



Emergency Preparedness Plan (EPP)

Embankment B088/EM4 Kingsbury to Queensbury

Jubilee Line

Date: October 2014

Document Number:

TLL-B087-P855-EST-PLN-00001

Note: This document relates to the planned 'Risk ALARP' monitoring of embankment B088/EM4. Kingsbury to Wembley Park. It details the actions that will be taken should certain monitoring trigger levels be exceeded.

This is a "live document" and will be updated as, and when, new information becomes available. Version control will be maintained through LU COP PDP ES Management System.

DOCUMENT REVISION HISTORY

Issue	Status	Reason for Amendment	Date
R1	First Issue	Issued for Comment	14.10.2014
R2	Second Issue	Addressed LDE comments.	28.10.2014
R3	Third Issue	Addressed PPWA Engineer comments.	11/12/2014



DOCUMENT APPROVAL

Created by:	Joseph Kennedy
Role:	LU CPD PDP, Discipline Engineer (Earth Structures)
Signature:	[Redacted Signature]
Date:	11/12/2014
Authorised by:	Athanasios Papachrysanthou
Role:	LU CPD PDP, Lead Discipline Engineer (Earth Structures)
Signature:	[Redacted Signature]
Date:	11/12/2014
Authorised by:	Kevin Stoakes
Role:	LU CPD PDP, Civil Asset Engineer
Signature:	[Redacted Signature]
Date:	11/12/14
Authorised by:	Ismail Suleyman
Role:	LU AP JNP, Civil Asset Manager
Signature:	[Redacted Signature]
Date:	18/12/14
Authorised for issue by:	Sean Tarrent
Role:	LU CPD PDP, Principal Permanent Way Asset Engineer
Signature:	[Redacted Signature]
Date:	19/12/14
Endorsed by:	Jed Crossfield
Role:	LU CPD PDP Track Availability Manager - GMI - Jubilee Line Track Maintenance
Signature:	[Redacted Signature]
Date:	18/12/14



Consultation:

Name	Company	Title	Review Date
Athanasios Papachrysanthou	LU CPD PDP	Lead Discipline Engineer	28/10/2014
Kevin Stoakes	LU CPD PDP	Civil Asset Engineer	27/11/2014
Ismail Suleyman	LU AP JNP	Civil Asset Manager	18/12/2014
Sean Tarrant	LU CPD PDP	Principal Permanent Way Asset Engineer	19/12/2014
Jed Crossfield	LU CPD PDP	Track Availability Manager GMI - Jubilee Line Track Maintenance	18/12/2014

Distribution:

Name	Company	Title / Directorate
As Above +		
ES Team	LU CPD PDP	-



Table of Contents

1.	GLOSSARY-----	5
2.	PURPOSE -----	6
3.	BACKGROUND-----	7
4.	DESCRIPTION OF THE CURRENT SITUATION -----	9
5.	INSTRUMENTATION AND MONITORING REGIME -----	10
6.	RESPONSE PREPAREDNESS-----	12
7.	ACTIVATION AND DEACTIVATION OF THE PLAN -----	13
8.	TRIGGER LEVELS -----	14
9.	ACTIONS IN THE EVENT OF A CHANGE IN STATUS -----	25
10.	RESPONSIBILITIES-----	30
11.	RECOVERY PLAN-----	31
12.	REFERENCES-----	32
APPENDIX A – ASSET LOCATION PLANS-----		33
APPENDIX B – COMMUNICATION DIRECTORY -----		36
APPENDIX C – CHECKLIST FOR ERP / EMRP MEETING-----		37
APPENDIX D – EMERGENCY RESPONSE - EPP-----		38



1. Glossary

Abbreviation	Meaning
DOE	LU JNP Duty Operations Engineer
EPP	Emergency Preparedness Plan
EMRP	Emergency Engineering Review Panel
ERP	Engineering Review Panel
ERU	Emergency Response Unit
ERU DM	Emergency Response Unit Duty Manager
TSR	Temporary Speed Restriction
LU	London Underground
LUCC	London Underground Control Centre
RDO	LU Rostered Duty Officer
CAE	Civil Asset Engineer
CAM	Civil Asset Manager
LU COP PDP	London Underground – Capacity Optimisation Programme – Programme Delivery Partnership
AP - JNP	Asset Performance - Jubilee, Northern, Piccadilly
ES	Earth Structures
ALARP	As Low As Reasonably Practicable
ESA	Earth Structure Assessment
ACA	Asset Condition Assessment
DSP	Dual Standpipe Piezometer
PGM	Survey Permanent Ground Marker



2. Purpose

This 'site specific' Emergency Preparedness Plan (EPP), is for embankment B088/EM4, between Kingsbury to Wembley Park Stations, on the Jubilee Line.

The purpose of this document is to present guidelines to ensure the Earth Structure Asset is kept safe and the risk to the earth structure, track furniture, cable runs, and track is maintained 'Risk ALARP'. This EPP formalises the process of reviewing the monitoring data obtained in the 'Risk ALARP' monitoring.

The EPP defines the monitoring process, trigger values and their associated actions. It defines the roles and responsibilities of all parties involved with this activity and how LU COP PDP will manage a number of potential scenarios, which may develop if trigger values are exceeded.

A 'site specific' EPP is required for embankment B088/EM4, due to geotechnical monitoring installations installed on the embankment breaching the 'Amber' trigger level, as defined in the Earth Structures Assessment – EPP (ESA-EPP) [5].



3. Background

3.1 Embankment Description

Embankment slope B088/EM4 is located adjacent to the southbound Jubilee Line track from LU LCS chainages B088/JSB1070 to JSB1615. It has a total length of approximately 545m and is located between Kingsbury and Wembley Park Stations. The asset location plans are presented in Appendix A.

The slope form is variable along the embankment length and reaches a maximum height of approximately 7m-8m at chainage JSB1615, before reducing in height to the north until it reaches natural ground level at chainage JSB1070. The embankment slope has an approximate angle of 20° to 25° and is generally split into two slopes by a mid-slope terrace, with an approximate slope angle of 2° to 10°.

The embankment has a clay core, with ash at the crest and shoulders. It has been constructed on thin layers of Relic Topsoil and Alluvium, overlying the London Clay Formation.

3.2 Previous History

The embankment has a history of poor track performance and slope instability, with records of slope failure and constant track maintenance. It has undergone embankment remediation on a number of occasions, which have generally been unsuccessful in stabilising the embankment and stopping the seasonal track deformation.

3.2 Recent History

In September 2012, a track team reported possible movement of the cable run around chainage JSB1345, on embankment B088/EM4. An LU COP PDP ES engineer immediately inspected the embankment and identified tension cracks, cable run deformation, toe movement and waterlogging at the toe. Each of these observations indicated potential deep-seated slope instability between chainages JSB1340-1370.

As a result of these observations, LU COP PDP installed geotechnical monitoring instrumentation at four transects spaced along the embankment and centred on the area of potential slope instability. Geotechnical monitoring instrumentation comprised of survey permanent ground markers (PGM's), duel standpipe piezometers (DSP's) and inclinometers. Monitoring of these instruments was then undertaken once every four weeks, with the results interpreted and checked against the ESA-EPP [5], which defines trigger levels and associated actions to ensure early response to any potential slope movements.

During the record breaking wet winter of 2013-2014, inclinometers installed in the area of potential slope instability began showing evidence of deep-seated slip surfaces, which accelerated in movement during the wet winter months. The duel standpipe piezometers also recorded very high piezometric levels within the embankment.



In July 2014, during a routine inspection following inclement weather, possible enlarging of tension cracks at the crest of the embankment was noted. This was likely due to the shrinkage of the cohesive Made Ground in which the cracks have formed, however, based on the results and observations obtained over the first year of monitoring, it was decided that an 'Emergency Earth Structure Assessment / Design' should be undertaken.

This report was completed in August 2014 [7] and covered the area between JSB1340-1370. It assessed the embankment stability and investigated potential emergency remedial solutions.

A subsequent full analytical assessment was undertaken in September 2014 [8], which covered the entire embankment.

The outcome of these assessments found that monitoring showed a range of deformation mechanisms are taking place. Inclinoimeters have recorded movement at depth within the embankment, indicative of deep-seated slope failure. PGM's and inclinometers have also recorded shallow instability in the form of soil creep and seasonal shrink/swell of the cohesive embankment fill, leading to serviceability instability and poor track performance. Finally, DSP's are recording an elevated piezometric level in the embankment during the wet winter months.

Long-term slope stability analysis and Asset Condition Assessment (ACA) Classification has been carried out to Level 3 - analytical assessment. The earth structure has been classified as 76% E2 (Poor), 14% D (Poor) and 10% A (Serviceable), as summarised in Table 1 below.

Table 3.2: Summary of Estimated ACA for Embankment B088/EM4 [8]

Earth Structure	Chainage (m)	PI Condition Score (%)	Date of Latest PI	Actual Global FoS for Deep-Seated Slope Stability*	Extrapolated Global FoS for Deep-Seated Slope Stability**	Level 3 Assessment	
						Assessment Classification	Condition Category
B088/EM4	JSB1100	75	Aug 2014	1.39	1.64	A	Serviceable
	JSB1125	-	-	1.31	1.54	A	Serviceable
	JSB1150	-	-	1.03	1.21	D	Poor
	JSB1199	40	Mar 2014	1.02	1.20	D	Poor
	JSB1345	-	-	0.88	1.04	E2	Poor
	JSB1360	35	Mar 2014	0.90	1.06	E2	Poor
	JSB1600	65	Mar 2014	0.99	1.17	(C) E2***	Poor
	JSB1605	-	-	1.16	1.37	(B) E2****	Poor

* Target global FoS of >1.10 is required for deep-seated slips when using the LU Earth Structures Design Guide.

** Extrapolated to a target global FoS of >1.30 to correlate with LU Standard 1-054 A3.

*** Categorised as E2 owing to deep-seated movement recorded on the inclinometer at this transect.

**** Categorised as E2 owing to the progressive failure of wall W670.



4. Description of the Current Situation

On the 2nd October 2014, an emergency engineering review panel (ERP) meeting was called by LU COP PDP ES team due to inclinometers installed on the embankment, breaching the 'Amber' trigger level, as defined in the ESA-EPP [5].

In response to the 'Amber' trigger level breach, the following actions have been instigated:

- Production of a site specific EPP for embankment B088/EM4, as this document will become.
- Geotechnical instrumentation monitoring frequency has now been increased to once every two weeks. Results will be interpreted immediately and checked against new trigger levels defined in this document, with site specific actions.
- Installation of three additional inclinometers to ensure more comprehensive coverage of the entire embankment. Once installed, these will be monitored against trigger levels defined in this document.
- Visual inspections have now been increased to once every two weeks; with results reported back to the LU COP PDP ES team.
- Track monitoring has been instigated, with a frequency of once every two weeks. Results will be interpreted and checked against new trigger levels defined in this document, with site specific actions.

The embankment has been selected for remediation, however, until these works can be implemented, the embankment will be monitored closely to ensure it continues to be in a 'Risk ALARP' condition. At the time of writing this document, it has been agreed that the embankment currently has an 'AMBER' status.



5. Instrumentation and Monitoring Regime

As discussed in Sections 3-4, geotechnical and survey monitoring instrumentation has been installed, with the function of monitoring groundwater levels, track movement, and slope movement within the embankment.

5.2 Embankment Monitoring

An embankment monitoring strategy has been developed for embankment B088/EM4. All instruments detailed below are monitored at a frequency of once every two weeks. All data is collated and interpreted immediately by the LU COP PDP ES team to identify trends and possible evidence of earth structure instability.

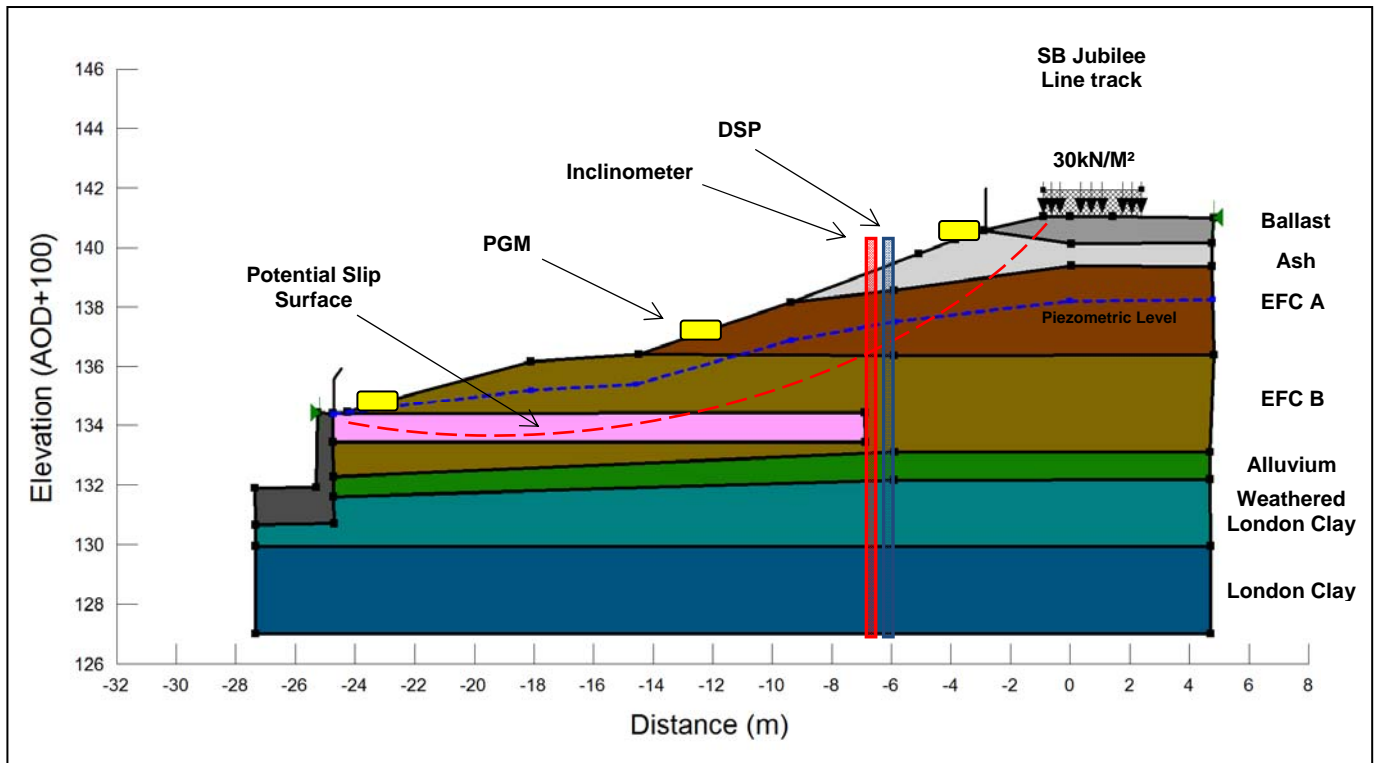
Permanent Ground Markers (PGM's): Basic instrumentation in the form of PGM's are used to monitor ground movements and are generally installed at the crest, upper mid-slope, mid-slope, lower mid-slope and toe of the embankment (Figure 1). Depending on the slope height and geometry, additional PGM's have been installed to allow complete monitoring of the slope profile. Retaining structures also have monitoring points installed at various locations on the structure. The PGM's are monitored by the LU COP PDP survey team and the results supplied to the LU COP PDP ES team on an excel spreadsheet. The results are plotted into graphical format for review.

