

We are seeking an extended tunnel  
through the Chilterns

The only AONB on the route of HS2

# I will describe Engineering and Environmental Aspects of the extended tunnel

I am Bruce Blaine; BSc Eng (Civil), MSc, CEng, MICE,  
MCIWEM, MIEMA.



# I represent

- Buckinghamshire County Council;
- Chiltern DC;
- Aylesbury Vale DC;
- South Bucks DC;
- Chilterns Conservation Board

# Can there be a tunnel?

**YES!**

- PBA have undertaken a full study of options

# Can there be a tunnel?

**YES!**

- HS2 Ltd have confirmed it
  - Arup studies of 2012
  - HS2 review of CRAG T2 tunnel – May 2013
  - Statement in ES Vol 2 CFA 9 para 2.6.14

*"While the extended options are feasible in engineering terms and would have an environmental benefit, there would be a financial cost in extending the bored tunnel."*
  - HS2 review of Green Route – November 2014
  - HS2 review of Long Tunnels; Pts 1,2,3,4&5 – June 2015

# PBA Work

- Reviewed routes through the Misbourne Valley
- Used HS2 Design Standards

# PBA Work

- Selected two preferred routes
- Agreed a final preferred route with CDC and the other authorities



# PBA Work

- Developed the design and reported (Green Route)
- Revised the design to suit new safety standard – Chilterns Long Tunnel

# Chilterns Long Tunnel

- Supported by these local petitioners:
  - 5 Local Authorities
  - 5 Parish Councils
  - 9 Civic societies and charities
  - 9 Residents Groups



# Chilterns Long Tunnel

- Complies with latest TSI (Safety in Railway Tunnels 2014)
  - Requires a safety intervention at up to 20km intervals, or some other facility, or trains designed to go further than 20km under own power.
  - Allows for an underground fire fighting point
  - Please note: in any event, there must be a safety risk assessment which can allow for longer than 20km in a tunnel

# Chilterns Long Tunnel

- CLT, includes an underground Fire Fighting Point,

However it could be:

- CLT i has an open to air Intervention Gap  
Or
- avoided after a safety risk assessment



# Chilterns Long Tunnel (CLT)

- Provides for Stoke Mandeville Maintenance Loop
  - Operational need might reduce
  - Crossover provision is to rail standards

# CLT Route description

- Takes account of rail design and geology
- In plan follows the Government Proposed Scheme (GPS) to Leather Lane

# CLT Route description

- A slight deviation westwards to cross under the A413
- North Portal positioned on more steeply sloping ground
  - Rapid increase in cover
  - Better geological interface



