time and for all intermediate sections between stations of a drive.</p>	<p>Systems tender is yet to be finalized, and therefore the exact method of access (each axis separately or both together) is yet to be determined</p>	<p>Noted</p>
<p>Breakdown of NATM tunnel construction activities is not detailed to support the duration presented.</p>	<p>The schedule is a high level Master Schedule that does not go into this kind of breakdown. The overall duration is sufficient to accommodate sub-activities.</p>	<p>EMC view is that the NATM Construction duration is underestimated.</p>
<p>Waterproofing system installation for the complete station/tunnel containment is not presented (this should present slack allowed for D-wall repairs/subgrade preparation).</p>	<p>The schedule is a high level Master Schedule that does not go into this kind of breakdown. This is a part of the inner box activity. The overall duration is sufficient to accommodate sub-activities.</p>	<p>Station box concreting works duration already seem to be low without the additional activities such as the waterproofing works. Therefore the response is not accepted.</p>