Dual Standpipe Piezometers (DSP's): Intermediate instrumentation in the form of DSP's are used to monitor piezometric levels and pore water pressures within the embankment. They have been installed on the upper slope and comprise a deep piezometer tip, located approximately 1m beneath the embankment and a shallow piezometer tip, located approximately within the embankment core (Figure 1). The DSP's are monitored by the LU COP PDP ES team and the results stored on an excel spreadsheet and plotted into graphical format for review.

Inclinometers: Detailed instrumentation in the form of inclinometers are used to monitor slope movements and are installed on the upper slope (Figure 1). The inclinometers are monitored by the LU COP PDP ES team and the results stored on an access database and plotted into graphical format for review.

Visual Inspections: Monitoring will also take the form of visual inspections of the retaining structures, embankment slope, and cabling furniture. These will be completed once every two weeks. They will be completed by an LU COP PDP ES team member (Safety Critical Licensed Personnel, TC001). The retaining structures, embankment slope and cabling furniture will be inspected to check for any signs of slope instability and the condition reported and recorded on a register, which is managed by the LU COP PDP ES team.

Figure 5.2: Ground Model and General layout of Embankment Geotechnical Monitoring Instrumentation



5.3 Track Monitoring

A track monitoring strategy has been developed for the southbound Jubilee Line track, across embankment B088/EM4. It has been proposed that only the southbound Jubilee Line track on the embankment is monitored, without significant extension beyond the earth structure limits. The track category for this embankment is Track Type A.

Track Survey Monitoring: Track survey monitoring will be undertaken by the LU COP PDP survey team. The track will be base-lined three times before monitoring commences at a two week frequency. Track monitoring will be undertaken to within a 5mm accuracy (x, y, z), with results presented on an excel spreadsheet for interpretation and review of the following:

- 2m twist;
- 10m twist;
- Vertical deviation of track;
- Horizontal deviation of the track;

Amber Survey Trolley: Track monitoring using an Amber Survey Trolley will be undertaken on a monthly basis, with an initial baseline survey. This survey will be supported by scheduled cab rides and TRV frequency.



6. Response Preparedness

The responsibility for maintaining the current status of the EPP will rest with the Civil Asset Engineer (CAE), Civil Asset Manager (CAM) and the LU COP PDP ES team. After each monitoring visit, the results will be reviewed and any trigger level breaches recorded on a trigger level breach log. Actions will be taken thereafter as detailed in Tables 8.1-8.6, depending on the status of the breach.

To be prepared to instigate the trigger level actions defined in Tables 8.1-8.6, the LU COP PDP ES team must have the capacity to undertake the following actions at all times:

- Increase the monitoring of the track, inclinometers, DPS's and PGM's, should a higher frequency than once every two weeks be required.
- Install additional monitoring installations if required.
- Undertake a detailed site inspection within 24 hours of YELLOW²/AMBER status breach and immediately following a RED/BLACK status breach
- Call an Engineering Review Panel meeting within 24 hours of an AMBER status breach.
- Call an Emergency Review Panel meeting within 2 hours of an RED status breach.
- Following a BLACK status breach, call an Emergency Review Panel meeting within 2 hours and conform to the Earth Structures – Emergency Response EPP (Appendix D).



7. Activation and Deactivation of the Plan

This EPP will be active throughout any period of 'Risk ALARP' monitoring of embankment B088/EM4.

The EPP will remain active until either:

- It has been determined through monitoring, observation and assessment, that the Earth Structure Asset is considered to be in safe and stable condition and no further embankment instability is recorded.
- Remedial works are undertaken to stabilise the embankment and confirmed through one year post-construction monitoring that they have been successful.

The EPP cannot be deactivated without the joint consent of the Civil Asset Engineer (CAM), Civil Asset Engineer (CAE) and the LU COP PDP ES team.



8. Trigger Levels

As discussed in Section 2, the aim of this EPP is to provide a process for reviewing the monitoring data obtained from 'Risk ALARP' monitoring of embankment B088/EM4.

It is not possible to adopt the same trigger level values for the basic, intermediate and detailed embankment monitoring instrumentation, along with retaining structures and track monitoring. As a result, different trigger values will be used for PGM's, DSP's and inclinometers, as well as retaining structures and track monitoring. At the time of writing this EPP, monitoring instrumentation installed on some ESA sites have undergone over two years of monitoring [1,2]. This data has been reviewed, along with engineering judgement and written literature, to define the trigger level values.

8.1 Inclinometers

Upon review of current available monitoring data for all ESA sites [1], it has been noted that inclinometers installed in cohesive materials can record natural seasonal movements associated with swelling during wet periods and shrinkage during dry periods. This movement is confined to the upper 1.5m-3.0m of the slope, depending on the type and density of vegetation at the surface. This agrees with documented research by O'Driscoll (1983) [3] who found that slopes with light vegetative cover experienced seasonal influences up to 1.5m below ground level and heavily vegetated slopes up to 5m below ground level. Beyond the influence of these seasonal processes, movement in cohesive slopes is not expected to be recorded at depth and can reasonably be attributed to potential slope failure. To be conservative, different trigger level values will be used above and below 1.5m, to ensure early warning of potential slope failure, whilst compensating for expected seasonal movements.

In the top 1.5m, a difference of up to 20mm of horizontal movement has been recorded between summer and winter periods, by inclinometers installed in cohesive materials. Below this level, movements reduce with depth to the expected margins of error for the inclinometer probe instrument. This is in agreement with the BRE Digest 412 (1996) [4], which reports that maximum swell/shrink movements will occur at the surface and reduce with depth, until the soil is no longer influenced by seasonal processes.

Taking the above into consideration, the conservative YELLOW¹ status will adopt a >20mm horizontal movement trigger value in the upper 1.5m, but reduce to a 5mm trigger value below 1.5m. These values will ensure movements above what is expected through seasonal processes are captured early and investigated.

The YELLOW² status will adopt a >25mm horizontal movement trigger value in the upper 1.5m, but reduce to an 8mm trigger value below 1.5m. This will allow further movement to be scrutinised prior to higher trigger level actions being instigated.

The AMBER status will adopt a >30mm horizontal movement trigger value in the upper 1.5m, but reduce to a 10mm trigger value below 1.5m, as movement beyond this is deemed to be indicative of potential slope failure and suitable action may be required.



The RED status will adopt a >50mm horizontal movement trigger value in the upper 1.5m, but reduce to a 30mm trigger value below 1.5m, as movement beyond this is deemed to be potential slope failure and suitable action is now required. More importantly, the change in rate of movement will be monitored, with an increase of +40% movement from the previous reading defined as a breach of the RED trigger level.

The BLACK status will not adopt a value for total/rate of monitored movement. This trigger level will be defined through interpretation of the monitoring results by a suitably qualified ES engineer, indicating an accelerating rate of movement which is indicative of imminent failure.

Table 8.1: Summary of Inclinator Trigger Level Values on Embankment B088/EM4

<u>Depth (m)</u>	<u>Green</u>	<u>Yellow¹</u>	<u>Yellow²</u>	<u>Amber</u>	<u>Red</u>		<u>Black</u>
0.00 – 1.50	<20mm	20mm	25mm	30mm	50mm	+40% increase	Acceleration in rate of movement indicative of imminent failure.
>1.50	<5mm	5mm	8mm	10mm	30mm	+40% increase	



8.2 Survey Permanent Ground Markers

Upon review of current available monitoring data [2], it has been noted that survey ground markers installed in cohesive materials can record seasonal movements, as described in Section 8.1. As a result of their installation on the slope surface, they record both horizontal and vertical movements which are higher than those recorded by inclinometers. This is in agreement with the BRE Digest 412 (1996) [4] which reports that maximum swell/shrink movements will occur at the surface and reduce with depth until the soil is no longer influenced by seasonal processes.

A difference of up to 50mm horizontal/vertical movement has been recorded between summer and winter periods by survey ground markers installed in cohesive materials. This agrees with documented research by O'Driscoll (1983) [3] who conservatively estimates that ground surface movements of between 50mm - 100mm seasonally could be recorded in the south east of England. Survey ground markers are also susceptible to other shallow surface influences such as root growth, burrowing and external damage.

Taking the above into consideration, the conservative YELLOW¹ status will adopt a >50mm horizontal/vertical movement trigger value to ensure movements above what is expected through seasonal processes are captured early and investigated.

The YELLOW² status will adopt a >80mm horizontal/vertical movement trigger value to allow further movement to be scrutinised prior to higher trigger level actions being instigated.

The AMBER status will adopt a >90mm horizontal/vertical movement trigger value, as movement beyond this is deemed to be indicative of potential slope failure and suitable action is may be required.

The RED status will adopt a >100mm horizontal/vertical movement trigger value, as movement beyond this is deemed to be indicative of slope failure and suitable action is now required.

The BLACK status will not adopt a value for total/rate of movement. This trigger level will be defined by interpretation of the monitoring results by a suitably qualified ES engineer, indicating an accelerating rate of movement which is indicative of imminent failure.

Table 8.2: Summary of PGM Trigger Level Values on Embankment B088/EM4

<u>Green</u>	<u>Yellow¹</u>	<u>Yellow²</u>	<u>Amber</u>	<u>Red</u>	<u>Black</u>
<50mm	50mm	80mm	90mm	100mm	Acceleration in rate of movement indicative of imminent failure.



8.3 Duel Standpipe Piezometers

Groundwater levels fluctuate depending on the season and amount of rainfall over a period of time. As a result, piezometric levels recorded within a slope can change over time. Piezometric levels are critical to slope stability, as higher levels increase pore water pressures and reduce soil strength leading to slope failure. Embankments are typically constructed on top of original ground level and therefore are not expected to have a natural piezometric level within the embankment (Figure 2). Any recorded piezometric level within the embankment above the toe, reduces the earth structures stability and could lead to failure.

The assessment report has plotted the first year of DSP monitoring, which included the record breaking wet winter of 2013-2014 [6]. The results from this monitoring showed that worst case, the groundwater rises from within the Alluvium beneath the embankment, to within approximately 1m from the Ash/EFC interface. Analysis has shown that this has a significant effect on the embankment stability, therefore, the groundwater levels adopted for the DSP monitoring trigger levels, are intended to raise the risk of earth structure failure and implement actions to monitor this increased risk.

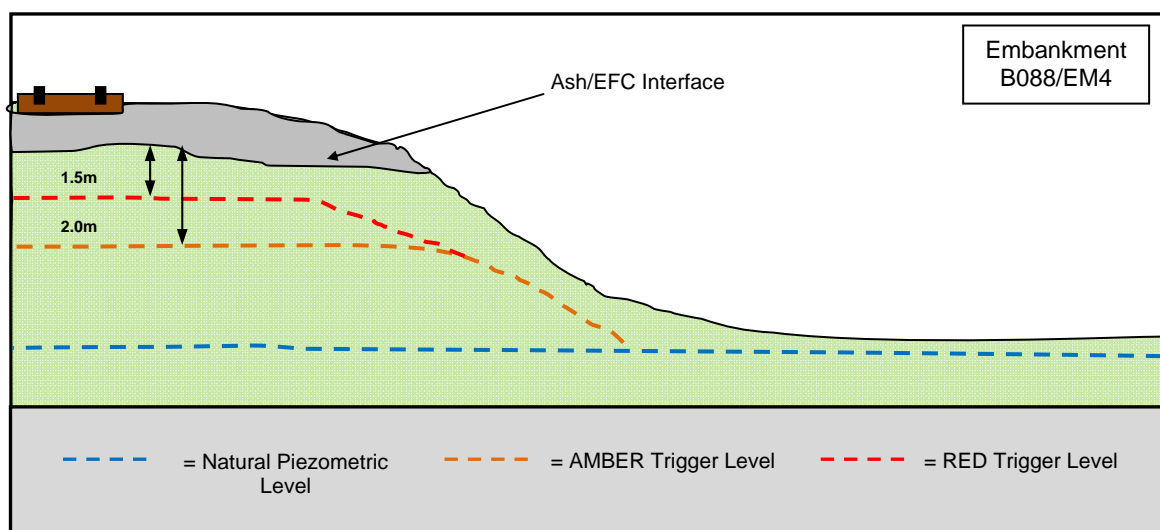
The piezometric trigger levels should always be read in conjunction with any inclinometer recorded movements.

Taking the above into consideration, an AMBER status will adopt a piezometric trigger level of >1.50m-2.00m below the Ash/EFC interface. Piezometer levels within this range begin to increase the risk of earth structure failure.

A RED status will adopt a recorded piezometric trigger level of <1.5m below the Ash/EFC interface. Any recorded piezometric level above this point is deemed to put the embankment under high risk of earth structure failure.

No BLACK status will be adopted for DSP monitoring data.

Figure 8.3: Generalised diagram showing DSP trigger levels for Embankment B088/EM4





8.4 Retaining Walls

Upon review of the retaining wall monitoring data obtained in all ESA's to date, movements fluctuating between 5mm from the initial baseline survey were commonly recorded. This has been attributed to the expected survey error of the survey equipment used by the LU COP PDP survey team, as well as movement of the fixed control points. Beyond this margin of error, any movements recorded on a retaining wall should be taken as actual movement.

Due to the severity of retaining wall failure, any movement beyond the expected survey error of 5mm, is potentially indicative of failure and therefore will revert straight to AMBER status without using a YELLOW¹ or YELLOW² status.

Further monitoring of any structures beyond the AMBER trigger level will monitor the rate of movement rather than total movement. The Red trigger level will be defined as an increase in the rate of movement by >40%.