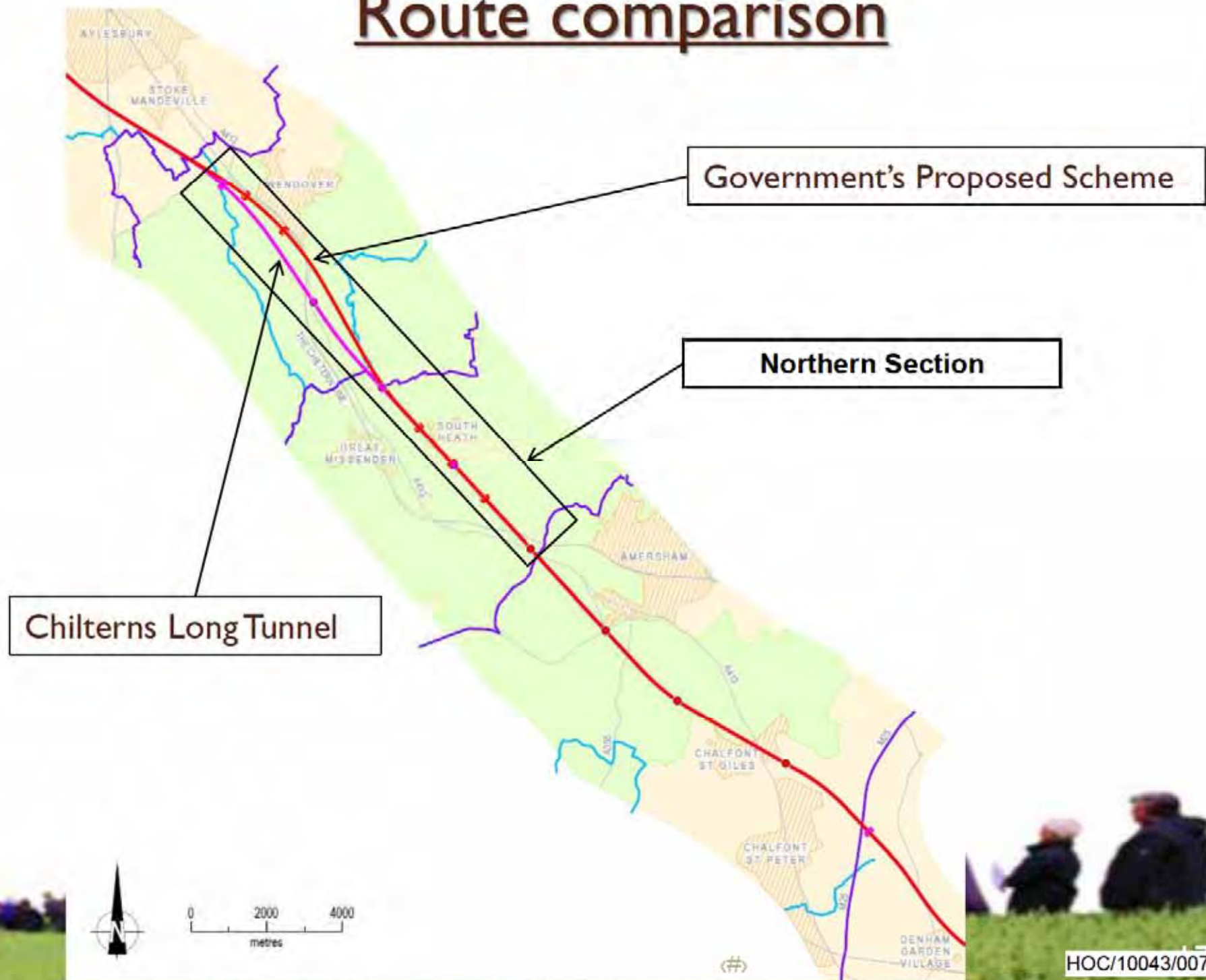
# CLT Route description

- 3 additional vent shafts
- Underground Fire Fighting Point
  - proposed at Little Missenden Vent Shaft

# Route comparison

- Next slide will show a plan of the two routes to indicate the key difference
- The box surrounds the NORTHERN SECTION from Little Missenden VS to the AONB boundary
- This box will be represented and referred to regularly

# Route comparison



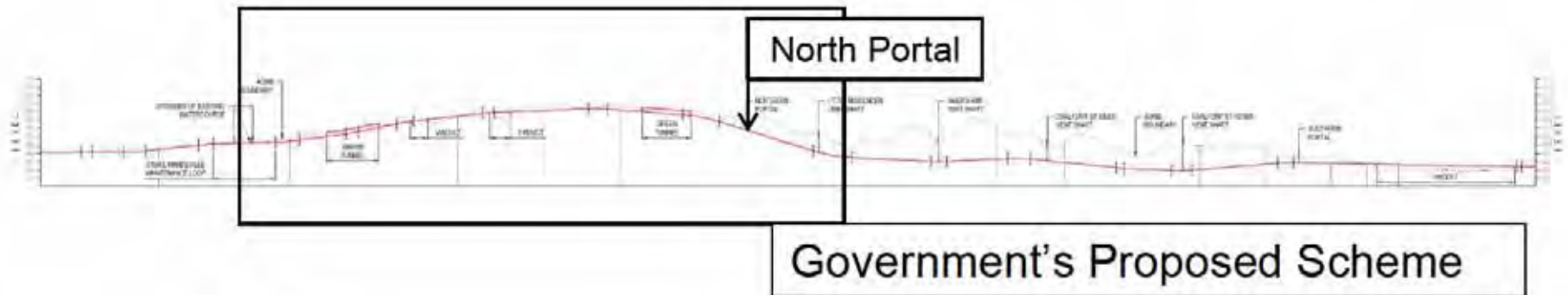
# Route comparison

- The Chilterns Long Tunnel follows exactly the same line as the Government's Proposed Scheme in tunnel from M25 to Little Missenden Vent Shaft
  - Over next 11 km continues in tunnel
  - Deviates from the Government's Proposed Scheme alignment
- but
- Less than 500m apart in plan in the northern section

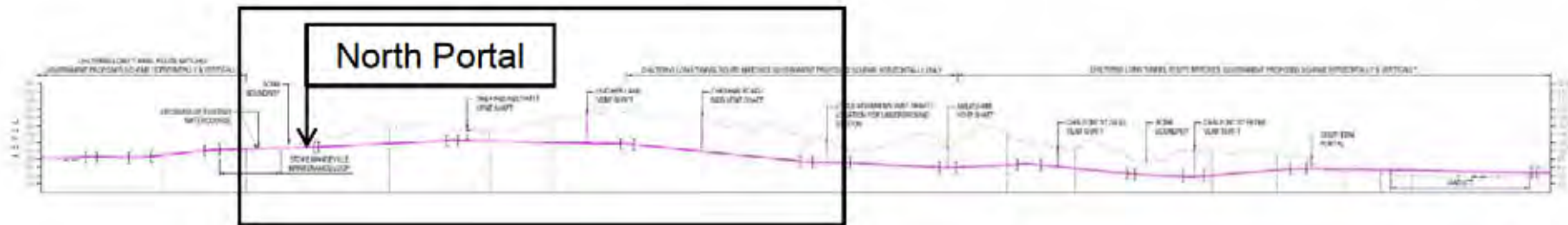
# Route comparison

- The next slide shows the two routes in section over the whole length through the AONB
- The box indicates the northern section, where the CLT has a lower alignment – in tunnel

## Route Comparison through AONB



## Northern Section



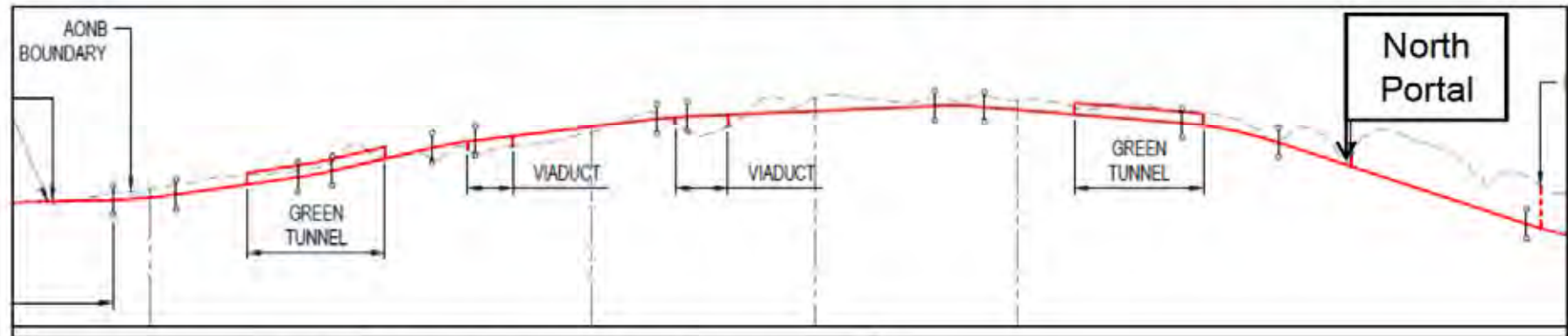
Chilterns Long Tunnel



# Route comparison

- The next slide shows the two routes in more detail through the northern section
- The lower alignment of the Chilterns Long Tunnel can be seen more clearly