8.5 Track Survey Monitoring / Amber Survey Trolley

Table 8.5 provides the proposed trigger levels adopted for amber survey trolley track monitoring. Maintenance actions will be aligned with LU Standard 1-159 Track Dimensions and Tolerances A2 Twist, Alignment, LTOP and RTOP, which will be measured manually as part of the monitoring procedure.

Table 8.6 provides the proposed trigger levels adopted for survey track monitoring of vertical and horizontal deviation of the rail. This will be used to monitor track movements potentially attributed to embankment deformations. The track monitoring data can be cross checked with other monitoring to investigate the effect that embankment movements have on the track performance.

A comparable track monitoring scheme was adopted during another recent earth structure remediation project between Canons Park and Queensbury Stations. A full review of the data obtained from this monitoring regime has been undertaken, along with engineering judgement, to define the triggers levels for the track monitoring.

Note: Where track rough ride is reported between TBTC Signal Post 50264 and Blue Whistle Board located on left hand side in DOT, Track ZMM to notify Civil's colleague, as this coincides with concerns regarding Embankment B088/EM4.



Table 8.1 Inclinator Trigger Levels & Responses

Status	Measure	Action
GREEN (ALARP)	<p>0.00m – 1.50m: <20mm horizontal movement on the A Axis (perpendicular to the slope).</p> <p>>1.50m: <5mm horizontal movement on the A Axis (perpendicular to the slope).</p>	No action.
YELLOW¹	<p>0.00m – 1.50m: >20mm horizontal movement on the A Axis (perpendicular to the slope).</p> <p>>1.50m: >5mm horizontal movement on the A Axis (perpendicular to the slope).</p>	<ul style="list-style-type: none"> • Discussion between two members of the ES team. • Inclinator added to the trigger level breach log. • Possible reasons for the movement recorded and agreed. • Option to increase monitoring frequency.
YELLOW²	<p>0.00m – 1.50m: >25mm horizontal movement on the A Axis (perpendicular to the slope).</p> <p>>1.50m: >8mm horizontal movement on the A Axis (perpendicular to the slope).</p>	<ul style="list-style-type: none"> • Discussion between two members of the ES team. • Detailed visual inspection of the embankment and review of other monitoring data. • Undertake a detailed site inspection. • Trigger level breach log updated. • Option to increase monitoring frequency.
AMBER	<p>0.00m – 1.50m: >30mm horizontal movement on the A Axis (perpendicular to the slope).</p> <p>>1.50m: >10mm horizontal movement on the A Axis (perpendicular to the slope).</p>	<ul style="list-style-type: none"> • Call ERP meeting within 24 hours and implement agreed actions. • Detailed visual inspection of the embankment and review of other monitoring data. • Trigger level breach log updated. • Increase monitoring frequency. • Install additional monitoring instrumentation. (Optional)
RED	<p>0.00m – 1.50m: >50mm horizontal movement on the A Axis (perpendicular to the slope).</p> <p>>1.50m: >30mm horizontal movement on the A Axis (perpendicular to the slope).</p> <p>+40% increase in degree of movement.</p>	<ul style="list-style-type: none"> • Call EMRP meeting within 2 hours and implement agreed actions. • Detailed visual inspection of the embankment and review of other monitoring data. • Trigger level breach log updated. • Increase monitoring frequency. • Install additional monitoring instrumentation. • TSR to be proposed/decision for implementation.
BLACK	Monitoring suggesting imminent failure or failure of the earth structure.	Refer to Earth Structures - Emergency Response EPP (Appendix D)



Table 8.2 Survey Permanent Ground Marker Trigger Levels & Responses

Status	Measure	Action
GREEN (ALARP)	<50mm horizontal / vertical movement.	No action.
YELLOW¹	>50mm horizontal / vertical movement.	<ul style="list-style-type: none"> • Discussion between two members of the ES team. • Inclinator added to the trigger level breach log. • Possible reasons for the movement recorded and agreed. • Option to increase monitoring frequency.
YELLOW²	>80mm horizontal / vertical movement.	<ul style="list-style-type: none"> • Discussion between two members of the ES team. • Detailed visual inspection of the embankment and review of other monitoring data. • Trigger level breach log updated. • Option to increase monitoring frequency.
AMBER	>90mm horizontal / vertical movement.	<ul style="list-style-type: none"> • Call ERP meeting within 24 hours and implement agreed actions. • Detailed visual inspection of the embankment and review of other monitoring data. • Trigger level breach log updated. • Increase monitoring frequency. • Install additional monitoring instrumentation. (Optional)
RED	>100mm horizontal / vertical movement.	<ul style="list-style-type: none"> • Call EMRP meeting within 2 hours and implement agreed actions. • Detailed visual inspection of the embankment and review of other monitoring data. • Trigger level breach log updated. • Increase monitoring frequency. • Install additional monitoring instrumentation.
BLACK	Monitoring suggesting imminent failure or failure of the earth structure.	Refer to Earth Structures - Emergency Response EPP (Appendix D)



Table 8.3 Piezometer Trigger Levels & Responses

<u>Status</u>	<u>Measure</u>	<u>Action</u>
GREEN (ALARP)	Embankment: Piezometric Level 2.00m below Ash/EFC interface.	No action.
AMBER	Embankment: Piezometric Level 2.00m - <1.50m below Ash/EFC interface.	<ul style="list-style-type: none"> • Notify ERP meeting representatives within 24 hours. • Trigger level breach log updated. • Increase monitoring frequency to once per week.
RED	Embankment: Piezometric Level <1.50m below Ash/EFC interface.	<ul style="list-style-type: none"> • Notify EMRP meeting representatives within 2 hours. • Trigger level breach log updated. • Increase monitoring frequency to twice per week.

Table 8.4 Retaining Wall Trigger Levels & Responses

<u>Status</u>	<u>Measure</u>	<u>Action</u>
GREEN (ALARP)	< +/- 5mm horizontal / vertical movement	No action.
AMBER	> +/- 5mm horizontal / vertical movement	<ul style="list-style-type: none"> • Notify ERP meeting representatives within 24 hours. • Detailed visual inspection of the structure and embankment. Review other monitoring data in the area. • Trigger level breach log updated. • Increase monitoring frequency to once per week.
RED	+40% increase in degree of movement.	<ul style="list-style-type: none"> • Notify EMRP meeting representatives within 2 hours. • Detailed visual inspection of the embankment and review of other monitoring data. • Trigger level breach log updated. • Increase monitoring frequency to twice per week.



Table 8.5 Amber Survey Trolley Trigger Levels & Responses

Twist 2 metre base (cross level variation)							
2 metre twist, ballasted track	Tolerance for track category					Minimum action	Trigger Level
	Standard	A	B	C	D		
The maximum values of twist on a 2 metre base. Voids should be measured where possible or estimated and included in the twist calculation	All lines except defined lines						
	SS Level 3	25	25	25	25	Consider imposing a speed restriction, rectify within 24 hours.	Red
	ML Level 2	20	20	20	20	Inspect within 24 hours	Amber
	MT Level 1	12	13	15	18	Plan maintenance if required	Green
	If 2 metre twist is over 25mm impose 10mph speed restriction and correct within 24 hours						
Twist 10 metre base (cross level variation)							
10 metre twist, ballasted track	Tolerance for track category					Minimum action	
	Standard	A	B	C	D		
The maximum values of twist on a 10 metre base. Voids should be measured where possible or estimated and included in the twist calculation	SS Level 3	40 (1 in 250)	40 (1 in 250)	40 (1 in 250)	40 (1 in 250)	Inspect within 24 hours, rectify within a further 48 hours	Red
	ML Level 2	33 (1 in 300)	33 (1 in 300)	33 (1 in 300)	33 (1 in 300)	Inspect within 24 hours	Amber
	MT Level 1	30 (1 in 333)	30 (1 in 333)	30 (1 in 333)	30 (1 in 333)	Plan maintenance if required	Green
	If 10 metre twist is over 40mm impose 10mph speed restriction and correct within 24 hours						



Table 8.6 Survey Track Monitoring Trigger Levels & Responses

<u>Status</u>	<u>Measure</u>	<u>Action</u>
GREEN (ALARP)	<10mm horizontal / vertical (downward) movement.	No action.
AMBER	>10mm horizontal / vertical (downward) movement.	<ul style="list-style-type: none"> • Call ERP meeting within 24 hours and implement agreed actions. • Detailed visual inspection of the track, embankment and review of other monitoring data. • Trigger level breach log updated. • Option to increase monitoring frequency. • Carry out Amber Trolley Survey.
RED	>30mm horizontal / vertical (downward) movement.	<ul style="list-style-type: none"> • Call EMRP meeting within 2 hours and implement agreed actions. • Detailed visual inspection of the track, embankment and review of other monitoring data. • Trigger level breach log updated. • Increase monitoring frequency. • TSR to be proposed/decision for implementation.
BLACK	Track monitoring movement suggesting imminent failure or failure of the earth structure.	Refer to Earth Structures - Emergency Response EPP (Appendix D)



8.6 **Inclement Weather**

LU reports titled 'Effect of Inclement Weather on Earth Structures (Phase I and Phase II)' [9, 10] have been reviewed to obtain guidance on this subject. Inclement weather in the form of prolonged rainfall and low Soil Moisture Deficit (SMD) put the embankment at higher risk of slope instability. Prolonged rainfall can saturate the soil to the extent that low or even zero SMD values develop, especially during the winter, as rainfall increases and moisture uptake from vegetation decreases. This creates elevated pore pressures within the embankment, with a reduction in effective shear strength lead to potential shear failure.

As a result of the above, the amount of rainfall and SMD values will be monitored closely. For embankment B088/EM4, the following trigger levels will be adopted based those defined in the LU reports detailed above [9, 10]:

- 175% of long term average rainfall for the week
- SMD for deciduous trees below 50mm

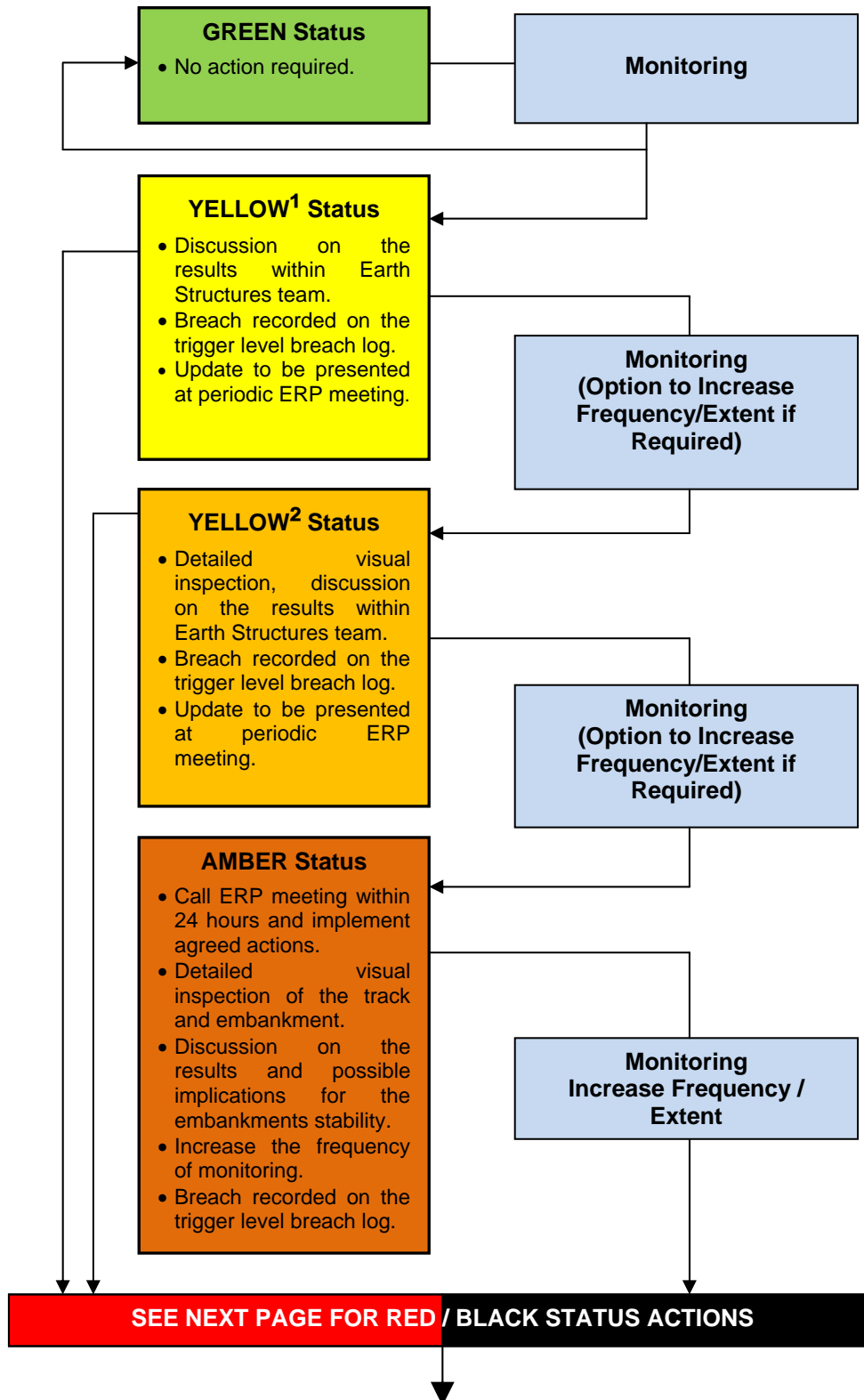
Throughout periods where these levels are breached, monitoring frequency will increase to twice per week to reflect the increased risk of embankment failure.

Daily rainfall data will be obtained from the Northolt weather station and reviewed by the LU COP PDP ES team. SMD values in the form of MORECS data will also reviewed by the LU COP PDP ES team.