# Route comparison – Northern Section



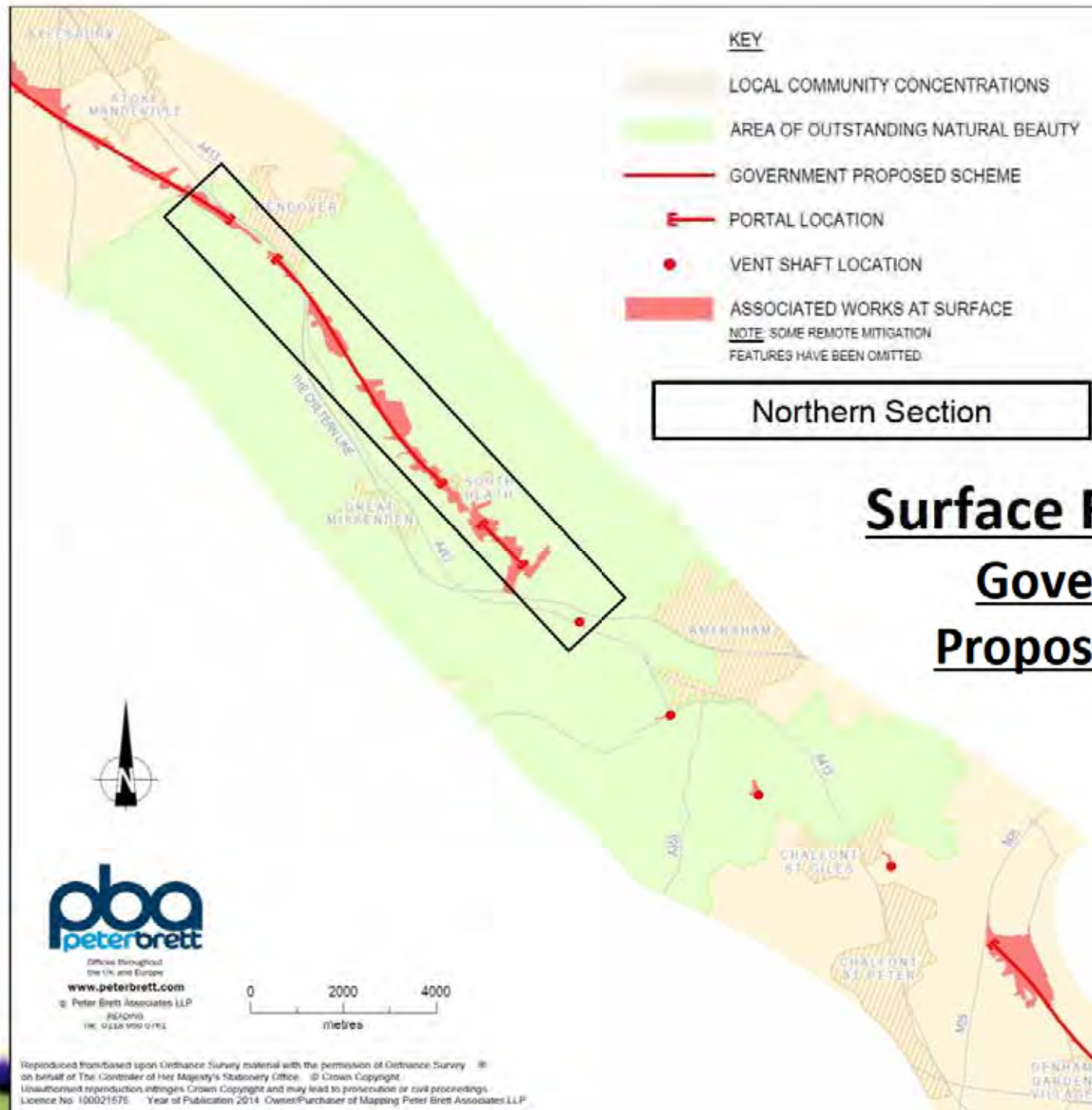
Government's Proposed Scheme

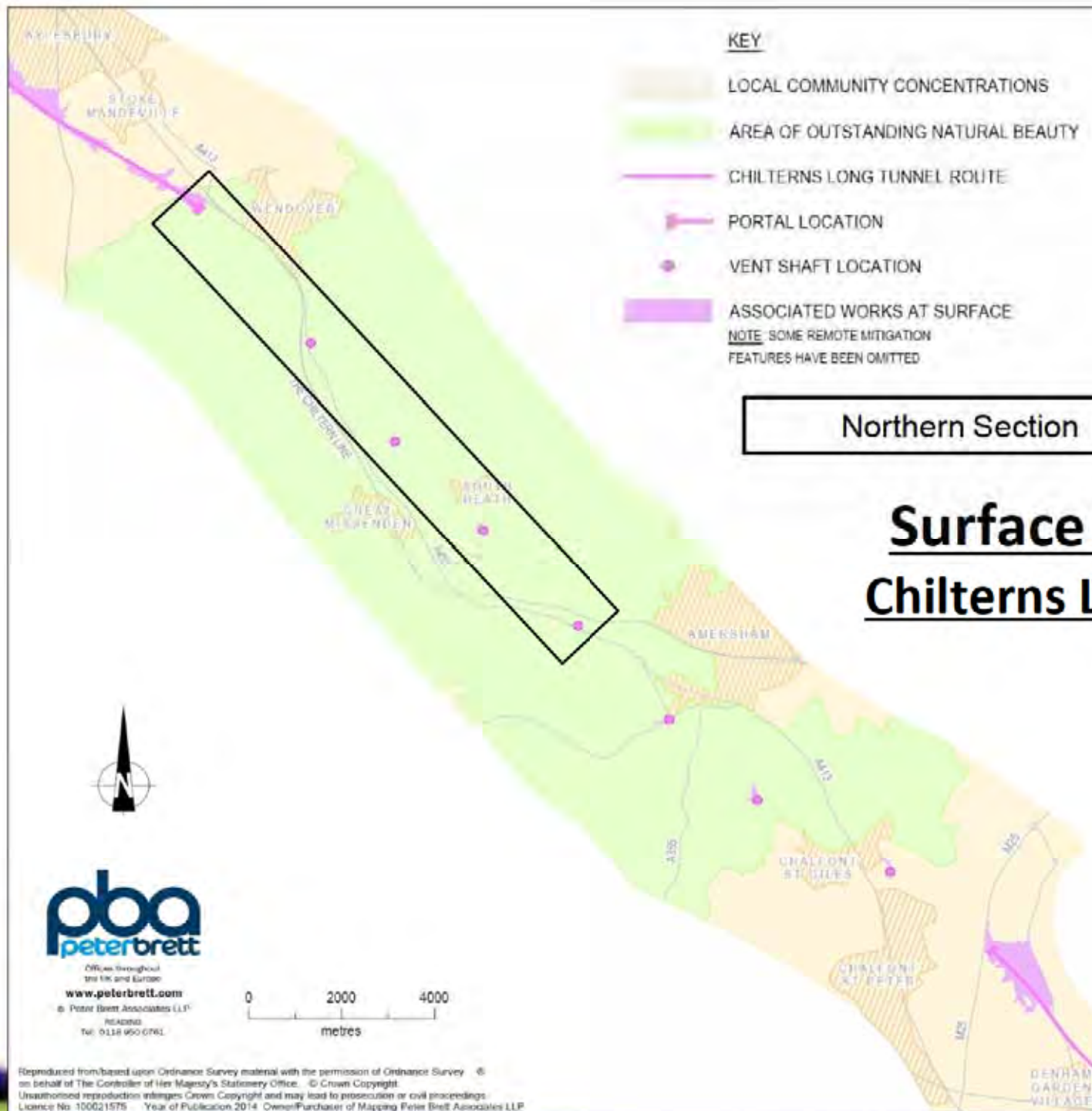


Chilterns Long Tunnel

# Route comparison

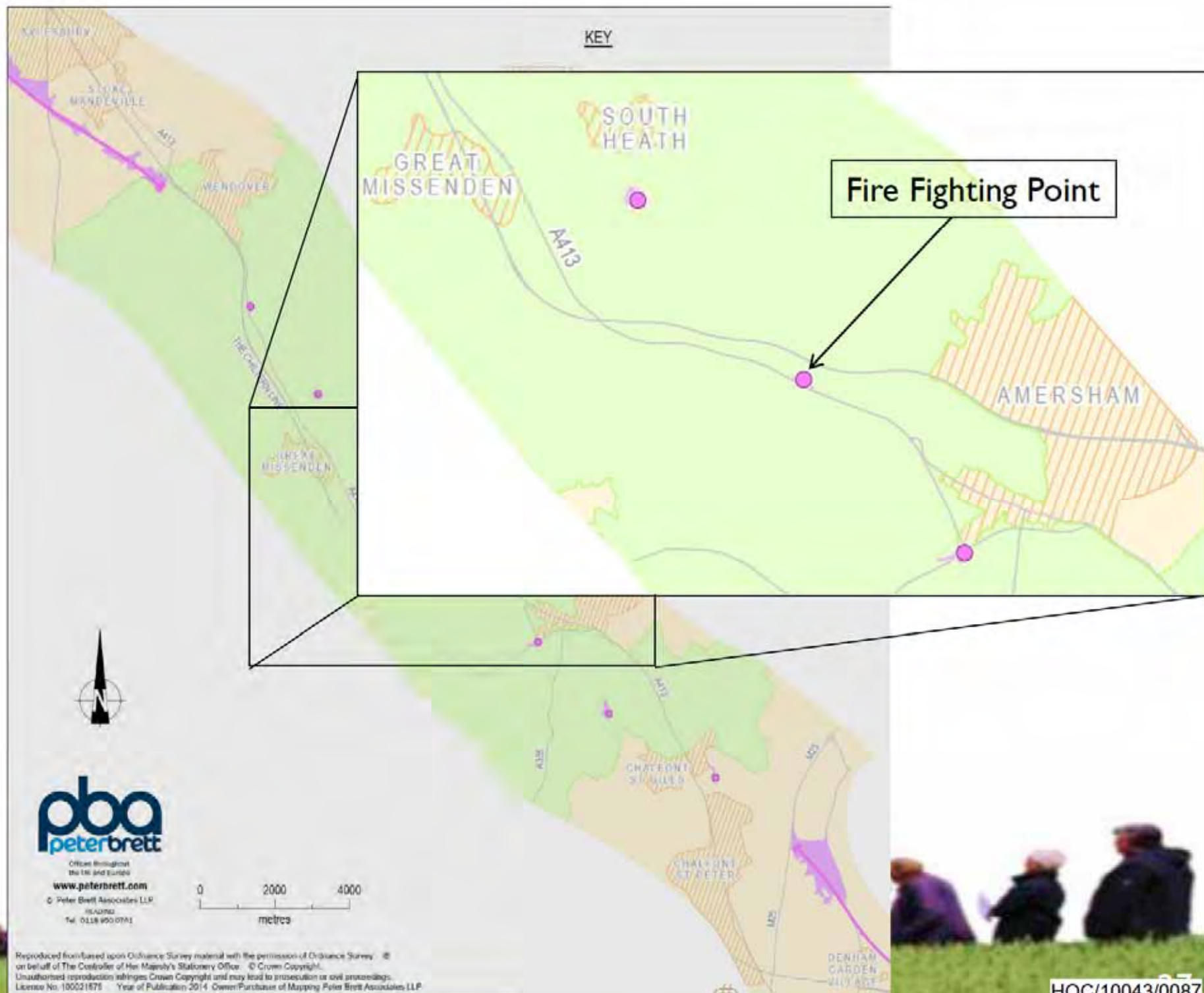
- The next two slides show the effect on the SURFACE of the two routes when completed
- The Government's Proposed Scheme cuts across **8,870 m of AONB**
- The CLT cuts across **405 m of AONB**
  - mainly at northern boundary