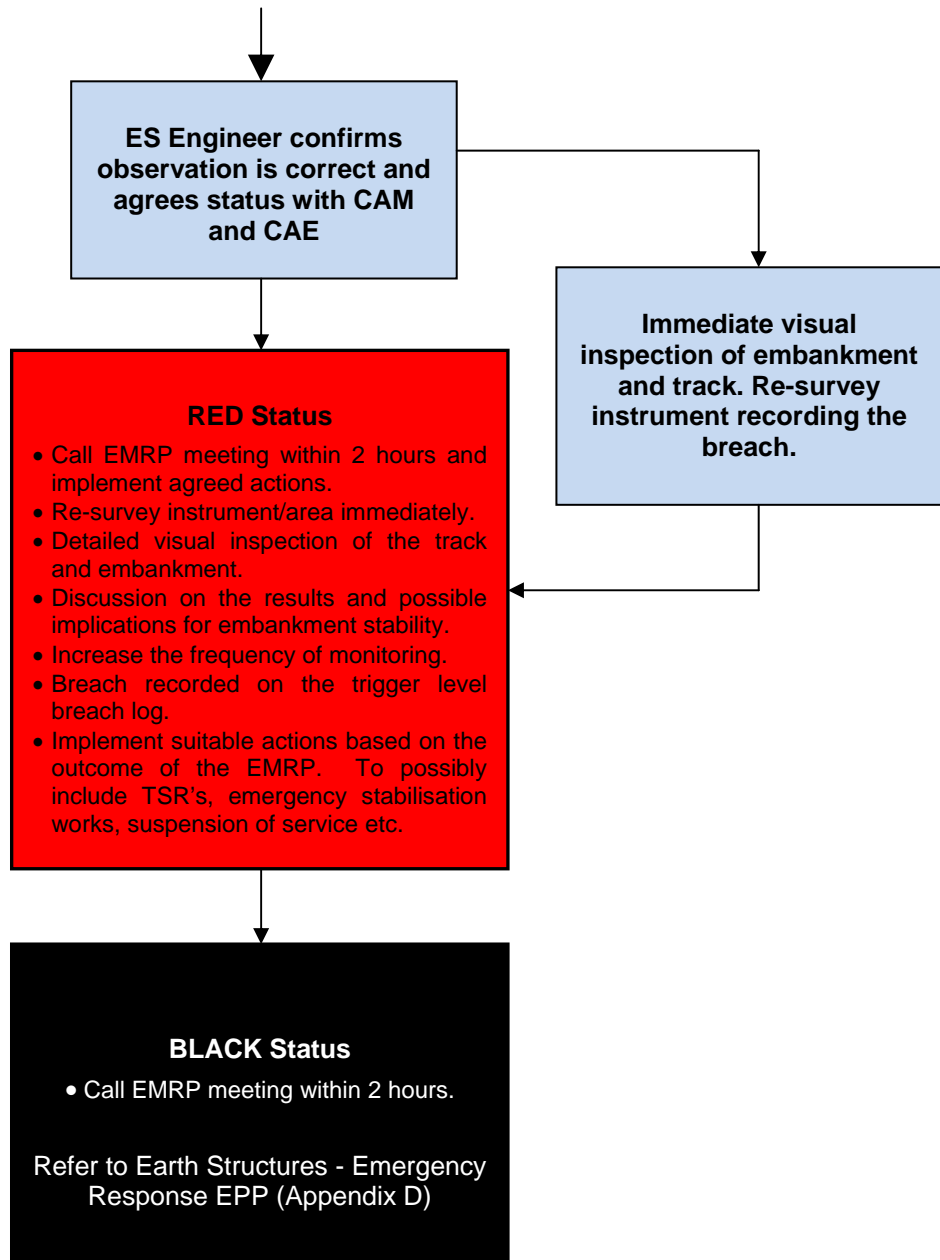
9. Actions in the Event of a Change in Status

In the event of a change of status higher than GREEN shown in Tables 8.1-8.6, the following actions shall be carried out.





In the event of a change of status higher than AMBER shown in Tables 8.1-8.6, the following actions shall be carried out.





9.1 Earth Structures Discussion and Trigger Level Breach Log

For a YELLOW¹ or YELLOW² status breach, a discussion between two or more of the LU COP ES team will take place. They will discuss the results and the implications for the Earth Structures stability. They may decide to increase the monitoring frequency or raise the status level to AMBER.

A trigger level breach log will record all monitoring installations that record a breach and the subsequent discussion on the likely reason for the movement. This will ensure consistent records are kept on monitoring movements and the interpreted reasons for them.

The LU COP PDP ES team discussion is to include at least two of the following from the table below. The LU COP PDP ES team member who records the breach shall be responsible for assembling the discussion, contact details for each member can be found in Appendix B.

Table 9.1 Earth Structure Discussion Attendees

Earth Structure Discussion Attendees		
Job Title	Directorate	Person
Lead Discipline Engineer	LU COP PDP	Athanasios Papachrysanthou
Discipline Engineer	LU COP PDP	Joseph Kennedy
Discipline Engineer	LU COP PDP	Matt Beth
Discipline Engineer	LU COP PDP	Oscar Azumendi
Assistant Engineer	LU COP PDP	Kat Hagger
Construction Manager	LU COP PDP	Martyn Tribe



9.2 Engineering Review Panel Meeting

Following the breach of the 'AMBER' trigger level, defined in the ESA-EPP, periodic ERP meetings are now held to discuss the latest monitoring results and decide on the status of the embankment.

Should there be any further 'AMBER' status breaches, an ERP meeting will be called outside of these routine ERP meetings, within 24 hours of the status breach.

The ERP meeting may use teleconference facilities if necessary. A preliminary checklist for discussion during the Review Panel meeting is included in Appendix C.

An Earth Structures Engineer shall be responsible for assembling the Review Panel, contact details for each member can be found in Appendix B. The Review Panel is to include the following representatives or their deputies as follows:

Table 9.2 Engineering Review Panel Attendees

Engineering Review Panel Representatives		
Representative	Directorate	Person
Lead Discipline Engineer (Earth Structures)	LU COP PDP	Athanasios Papachrysanthou
Construction Manager (Earth Structures)	LU COP PDP	Martyn Tribe
Discipline Engineer (Earth Structures)	LU COP PDP	Joseph Kennedy
Civil Asset Engineer	LU COP PDP	Kevin Stoakes
Delivery Manager	LU COP PDP	Amanda Fowler
Civil Asset Manager	AP JNP	Ismail Suleyman
Engineering Manager	LU COP PDP	Kelly Allen
Permanent Way Asset Engineer	LU COP PDP	Sean Tarrant
Acting Head of PDP	LU COP PDP	Nick West
Discipline Engineer	LU COP PDP	Matt Beth
Discipline Engineer	LU COP PDP	Oscar Azumendi
Assistant Engineer	LU COP PDP	Kat Hagger
Profession Head - Earth Structures and Geotechnical Engineering	LU CPD	Nader Saffari
Civil Asset Manager	LU CPD	Fiona Thomson



9.3 Emergency Review Panel Meeting

Should there be a 'RED' or 'BLACK' status breach, an EMRP meeting will be called within two hours.

The EMRP meeting may use teleconference facilities if necessary. A preliminary checklist for discussion during the Review Panel meeting is included in Appendix C.

An Earth Structures engineer shall be responsible for assembling the Review Panel, contact details for each member can be found in Appendix B. The Review Panel is to include the following representatives or their deputies as follows:

Emergency Review Panel Representatives		
Representative	Directorate	Person
Lead Discipline Engineer (Earth Structures)	LU COP PDP	Athanasios Papachrysanthou
Construction Manager (Earth Structures)	LU COP PDP	Martyn Tribe
Discipline Engineer (Earth Structures)	LU COP PDP	Joseph Kennedy
Civil Asset Engineer	LU COP PDP	Kevin Stoakes
Delivery Manager	LU COP PDP	Amanda Fowler
Civil Asset Manager	AP JNP	Ismail Suleyman
Engineering Manager	LU COP PDP	Kelly Allen
Permanent Way Asset Engineer	LU COP PDP	Sean Tarrant
Acting Head of PDP	LU COP PDP	Nick West
Discipline Engineer	LU COP PDP	Matt Beth
Discipline Engineer	LU COP PDP	Oscar Azumendi
Assistant Engineer	LU COP PDP	Kat Hagger
Profession Head - Earth Structures and Geotechnical Engineering	LU CPD	Nader Saffari
Civil Asset Manager	LU CPD	Fiona Thomson



10. Responsibilities

10.1 Principle Permanent Way Asset Engineer

The Principle Permanent Way Asset Engineer (or their designated authority), will be responsible for the track monitoring in the form of Amber Trolley and TRV surveys. Subsequently, they will undertake the review of all monitoring data within twenty four hours and report these results to the LU COP PDP ES team immediately and at the periodic ERP meetings. The Track EM / Track AM will be responsible for the implementation of any actions relating to the track monitoring listed above.

10.2 LU COP PDP ES team

The LU COP PDP ES team will be responsible for the survey track monitoring and all forms of embankment monitoring. Subsequently, they will undertake the review of all monitoring data within 24hours and report these results at the periodic ERP meetings. The LU COP PDP ES team will be responsible for the implementation of any actions relating to the survey track monitoring and embankment monitoring.



11. Recovery Plan

10.1 Recovery from YELLOW¹ / YELLOW² Status – ES Team Discussion

Should a YELLOW¹ and YELLOW² status be declared, the LU COP PDP ES Team shall meet to discuss the actions to be taken subsequent to the change of status. An LU COP PDP ES team member will be responsible for assembling the discussion, who may decide to:

- Return to non-emergency ALARP status.
- Maintain at YELLOW¹ / YELLOW² status and continue to monitor.
- Increase monitoring frequency / additional monitoring installations.
- Move to an AMBER, RED or BLACK status and call an ERP/EMRP meeting.
- Suggest maintenance or simple remedial works to improve asset condition.

10.2 Recovery from AMBER Status – Engineering Review Panel Meeting

Should an AMBER status be declared, an ERP meeting shall convene to discuss the actions to be taken subsequent to the change of status. An LU COP PDP ES team member will be responsible for assembling the meeting, who may decide to:

- Return to non-emergency ALARP status.
- Maintain at AMBER status or reduce to YELLOW¹ / YELLOW² status and continue to monitor.
- Increase monitoring frequency and install additional monitoring installations.
- Instruct other actions to keep the embankment in 'Risk ALARP' condition.
- Move to a RED or BLACK status and call an EMRP meeting.
- Implement maintenance or emergency remedial works to improve asset condition.

10.3 Recovery from RED / BLACK Status – Emergency Review Panel Meeting

Should a RED or BLACK status be declared, an EMRP meeting shall convene to discuss the actions to be taken subsequent to the change of status. An LU COP PDP ES team member will be responsible for assembling the meeting, who may decide to:

- Return to non-emergency ALARP status.
- Maintain at RED status or reduce to a YELLOW¹ / YELLOW² / AMBER status and continue to monitor.
- Maintain or upgrade to BLACK status and revert to Emergency Response – EPP [6].
- Increase monitoring frequency and install additional monitoring installations.
- Instruct other actions to keep the embankment in 'Risk ALARP' condition.
- Implement maintenance or emergency remedial works to improve asset condition.

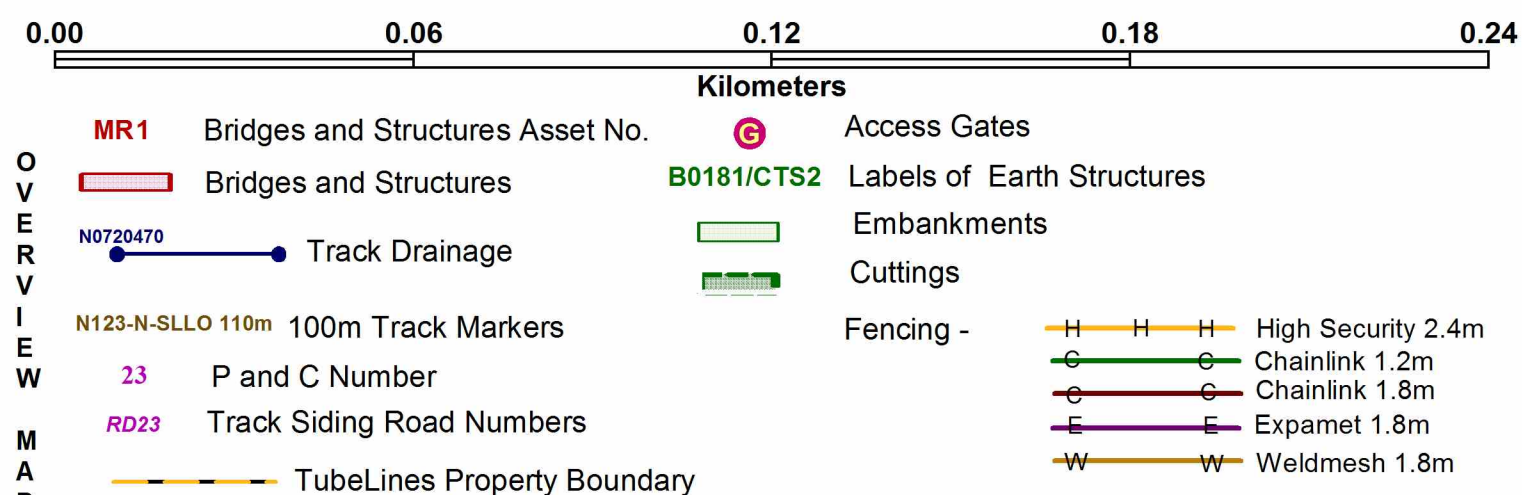
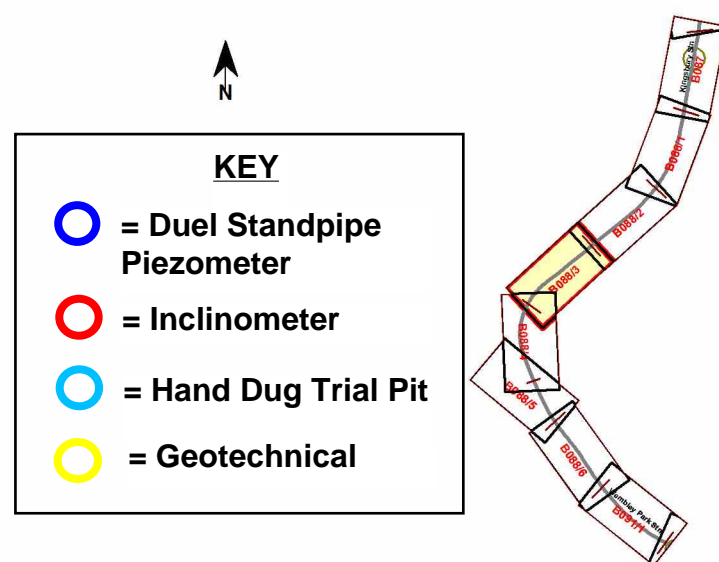