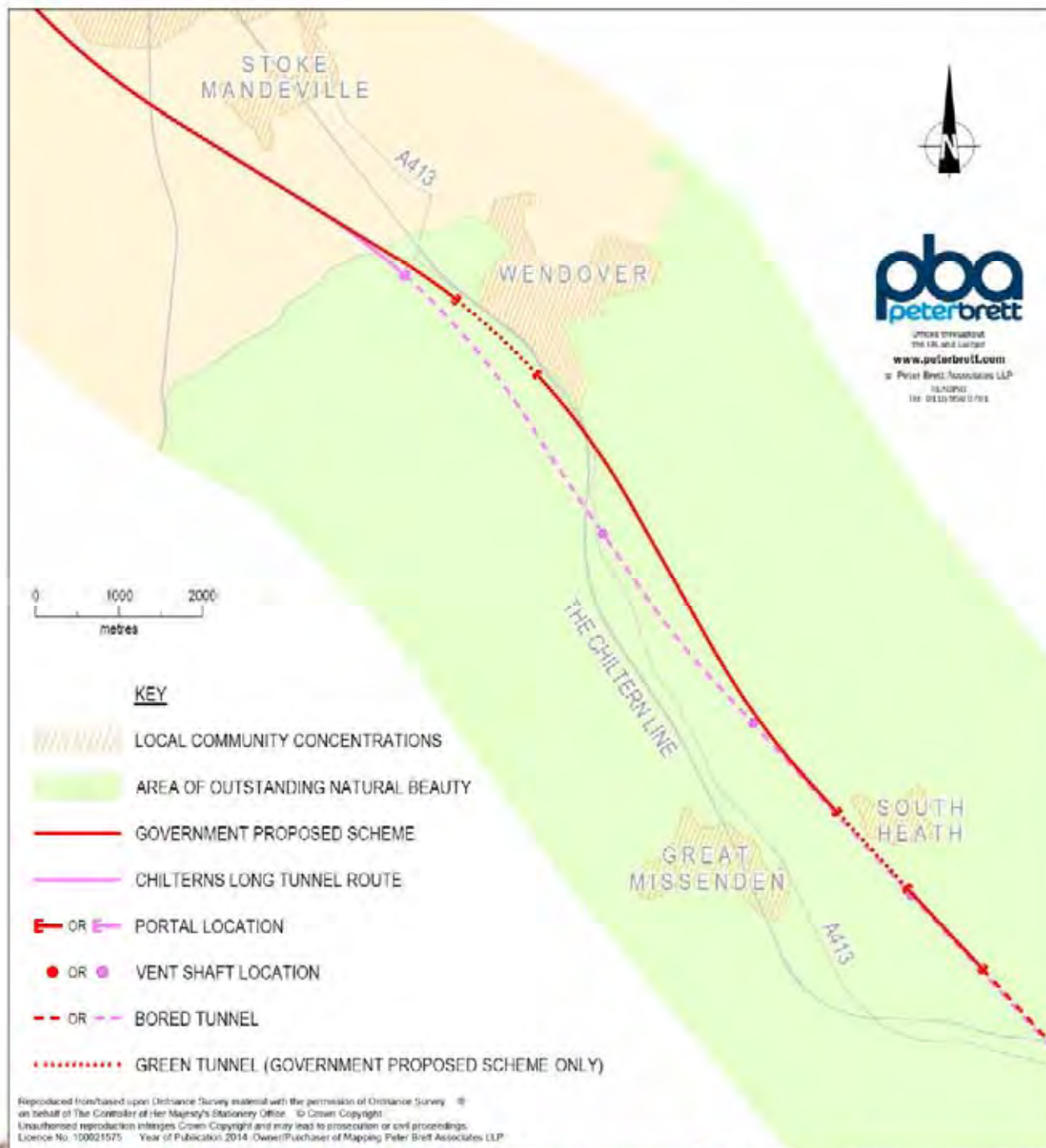
# Route comparison

- The next slide shows the location of the underground Fire Fighting Point if there is one or a need for one
  - at Little Missenden Vent Shaft
  - adjacent to A413