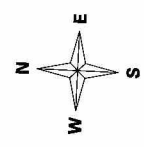
12. References

- 1) Earth Structures Assessment Programme, Observational Approach, Tranche 1 (14 Sites), Northern Line, Piccadilly Line and Jubilee Line, Ground Investigation, Geotechnical, Instrument Installation and Monitoring Report, Tube Lines Limited, January 2014, Document No: TLL-L001-P855-GEN-RPT-00001;
- 2) Earth Structure Assessment – Observational Approach, Survey Ground Marker monitoring results;
- 3) O'Driscoll. R., 'The influence of vegetation on the swelling and shrinking of clay soils in Britain', *Geotechnique*, Vol. 33, 1983, p. 93 – 105;
- 4) Desiccation in clay soils: Building Research Establishment (BRE) Digest 412, 1996;
- 5) LU Emergency Preparedness Plan (EPP), Earth Structures Assessment, LUL CDP JNP, June 2014, Document No: TLL-L001-P855-HSE-PLN-00002;
- 6) LU Emergency Preparedness Plan (EPP), Emergency Response, LUL CDP JNP, June 2014, Document No: TLL-L001-P855-HSE-PLN-00001;
- 7) Emergency Assessment / Preliminary Design Report, Embankment Stabilisation Emergency Works, Kingsbury to Wembley Park, B088/EM4, London Underground – Capacity Optimisation Programme, August 2014, Document No: TLL-B088-P855-EST-RPT-00001;
- 8) Earth Structures Assessment Programme, Earth Structures Assessment Report, Kingsbury to Wembley Park, B088/EM4, London Underground – Capacity Optimisation Programme, September 2014, Document No: TLL-B088-P855-CIV-RPT-00006;
- 9) Effect of Inclement Weather on Earth Structures (Phase I Report), Atkins, March 2009, Document No: 5074739/GTG.20082385/R001, Rev. 02
- 10) Effect of Inclement Weather on Earth Structures (Phase II Report), Earth Structures, London Underground, November 2010, Document No: RPT-EST-KA00-0539196, Rev. 01



Appendix A – Asset Location Plans

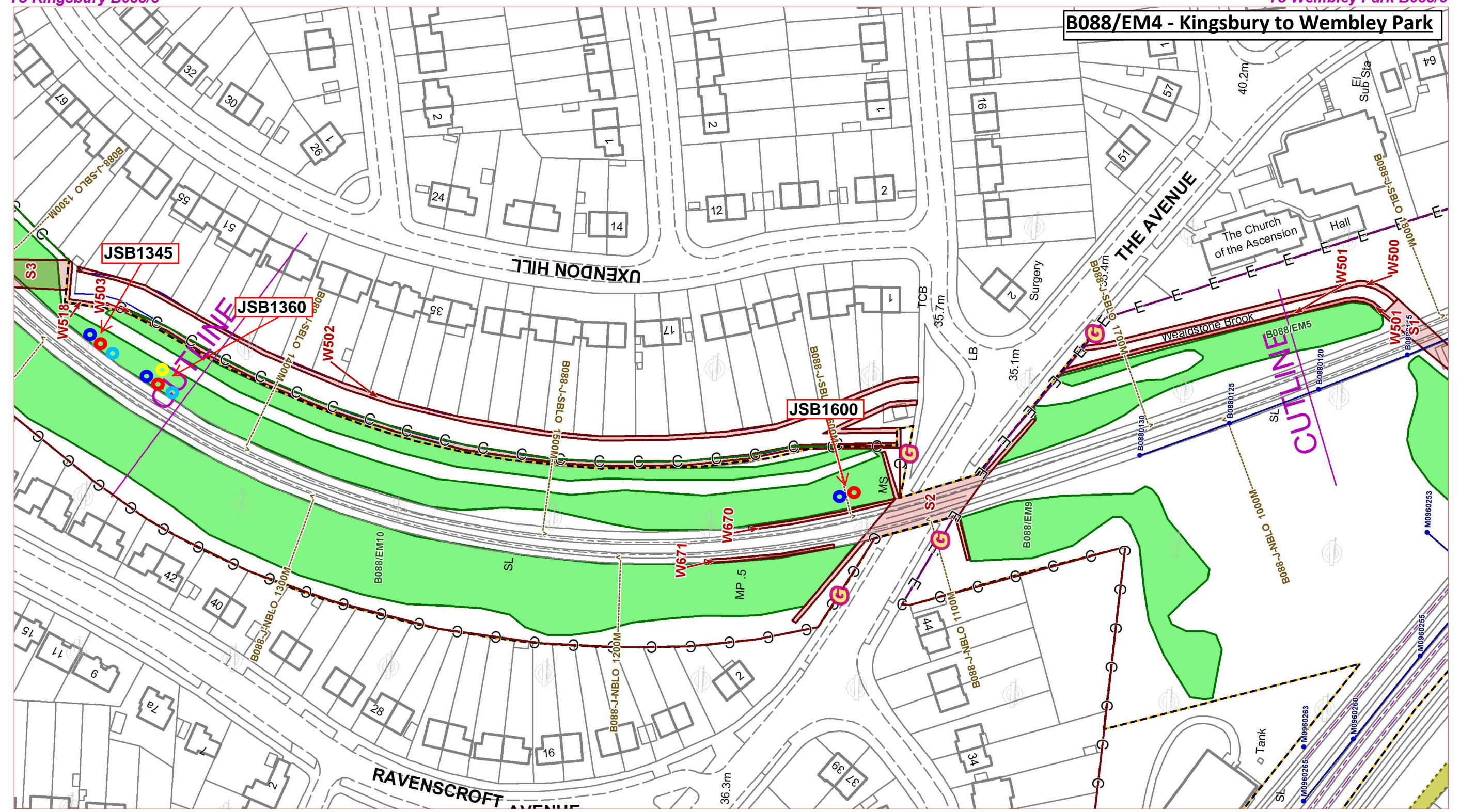




To Kingsbury B088/3

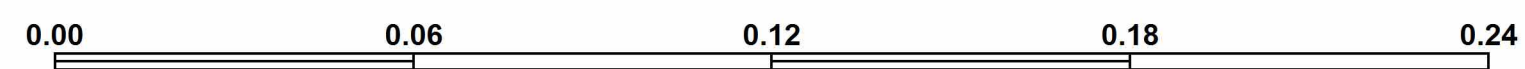
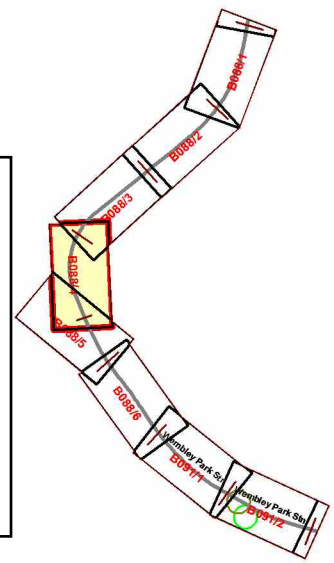
To Wembley Park B088/5

B088/EM4 - Kingsbury to Wembley Park



KEY

- = Duel Standpipe Piezometer
- = Inclinometer
- = Hand Dug Trial Pit
- = Geotechnical



- | | |
|---|--|
| MR1 Bridges and Structures Asset No. | Access Gates |
| Bridges and Structures | B0181/CTS2 Labels of Earth Structures |
| Track Drainage | Embankments |
| 100m Track Markers | Cuttings |
| 23 P and C Number | Fencing - |
| RD23 Track Siding Road Numbers | High Security 2.4m |
| TubeLines Property Boundary | Chainlink 1.2m |
| | Chainlink 1.8m |
| | Expamet 1.8m |
| | Weldmesh 1.8m |

Tube Lines
15 Westferry Circus
Canary Wharf
E14 4HD

ASSET LOCATION PLAN

Kingsbury To Wembley Park

B088/4

PRODUCED 07/12/2012
SCALE 1:1250



Appendix B – Communication Directory

Communication Directory			
Job Title	Person	Telephone/Mobile	Email
Lead Discipline Engineer	Athanasios Papachrysanthou	Tel: 020 7088 4683 Mob: 07712088247	athanasios.papachrysanthou@tubelines.com
Discipline Engineer	Joseph Kennedy	Tel: 020 7088 6368 Mob: 07730917716	joseph.kennedy@tubelines.com
Discipline Engineer	Matt Beth	Tel: 020 7088 6235 Mob: -	mathew.beth@tubelines.com
Discipline Engineer	Oscar Azumendi	Tel: 020 7088 6159 Mob: -	oscar.azumendi@tubelines.com
Assistant Engineer	Kat Hagger	Tel: 020 7088 6677 Mob: 07912186172	kathryn.hagger@tubelines.com
Construction Manager	Martyn Tribe	Tel: - Mob: 07854994897	martyn.tribe@tubelines.com
Civil Asset Engineer	Kevin Stoakes	Tel: 020 7088 4330 Mob: 07854994731	kevin.stoakes@tubelines.com
Delivery Manager	Amanda Fowler	Tel: 020 7088 5378 Mob: 07834614481	amanda.fowler@tubelines.com
Civil Asset Manager	Ismail Suleyman	Tel: 020 7088 4156 Mob: 07764429211	ismail.suleymxx@xxxxxxxxxx.xxx
Engineering Manager	Kelly Allen	Tel: 020 7088 5112 Mob: 07854994463	kelly.allen@tubelines.com
Permanent Way Asset Engineer	Sean Tarrant	Tel: 020 7088 4156 Mob: 07764429211	sean.tarrent@tubelines.com
Acting Head of PDP	Nick West	Tel: 020 7088 4936 Mob: 07854995037	nick.west@tubelines.com
Profession Head - Earth Structures	Nader Saffari	Tel: 020 7918 4111 Mob: 07720946526	nader.saffari@tube.tfl.gov.uk
Civil Asset Manager	Fiona Thomson	Tel: 020 3054 8746 Mob: 07802779838	fiona.thomson@tube.tfl.gov.uk



Appendix C – Checklist for ERP / EMRP Meeting

Tick when complete

- | | |
|--|--------------------------|
| 1. Ensure all Review Panel members are represented. | <input type="checkbox"/> |
| 2. Review all available information. | <input type="checkbox"/> |
| 3. Review reasons for Status Change: | <input type="checkbox"/> |
| <ul style="list-style-type: none">• Earth Structure deterioration?• Inclement weather?• Structure failure?• External influences? | |
| 4. Determine actions required. | <input type="checkbox"/> |
| 5. If required, determine requirements for additional surveys and investigations: | <input type="checkbox"/> |
| <ul style="list-style-type: none">• Check track geometry.• Check embankment stability and serviceability.• Additional ground investigation.• Monitoring installation. | |
| 6. Is a revision of the site specific EPP required? | <input type="checkbox"/> |
| 7. Agree actions and communicate to all parties. | <input type="checkbox"/> |
| 8. Review any changes/updates to LU COP PDP Corporate Risk Register. | <input type="checkbox"/> |



Appendix D – Emergency Response - EPP



Emergency Preparedness Plan (EPP)

Earth Structures Emergency Response

Jubilee, Northern and Piccadilly Line

Date: June 2014

Document Number:

TLL-L001-P855-HSE-PLN-00001

Note: This document relates to an emergency situation where an earth structure is showing signs of potential / imminent failure, or failure has occurred and immediate action is required.

This is a "live document" and will be updated as and when, new information becomes available. Version control will be maintained through the CPD JNP Management System.

DOCUMENT REVISION HISTORY

Revision	Status	Reason for Amendment	Date
R1	Draft	Issued for Comment	18/06/2014
R2	Final	CAE and CAM Comments Addressed	18/07/2014
R3	Final	PPAE Comments Addressed	27/08/2014



DOCUMENT APPROVAL

Created by:	Joseph Kennedy
Role:	LU CPD JNP, Support Construction Manager (Earth Structures)
Signature:	[REDACTED]
Date:	18.06.2014
Authorised by:	Athanasios Papachrysanthou
Role:	LU CPD JNP, Principle Lead Engineer (Earth Structures)
Signature:	[REDACTED]
Date:	18/06/14
Authorised by:	Kevin Stoakes
Role:	LU CPD JNP, Civil Asset Engineer
Signature:	[REDACTED]
Date:	28/7/14
Authorised by:	Ismail Suleyman
Role:	LU AP JNP, Civil Asset Manager
Signature:	[REDACTED]
Date:	28/07/14
Authorised by:	Sean Tarrent
Role:	LU CPD JNP, Principal Permanent Way Asset Engineer
Signature:	[REDACTED]
Date:	19/08/14
Authorised for issue by:	
Role:	
Signature:	
Date:	
Authorised for issue by:	
Role:	
Signature:	
Date:	



DOCUMENT APPROVAL

Created by:	Joseph Kennedy
Role:	LU CPD JNP, Support Construction Manager (Earth Structures)
Signature:	
Date:	
Authorised by:	Athanasios Papachrysanthou
Role:	LU CPD JNP, Principle Lead Engineer (Earth Structures)
Signature:	
Date:	
Authorised by:	Kevin Stoakes
Role:	LU CPD JNP, Civil Asset Engineer
Signature:	
Date:	
Authorised by:	Ismail Suleyman
Role:	LU AP JNP, Civil Asset Manager
Signature:	
Date:	
Authorised by:	Sean Tarrent
Role:	LU CPD JNP, Principal Permanent Way Asset Engineer
Signature:	
Date:	
Authorised for issue by:	
Role:	
Signature:	
Date:	
Authorised for issue by:	
Role:	
Signature:	
Date:	



Consultation:

Name	Company	Title	Review Date
Athanasios Papachrysanthou	LU CPD JNP	Principle Lead Engineer	18/06/2014
Kevin Stoakes	LU CPD JNP	Civil Asset Engineer	18/07/2014
Ismail Suleyman	LU AP JNP	Civil Asset Manager	18/07/2014
Sean Tarrant	LU CPD JNP	Principal Permanent Way Asset Engineer	27/08/2014
Sadie Moore	CPD JNP	Infrastructure Delivery Manager	
Kelly Allen	CPD JNP	Engineering Manager	
Nader Saffari	London Underground	Professional Head Earth Structures	

Distribution:

Name	Company	Title / Directorate
As Above +		
Brian McGinnity	London Underground	Professional Head, Civil Engineering
Fiona Thomson	Transport for London	Senior Client Engineer, Strategy & Service Development



TABLE OF CONTENTS

1.	GLOSSARY-----	5
2.	PURPOSE -----	6
3.	BACKGROUND AND CURRENT SITUATION -----	7
4.	RESPONSE PREPAREDNESS-----	8
5.	ACTIVATION AND DEACTIVATION OF THE PLAN -----	9
6.	ACTIONS IN THE EVENT OF AN EMERGENCY -----	10
7.	RECOVERY PLAN-----	20
8.	ROUTE FROM EARTH STRUCTURE ASSESSMENT EPP -----	21
9.	EARTH STRUCTURE SITE SPECIFIC EPP-----	22
	APPENDIX A – EMERGENCY COMMUNICATION DIRECTORY -----	24
	APPENDIX B – CHECKLIST FOR ESRP / EERP MEETING -----	25
	APPENDIX C – PREPARATION ACTION LIST -----	26
	APPENDIX D – ON-CALL LIST -----	27
	APPENDIX E – CONTACT FOR LU JNP DIRECTOR OF HSE&E -----	28



1. Glossary

Abbreviation	Meaning
DOE	LU JNP Duty Operations Engineer
EPP	Emergency Preparedness Plan
EERP	Emergency Engineering Review Panel
ERU	Emergency Response Unit
ERU DM	Emergency Response Unit Duty Manager
TSR	Temporary Speed Restriction
LU	London Underground
LUCC	London Underground Control Centre
RDO	LU Rostered Duty Officer
CAE	Civil Asset Engineer
CAM	Civil Asset Manager
CPD - JNP	Capital Projects Directorate - Jubilee, Northern, Piccadilly
AP - JNP	Asset Performance - Jubilee, Northern, Piccadilly
ES	Earth Structures
ALARP	As Low As Reasonably Practicable
PI / SI	Principle Inspection / Special Inspection
ACA	Asset Condition Assessment



2. Purpose

This Emergency Preparedness Plan (EPP) is for all London Underground Earth Structure Assets across the Jubilee, Northern and Piccadilly Lines.

The purpose of this document is to present guidelines on how to react and respond to an emergency situation where an earth structure is showing signs of potential / imminent failure, or failure has occurred and immediate action is required.

The EPP defines the processes and associated actions and the roles and responsibilities of all parties involved with this activity. It also provides details on how CPD JNP will manage a number of potential scenarios which may develop if certain events occur.

This is an overarching document that covers all Earth Structure Assets, with the exception of those under a Site Specific EPP (Figure 1 and Section 9). Sites undergoing monitoring within an Earth Structure Assessment (ESA) initially come under a specific ESA EPP. This attributes trigger level values and actions to any recorded monitoring movements. However, the ESA EPP reverts back to this Emergency Response EPP in an emergency situation (Figure 1 and Section 8).

3. Background and Current Situation

London Underground CPD JNP are required to maintain upgrade and improve the Jubilee, Northern and Piccadilly Lines.

Divided across the three lines, there are currently 438 identified Earth Structure Assets, specified as either embankments (184), or cuttings (254). They provide vertical and lateral support to the overlying permanent way and stability to the operational railway line-side services.

Embankments are sections of earthwork formed by material above original ground level. Cuttings are sections of earthwork formed by excavation below original ground level. Both embankments and cuttings on LU have been constructed from, or within cohesive materials such as London Clay, Glacial Till, Alluvium, or granular materials such as River Terrace Deposits and Ash. The geology, along with other influences such as vegetation, groundwater and retaining structures, dictate the failure mechanisms likely to be encountered. These include deep-seated slope instability, shallow-seated slope instability and flow failure to name a few.

Currently, all Earth Structure Assets are subjected to an inspection, assessment and remediation regime, managed through both AP JNP and CPD JNP, to ensure they are maintained risk ALARP (Figure 1). However, there is always a risk that an earth structure could fail, or exhibit signs of imminent failure without warning, or as a result of inspection, assessment or remediation. Transient external effects such as inclement weather, retaining structure failure, lack of maintenance, or other influences outside of CPD JNP control all contribute to possible causes of instability, along with progressive influences such as seasonal deformation and poor historical construction techniques.

Earth structure failure, or imminent failure could result in an emergency situation, where an immediate response is required to ensure the safe operation of the railway and the earth structure is maintained in a risk ALARP condition.

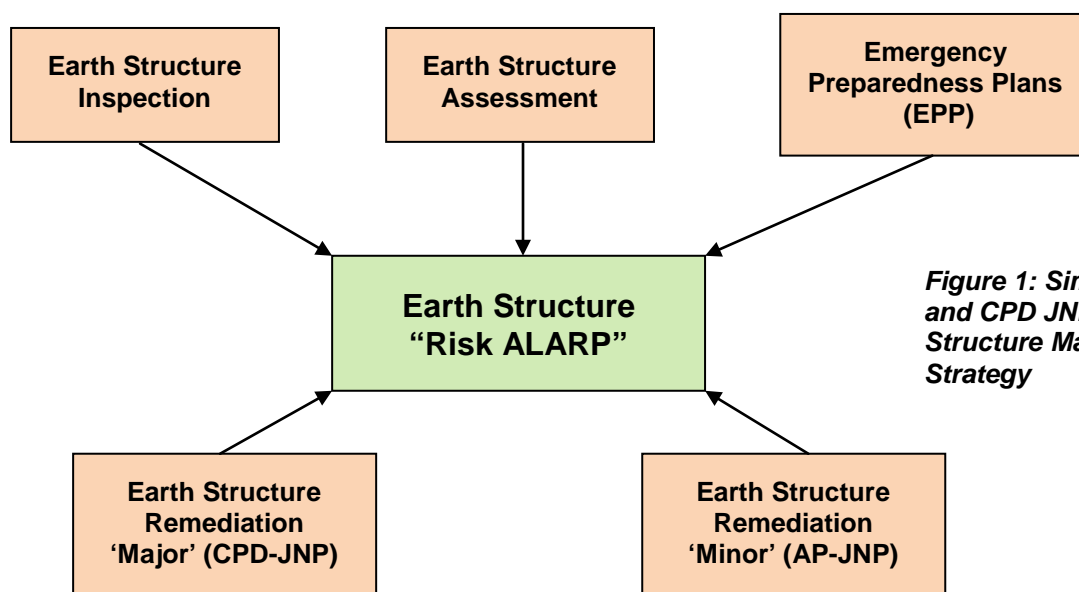


Figure 1: Simplified AP JNP and CPD JNP Earth Structure Management Strategy



4. Response Preparedness

Appendix C contains a list of actions that need to be taken to ensure response preparedness at all times. It also details further corrective actions along with the persons responsible for each action.

The overall responsibility for maintaining the current status of the EPP rests with the AP JNP Civil Asset Manager (CAM), along with the CPD JNP Civil Asset Engineer (CAE) and the CPD JNP Earth Structures (ES) team.

To be prepared to undertake immediate emergency reaction and response, the CAM must have the capacity to undertake the following:

- A 24-hour on-call Civil Engineer Operations, with the ability to provide immediate response to an emergency situation. (**Competency assessed – Inspection and Advising**)
- A Fault Response team that can be called upon to offer basic remedial response.
- Ability to liaise with the on-call Earth Structures Engineer, either over the phone, or in person 24/7.

To be prepared to undertake immediate emergency response, the ES team must have the capacity to undertake the following:

- On-call Earth Structures Engineer with the ability to provide immediate technical support in response to an emergency situation. This could be over the phone, or by attending site within four hours. (**Competency assessed – Inspection, Advising and Physical Works T&C001 License Holder**)
- Ability to immediately provide site specific information on any Earth Structure Asset, along with feasible emergency remedial solutions.
- Ability to convene an Earth Structure Review Panel (ESRP) meeting within 48 hours of an emergency **AMBER** status. (*If required*)
- Ability to convene an Emergency Engineering Review Panel (EERP) meeting within eight hours of an emergency **RED** status and two hours of an emergency **BLACK** status. (*If required*)
- Ability to instigate emergency topographical surveys and monitoring within 24 hours of an emergency **RED/BLACK** status occurring. (*If required*)
- Ability to begin undertaking an Earth Structure Assessment immediately following an emergency **AMBER/RED** status occurring. (*If required*)
- **Proposed for Future:** A framework of ground investigation contractors that can be called upon to undertake emergency site investigation or geotechnical monitoring installation. (*If required*)
- **Proposed for Future:** A framework of geotechnical specialist contractors that can be called upon to install emergency remedial measures. (*If required*)

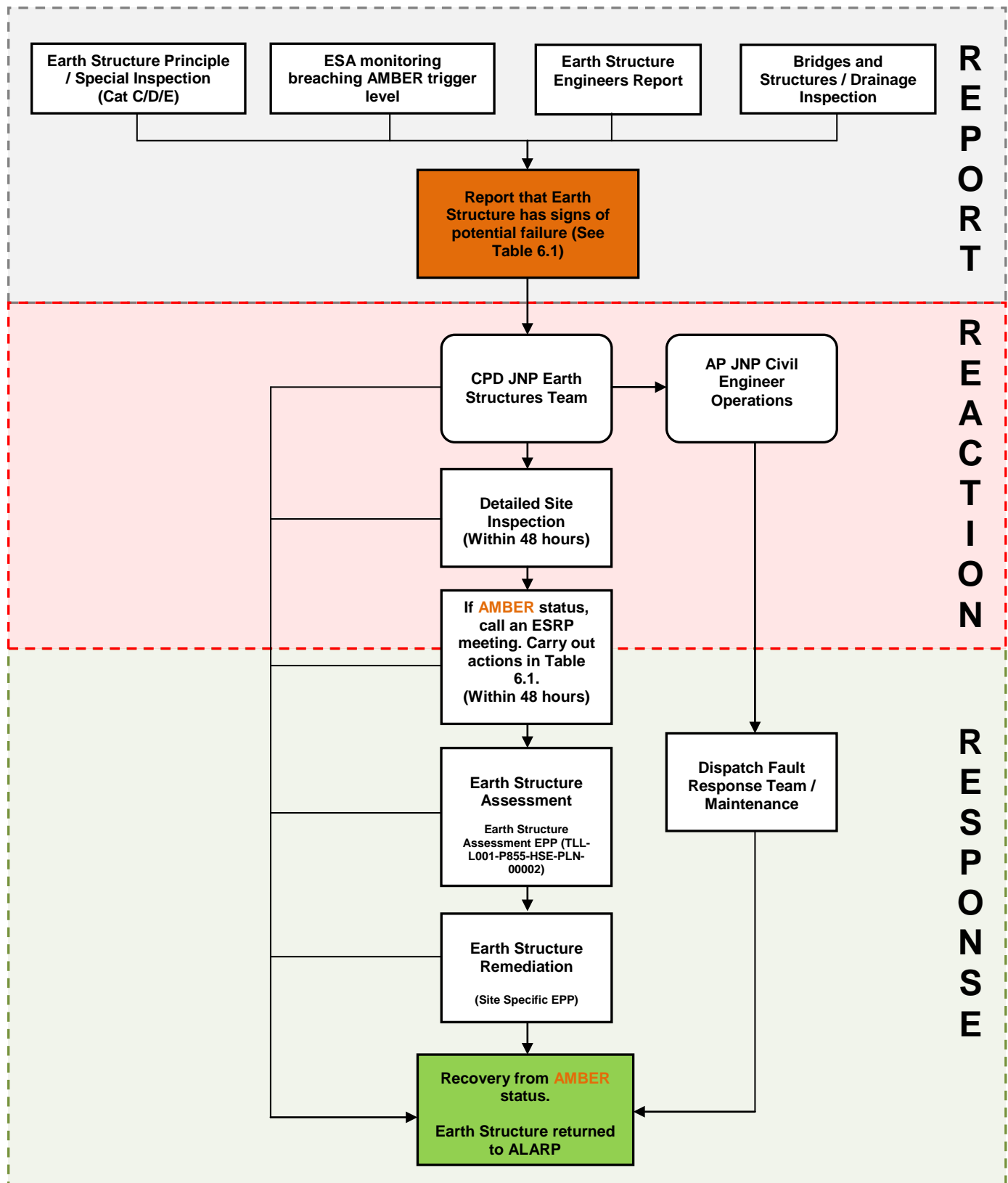


5. Activation and Deactivation of the Plan

The EPP will always be active and cannot be deactivated without the joint consent of the AP JNP CAM, CPD JNP CAE and CPD JNP ES team.

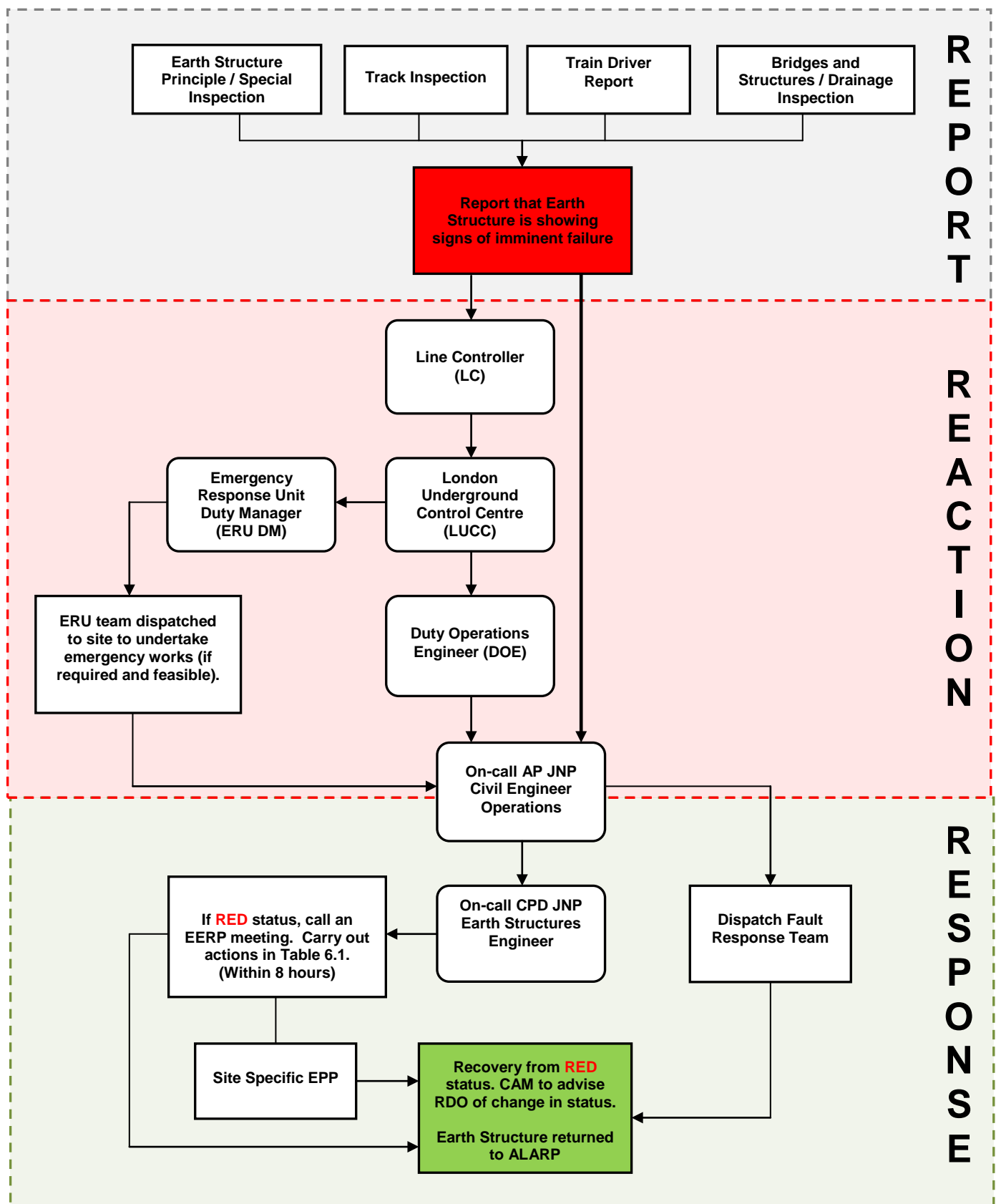
6. Actions in the Event of an Emergency

In the event of an **AMBER** status emergency, the following actions shall be carried out:





In the event of a **RED** status emergency, the following actions shall be carried out:





In the event of a **BLACK** status emergency, the following actions shall be carried out:

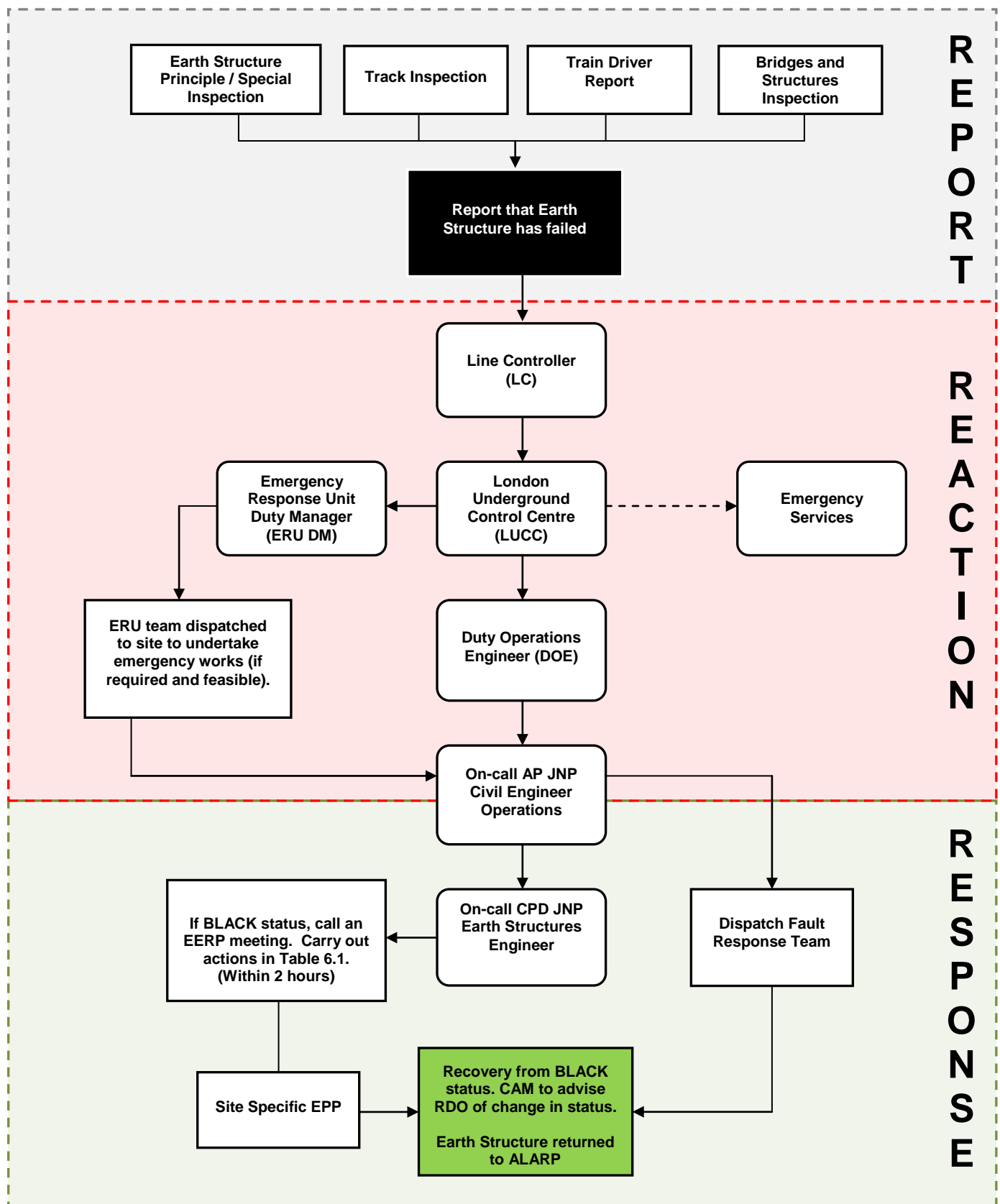




Table 6.1 Cutting Status Level and Response

<u>Status</u>	<u>Condition</u>	<u>Indicators</u>	<u>Action</u>
AMBER	Cutting showing signs of potential failure. Unsafe condition with safety risk or risk of suspension of service.	<p>Any but not limited to:</p> <ul style="list-style-type: none"> • Tension cracks. • Rise in track or cant / track deformation. • Toe bulging. • Water flow from within/over the slope. • Evidence of slope movement. • Excessive external loading above that originally designed for the slope. • PI/SI ACA condition rating <65% (C/D/E). • ESA monitoring breaching trigger level in recorded movements. • Retaining wall showing signs of failure. 	<p>1) Earth Structures Engineer to confirm status and inform CAM, if not already notified.</p> <p>2) Earth Structures Engineer to carry out Detailed Site Inspection within 48 hours.</p> <p>3) Earth Structures Engineer to convene ESRP meeting within 48 hours to determine the next actions. (See Section 7.1)</p> <p>4) Option to write a Site Specific EPP for the Earth Structure Asset.</p> <p>5) TRV data to be procured and assessed.</p>
RED	Cutting showing signs of imminent failure. Unsafe condition with significant safety risk or risk of suspension of service.	<p>Any but not limited to:</p> <ul style="list-style-type: none"> • Recently formed tension cracks. • Significant rise in track or cant / track deformation. • Recent toe bulging. • Heavy water flow from within/over the slope. • Visible slope movement. • Excessive external loading above that originally designed for the slope. • Retaining wall failing. 	<p>1) On-call Civil Engineer Operations to confirm the change in status and contact on-call Earth Structures Engineer.</p> <p>2) Civil Engineer Operations along with Earth Structures Engineer to make a judgement on the risk and implement safety measures such as TSR's, service suspension etc.</p> <p>3) Civil Engineer Operations will attempt to recover the situation using ERU and own Fault Response team.</p> <p>4) Earth Structures Engineer to convene Emergency Engineering Review Panel within 8 hours to determine the next actions. (See Section 7.2)</p>



<u>Status</u>	<u>Condition</u>	<u>Indicators</u>	<u>Action</u>
BLACK	Cutting failure too severe to continue train service.	<p>Any but not limited to:</p> <ul style="list-style-type: none"> • Track deformation too severe for trains run over. • Slope failure onto the track. • Slope failure leading to loss of support under the track. • Rapid movement of material down slope. • Significant risk of soil falling onto the track. • Retaining wall failure / collapse. 	<p>1) On-call Civil Engineer Operations to confirm the change is status and contact on-call Earth Structures Engineer.</p> <p>2) Civil Engineer Operations to call DOE and inform elevation to BLACK status. DOE to order suspension of service if this has not been done so already.</p> <p>3) Civil Engineer Operations will attempt to recover the situation using ERU and own Fault Response team.</p> <p>4) On-call Earth Structures Engineer to convene Emergency Engineering Review Panel within 2 hours to determine the next actions. (See Section 7.2)</p>



Table 6.2 Embankment Status Level and Response

<u>Status</u>	<u>Condition</u>	<u>Indicators</u>	<u>Action</u>
AMBER	Embankment showing signs of potential failure. Unsafe condition with safety risk or risk of suspension of service.	Any but not limited to: <ul style="list-style-type: none"> • Tension cracks. • Dip in track or cant / track deformation. • Toe bulging. • Water flow from within the slope. • Flooding at the toe of the slope. • Evidence of slope movement. • PI/SI ACA condition rating <65% (C/D/E). • ESA monitoring breaching trigger level in recorded movements. • Retaining wall showing signs of failure. 	<p>1) Earth Structures Engineer to confirm status and inform CAM, if not already notified.</p> <p>2) Earth Structures Engineer to carry out Detailed Site Inspection within 48 hours.</p> <p>3) Earth Structures Engineer to convene ESRP meeting within 48 hours to determine the next actions. (See Section 7.1)</p> <p>4) Option to write a Site Specific EPP for the Earth Structure Asset.</p> <p>5) TRV data to be procured and assessed.</p>
RED	Embankment showing signs of imminent failure. Unsafe condition with significant safety risk or risk of suspension of service.	Any but not limited to: <ul style="list-style-type: none"> • Recently formed tension cracks. • Significant flooding at toe of slope. • Significant dip in track or cant / track deformation. • Recent toe bulging. • Heavy water flow from within the slope. • Visible slope movement. • Retaining wall failing. 	<p>1) On-call Civil Engineer Operations to confirm the change in status and contact on-call Earth Structures Engineer.</p> <p>2) Civil Engineer Operations along with Earth Structures Engineer to make a judgement on the risk and implement safety measures such as TSR's, service suspension etc.</p> <p>3) Civil Engineer Operations will attempt to recover the situation using ERU and own Fault Response team.</p> <p>4) Earth Structures Engineer to convene Emergency Engineering Review Panel within 8 hours to determine the next actions. (See Section 7.2)</p>



<u>Status</u>	<u>Condition</u>	<u>Indicators</u>	<u>Action</u>
BLACK	Embankment failure too severe to continue train service.	<p>Any but not limited to:</p> <ul style="list-style-type: none"> • Track deformation too severe for trains run over. • Slope failure leading to loss of support under the track. • Rapid movement of material down slope. • Retaining wall failure / collapse. 	<p>1) On-call Civil Engineer Operations to confirm the change is status and contact on-call Earth Structures Engineer.</p> <p>2) Civil Engineer Operations to call DOE and inform elevation to BLACK status. DOE to order suspension of service if this has not been done so already.</p> <p>3) Civil Engineer Operations will attempt to recover the situation using ERU and own Fault Response team.</p> <p>4) On-call Earth Structures Engineer to convene Emergency Engineering Review Panel within 2 hours to determine the next actions. (See Section 7.2)</p>



6.1 Actions, Information Control and Situation Management

Actions In Response To An AMBER Emergency	
1.	The Earth Structures Engineer will confirm the status breach and inform the CAM, if this has not already been done.
2.	The Earth Structures Engineer will carry out a Detailed Site Inspection within 48 hours of the report.
Information Control & Situation Management	
1.	If an emergency AMBER status is declared, an Earth Structures Engineer will convene an ESRP meeting within 48 hours (Sections 6.2, 7.1).

Actions In Response To An RED/BLACK Emergency	
1.	The report will be made to the Line Controller, who in turn will inform the LUCC.
2.	The LUCC will make a judgement and if necessary dispatch an ERU team, or in extreme circumstances the emergency services. They will also inform the DOE, if this has not been done so already.
3.	The DOE will contact the on-call Civil Engineer Operations. The Civil Engineer Operations will make a judgement on the severity of the emergency, allocating it a RED or BLACK status and follow actions set down in Table 6.1. They will also liaise with the ERU and their own Fault Response Team to attempt to recover the situation.
4.	If required, the Civil Engineer Operations will contact the on-call Earth Structures Engineer, who will provide technical advice over the phone, or attend site if needed within 4 hours. The on-call Earth Structures Engineer will also have access to asset specific information, along with suggested feasible remedial solutions.
Information Control & Situation Management	
1.	If an emergency RED status is declared, the on-call Earth Structures Engineer will convene an EERP meeting within 8 hours (Sections 6.3, 7.2).
2.	If an emergency BLACK status is declared, the on-call Earth Structures Engineer will convene an EERP meeting within 2 hours (Sections 6.3, 7.2).



6.2 Earth Structure Review Panel Meeting

Should emergency **AMBER** status be declared, an Earth Structure Review Panel (ESRP) meeting will be called within 48 hours.

The ESRP meeting may use teleconference facilities if necessary. A preliminary checklist for discussion during the Review Panel meeting is included in Appendix B.

An Earth Structures Engineer shall be responsible for assembling the Review Panel, contact details for each member can be found in Appendix A. The Review Panel is to include the following representatives or their deputies as follows:

EARTH STRUCTURE REVIEW PANEL REPRESENTATIVES		
Representative	Directorate	Person
Principle Lead Engineer (Earth Structures)	CPD JNP	Athanasios Papachrysanthou
Construction Manager (Earth Structures)	CPD JNP	Martyn Tribe
Support Construction Manager (Earth Structures)	CPD JNP	Joseph Kennedy
Civil Asset Engineer	CPD JNP	Kevin Stoakes
Infrastructure Delivery Manager	CPD JNP	Sadie Moore
Civil Asset Manager	AP JNP	Ismail Suleyman
Engineering Manager	CPD JNP	Kelly Allen
Permanent Way Asset Engineer	AP JNP	Sean Tarrant



6.3 Emergency Engineering Review Panel Meeting

Should emergency **RED** status be declared, an Emergency Engineering Review Panel (EERP) meeting will be called within 8 hours.

Should emergency **BLACK** status be declared, an Emergency Engineering Review Panel (EERP) meeting will be called within 2 hours.

The EERP meeting may use teleconference facilities if necessary. LU shall be informed of the time and location. A preliminary checklist for discussion during the Review Panel meeting is included in Appendix B. Minutes of the EERP should be sent to the LU JNP Director of HS&E within 24 hours of the meeting (for forwarding address see Appendix E).