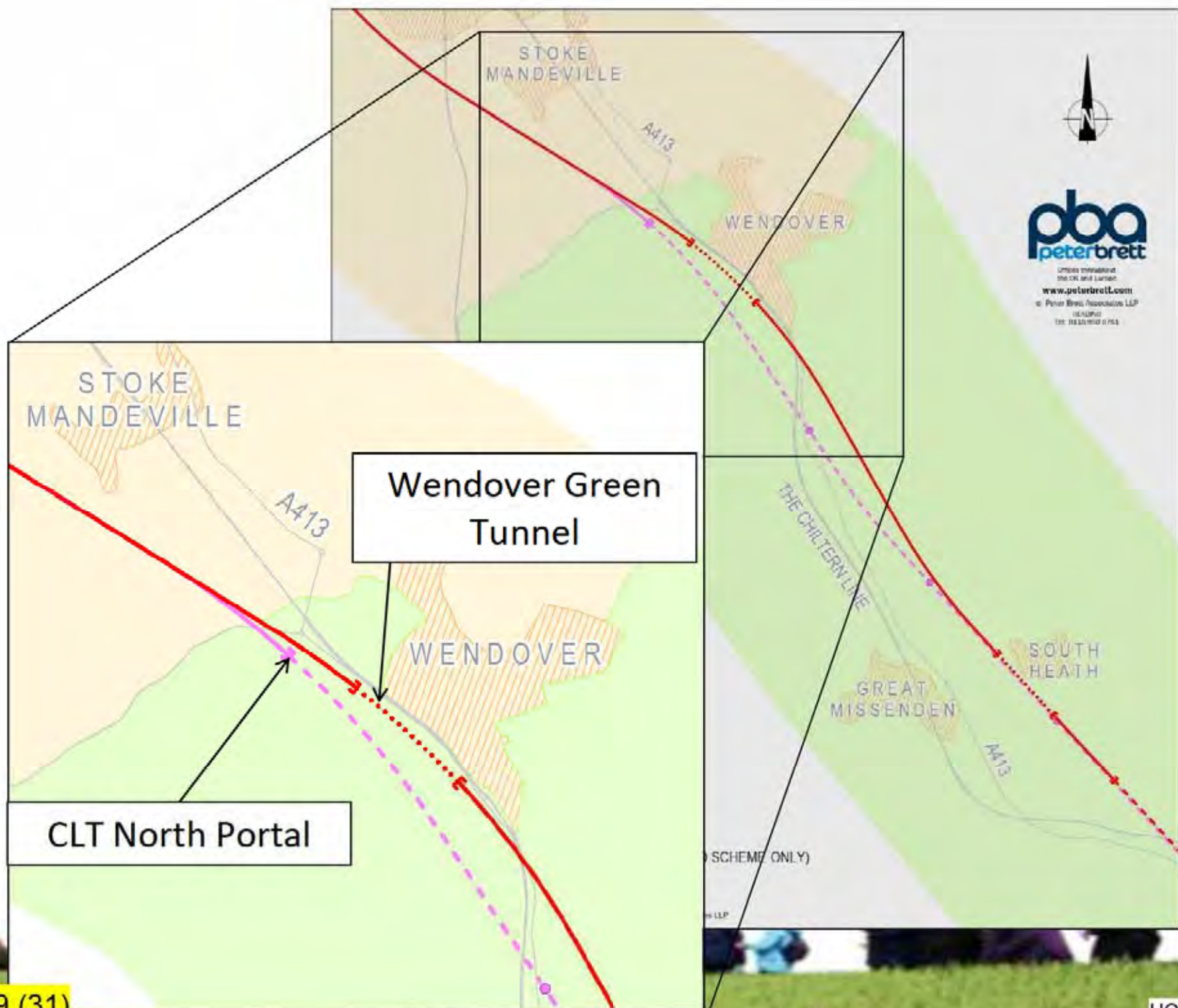
# Route comparison

- The next slide shows the difference in horizontal alignment between Great Missenden and Wendover
- CLT passes beneath A413, Chiltern Line and Bacombe Hill



# Route comparison

- The next slide identifies the position of the CLT North Portal in relation to the Wendover Green Tunnel in the Government's Proposed Scheme and the AONB boundary



# Construction of CLT

- **4 Tunnel Boring Machines**
  - 2 in each direction
  - Meet and withdrawn at Little Missenden Vent Shaft
- **Balanced drives**
  - 7 weeks shorter than proposed Chiltern Tunnel

# Construction of CLT

- Affects <50ha of AONB
- Work sites concentrated at discrete locations:
  - Vent shafts
  - North portal

# Construction of CLT

- South portal drive site
  - As proposed by HS2 Ltd
  - 1.1km shorter drive length
  - Quantity of arisings at South Portal reduced by  $\pm 10\%$

# Construction of CLT

- North portal drive site
  - Additional land outside of AONB
  - Avoids need for significant land in AONB

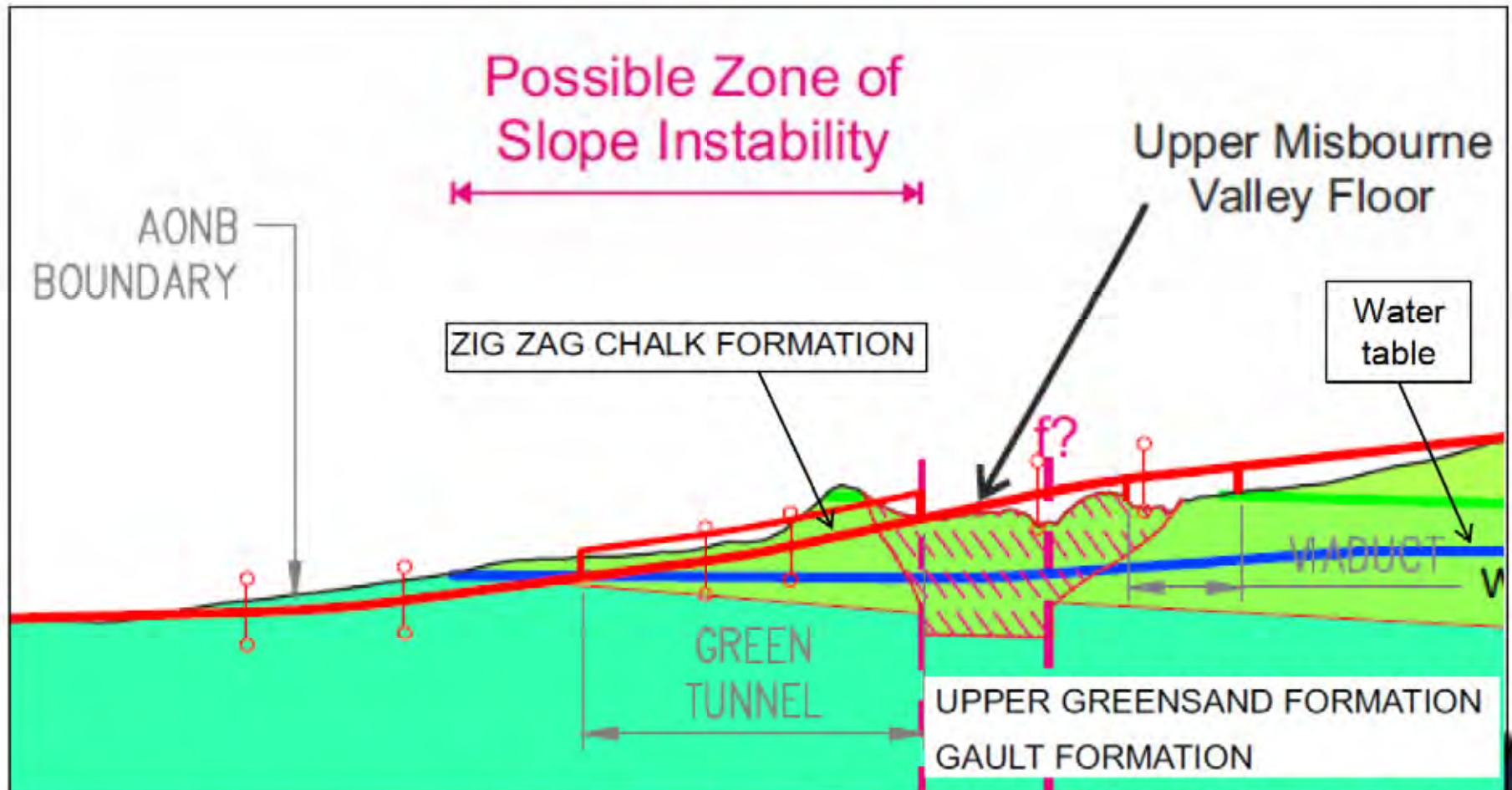
# Construction of CLT

- North Portal position suited to topography and geology
- Can be screened by local landscape mounding
- Founded in stable geological strata

# Construction of GPS

- Next slide shows the geology at the Wendover Green Tunnel
  - Groundwater level – blue line
  - Green Tunnel constructed in unstable ground
  - Groundwater flow fissures intersected
  - Upper greensand/Gault - impermeable

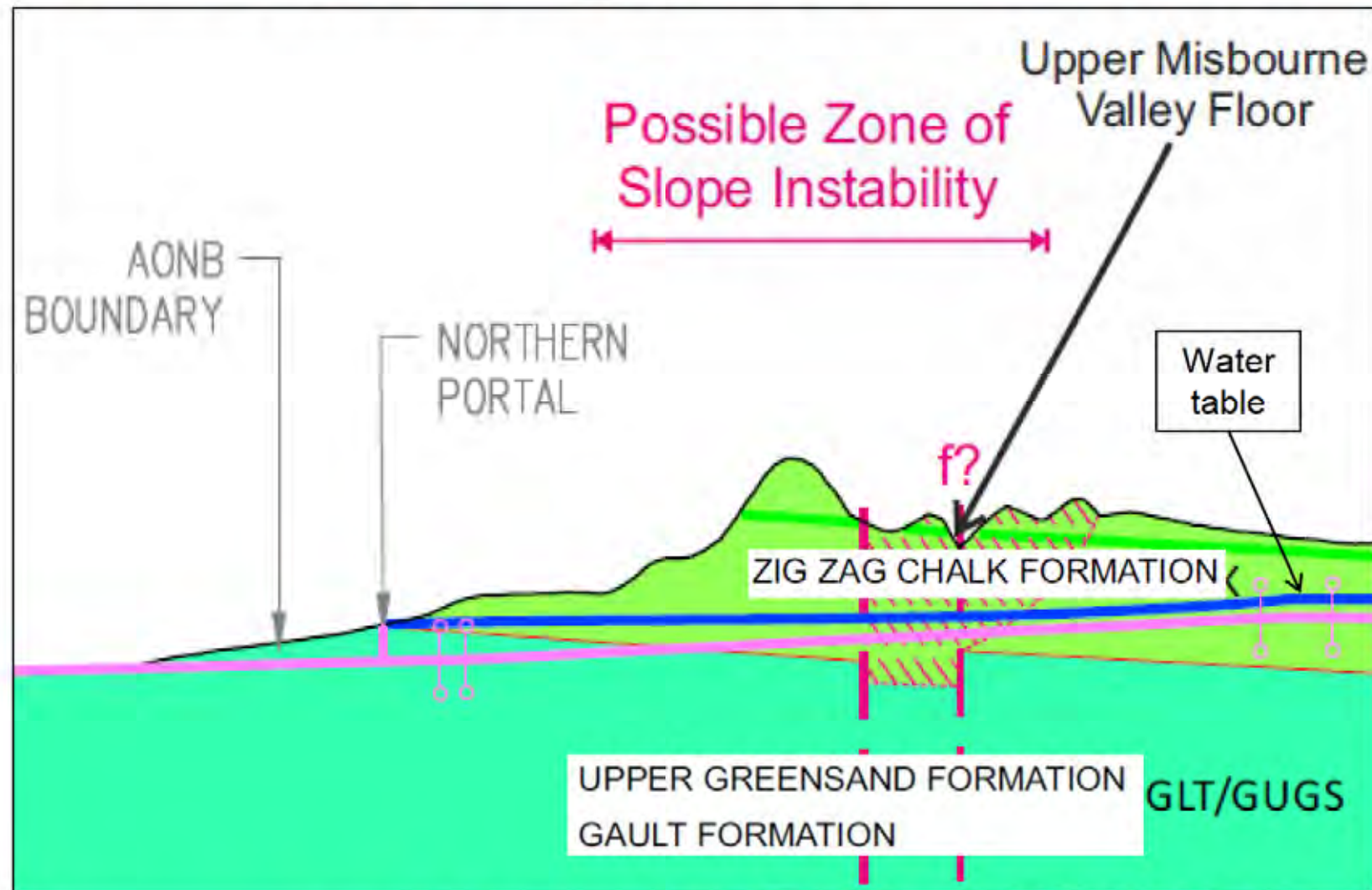
# Government Proposed Scheme – Wendover Green Tunnel