The on-call Earth Structures Engineer shall be responsible for assembling the Review Panel, contact details for each member can be found in Appendix A. The Review Panel is to include the following representatives or their deputies as follows:

EMERGENCY ENGINEERING REVIEW PANEL REPRESENTATIVES		
Representative	Directorate	Person
On-Call Earth Structures Engineer	CPD JNP	Ref. Appendix D for relevant person/s
On-Call Civil Engineer Operations	AP JNP	Ref. Appendix D for relevant person/s
Principle Lead Engineer (Earth Structures)	CPD JNP	Athanasios Papachrysanthou
Construction Manager (Earth Structures)	CPD JNP	Martyn Tribe
Support Construction Manager (Earth Structures)	CPD JNP	Joseph Kennedy
Civil Asset Engineer	CPD JNP	Kevin Stoakes
Infrastructure Delivery Manager	CPD JNP	Sadie Moore
Civil Asset Manager	AP JNP	Ismail Suleyman
Engineering Manager	CPD JNP	Kelly Allen
Permanent Way Asset Engineer	AP JNP	Sean Tarrant



7. Recovery Plan

7.1 Recovery from **AMBER** status – Earth Structure Review Panel Meeting

Should an emergency **AMBER** status be declared, the ESRP shall meet or otherwise communicate to establish the actions to be taken subsequent to the change of status. The ESRP may decide to:

- Return to a non-emergency ALARP status.
- Upgrade to emergency **RED/BLACK** status (Section 7.2) and instruct other actions, which may include the deployment of TSR's, emergency remedial measures, detailed monitoring etc.
- Maintain emergency **AMBER** status and agree actions including Earth Structure Assessment, increased inspections, monitoring, maintenance, site investigation.
- Option to produce a Site Specific EPP or use the Earth Structure Assessment EPP (Doc No. *TLL-B084-P412-ESRP4-40-EST-STR-00002*), if assessment is the approach decided in the meeting.

The panel will accordingly advise other parties involved of their decision.

7.2 Recovery from **RED/BLACK** status – Emergency Engineering Review Panel Meeting

Should an emergency **RED/BLACK** status be declared, the EERP shall meet or otherwise communicate to establish the actions to be taken subsequent to the change of status. The EERP may decide to:

- Return to a non-emergency ALARP status.
- Reduce to an **AMBER** or **RED** status and agree action including Earth Structure Assessment, increased inspections, monitoring, maintenance, site investigation, TSR's.
- Option to produce a Site Specific EPP or use the Earth Structure Assessment EPP (Doc No. *TLL-B084-P412-ESRP4-40-EST-STR-00002*), if assessment is the approach decided in the meeting.
- Maintain or upgrade to emergency **BLACK** status and instruct other actions, which may include the deployment of TSR's, emergency remedial measures, detailed monitoring etc.

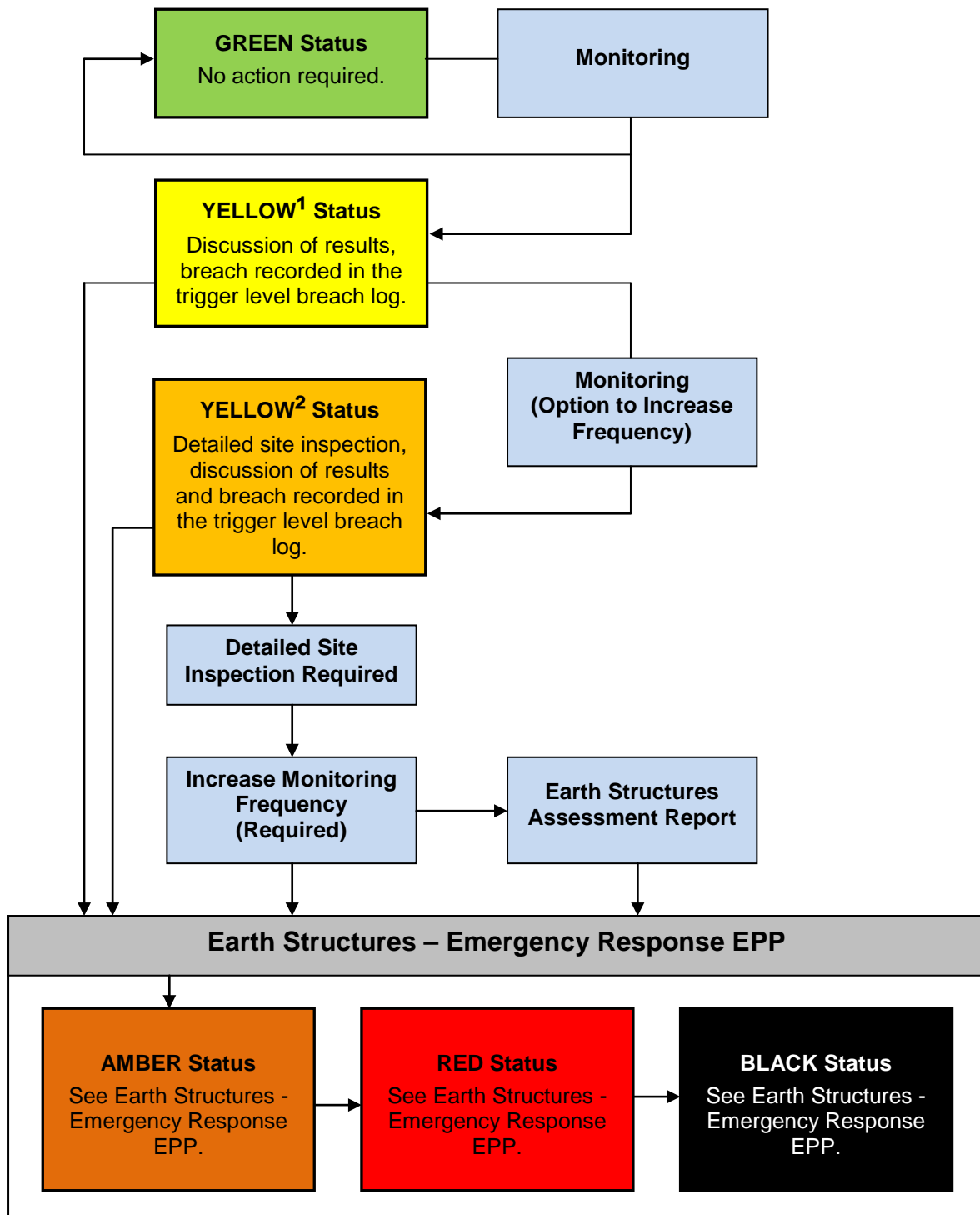
The panel will accordingly advise other parties involved of their decision.

Following downgrading from emergency **BLACK** status, the EERP shall make a recommendation to the RDO on the proposed resumption of service. The RDO shall make the final decision on resumption of services following downgrading from emergency **BLACK** status and shall inform other parties involved of their decision.



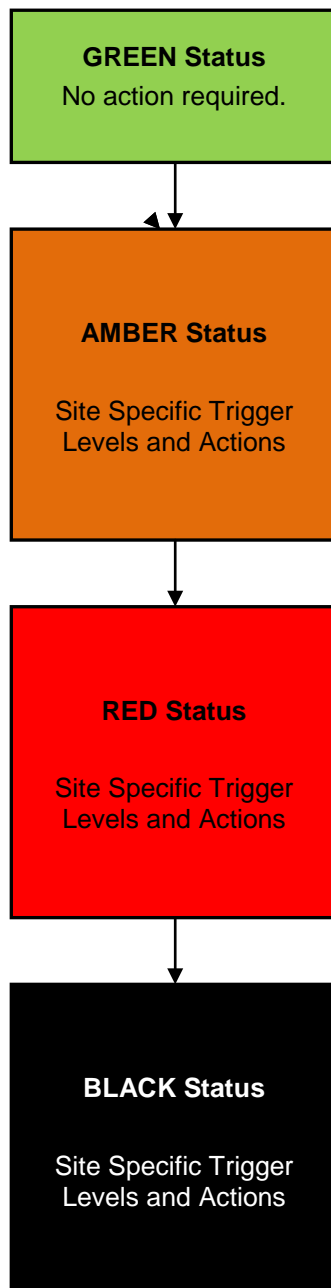
8. Route from Earth Structure Assessment EPP

Earth Structure Assets undergoing Earth Structure Assessment (ESA) fall under their own specific ESA EPP (Doc. No.TLL-L001-P855-HSE-PLN-00002). Earth Structure monitoring provides recorded movements to which trigger level values and actions can be assigned. However, the ESA EPP reverts back to this Emergency Response EPP for AMBER, RED and BLACK trigger levels as the below flow diagram shows.



9. Earth Structure Site Specific EPP

Earth Structure Assets that are regarded as high risk, or undergo Earth Structure Remediation, fall under their own Site Specific EPP. They will adopt the same AMBER, RED and BLACK status conditions, with associated site specific trigger levels and actions. This allows consideration on site specific issues such as access constraints, risk to neighbouring structures, consequences of failure to be considered, along with possible feasible remedial solutions.





Appendices



Appendix A – EMERGENCY COMMUNICATION DIRECTORY

LU Engineering		
Function/Name	Telephone/Mobile	Email
On-call Earth Structures Engineer	See Appendix D	-
On-call Civil Engineer Operations	See Appendix D	-
CPD JNP Principle Lead Engineer Athanasios Papachrysanthou	[REDACTED]	[REDACTED]
CPD JNP Construction Manager Martyn Tribe	[REDACTED]	[REDACTED]
CPD JNP Support Construction Manager Joseph Kennedy	[REDACTED]	[REDACTED]
AP JNP Civil Asset Manager Ismail Suleyman	[REDACTED]	[REDACTED]
CPD JNP Civil Asset Engineer Kevin Stoakes	[REDACTED]	[REDACTED]
CPD JNP Infrastructure Delivery Manager Sadie Moore	[REDACTED]	[REDACTED]
CPD JNP Permanent Way Asset Engineer Sean Tarrant	[REDACTED]	[REDACTED]
CPD JNP Engineering Manager Kelly Allen	[REDACTED]	[REDACTED]

LU Operational		
Function	Telephone (BT)	LU Auto-Phone
LU Control Centre (LUCC)	[REDACTED]	[REDACTED]
Rostered Duty Officer (RDO)	Contact via LUCC	Contact via LUCC
Duty Engineer	Contact via LUCC	Contact via LUCC
JNP Duty Operations Engineer (DOE)	[REDACTED]	[REDACTED]
JNP Control Centre	[REDACTED]	[REDACTED]



Appendix B – CHECKLIST FOR ESRP / EERP MEETING

Tick when complete

- | | |
|--|--------------------------|
| 1. Ensure all Review Panel members are represented. | <input type="checkbox"/> |
| 2. Review all available information. | <input type="checkbox"/> |
| 3. Review reasons for Status Change: | <input type="checkbox"/> |
| <ul style="list-style-type: none">• Earth Structure deterioration?• Inclement weather?• Structure failure?• External influences? | |
| 4. Determine actions required. | <input type="checkbox"/> |
| 5. If required, determine requirements for additional surveys and investigations: | <input type="checkbox"/> |
| <ul style="list-style-type: none">• Check track geometry.• Check embankment stability and serviceability.• Additional ground investigation.• Monitoring installation. | |
| 6. If required, agree and organise a monitoring schedule with trigger levels under the Earth Structure Assessment EPP or site specific EPP. | <input type="checkbox"/> |
| 7. Agree actions and communicate to all parties, including LU, and CPD JNP Director of HS&E. | <input type="checkbox"/> |
| 8. Review any changes/updates to CPD JNP Corporate Risk Register. | <input type="checkbox"/> |



Appendix C – PREPARATION ACTION LIST

The table below is the list of actions that will be performed and determined frequencies to help ensure awareness and that suitable emergency preparedness and response is available and/or are in place should this be required.

Action	Responsibility	Remedial Action	Frequency
Check each phone number in the emergency directory for correctness. (Appendix A + D)	AP JNP Civil Asset Manager	Revise document to ensure correct numbers and reissue.	Monthly.
Update the DOE of the anticipated EPP activation.	AP JNP Civil Asset Manager	Inform DOE. Provide training as necessary.	On activation.
Ensure that all people on the distribution list have the most recent version of the EPP and that they are aware of their involvement.	AP JNP Civil Asset Manager	Issue most recent version of the document.	Any change to the EPP.
Ensure that an on-call Civil Engineer Operations is always available and trained to a sufficient competency.	AP JNP Civil Asset Manager	Review the on-call list and competency of the staff on it.	Six monthly.
Ensure that an on-call Earth Structures Engineer is always available and trained to a sufficient competency.	CPD JNP Earth Structures Team	Review the on-call list and competency of the staff on it.	Six monthly.
Ensure that a framework of ground investigation and civil engineering contractors are of a sufficient competency and available to respond in an emergency.	CPD JNP Earth Structures Team	Review the framework of contractors and ensure emergency preparedness and competency.	Six monthly.
Ensure that asset specific information on all Earth Structures is kept up to date and available.	CPD JNP Earth Structures Team	Review the database and update any recent information.	Six monthly.
Ensure that feasibility study for temporary or permanent emergency remediation on each asset is undertaken and updated.	CPD JNP Earth Structures Team	Complete feasibility study and check that still applicable and best industry practise.	Annual Review.
Ensure the ability to instigate emergency monitoring / topographical surveys within 24 hours of an emergency situation.	CPD JNP Earth Structures Team	Check that the CPD JNP Survey team have the ability to meet the 24 hour response time and a store of survey materials is always available.	Six monthly.
Ensure the ability to undertake earth Structure Assessments immediately following an emergency status change.	CPD JNP Earth Structures Team	Check that the CPD JNP Survey team have the ability to meet the 24 hour response time and a store of survey materials is always available.	Six monthly.



Appendix D – ON-CALL LIST

In the event of an emergency situation, the DOE may contact the on-call Civil Engineer Operations:

On-Call Civil Engineer Operations			
Name	Job Title	Dates/Shifts	Telephone/Mobile
Ismail Suleyman	Civil Asset Manager		
Babajide Oriogun	Structures Manager		
Dominic Andoh	Inspector Manager		
Wohid Noman	Structures Support Manager		
Donavan Ellis	Drainage Support Manager		
(TBC) Robert Pain	Drainage Manager		

In the event of an emergency **RED/BLACK** status the Civil Engineer Operations may contact the on-call Earth Structures Engineer:

On-Call Earth Structures Engineer				
Name	Job Title	Dates/Shifts	T&C001 License Holder	Telephone/Mobile
Joseph Kennedy	Support Construction Manager		Yes	
Athanasios Papachrysanthou	Lead Principal Engineer		No	
Martyn Tribe	Construction Manager		Yes	
Oscar Azumendi	Discipline Engineer		No	



Appendix E – CONTACT FOR LU JNP DIRECTOR OF HSE&E

Name	Responsibility	Email	Contact No
Catherine Behan	Head of HS&E Capital Programmes LU	catherine.behan@tube.tfl.gov.uk	[REDACTED]
Denice Moss	HS&E Senior Manager JNP Projects	denice.moss@tubelines.com	[REDACTED]