# Construction of CLT

- Next slide shows the geology at the CLT North Portal
  - Groundwater level – blue line
  - Tunnel bored through zone of instability
  - Upper greensand/Gault – impermeable / stable

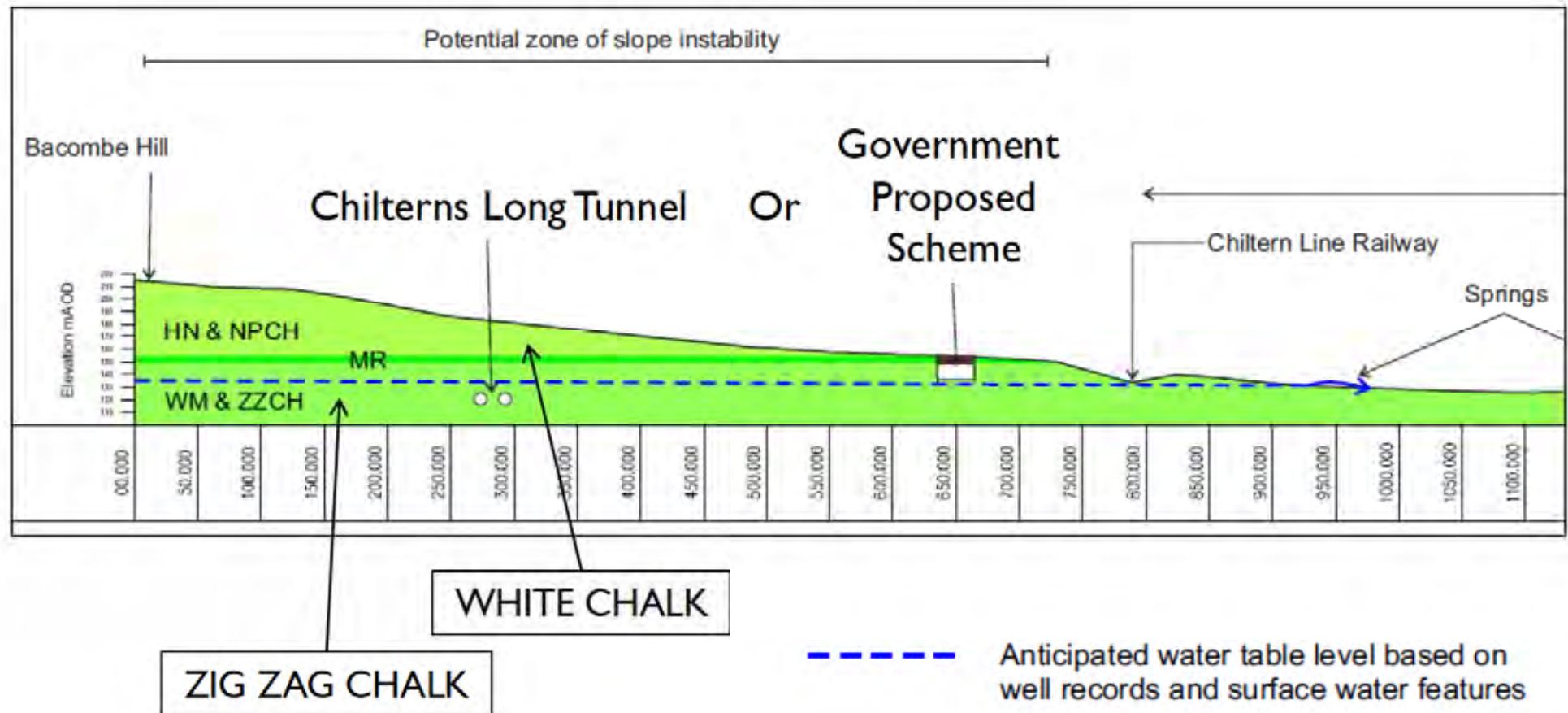
# Chilterns Long Tunnel – North Portal



# Construction of CLT

- Next slide shows a cross-section through this important feature in AONB showing:
- Groundwater level – blue line
- The CLT bores passing beneath, whereas
- The GPS sits on the water table and potentially interferes with springs

# Cross Section - showing both schemes



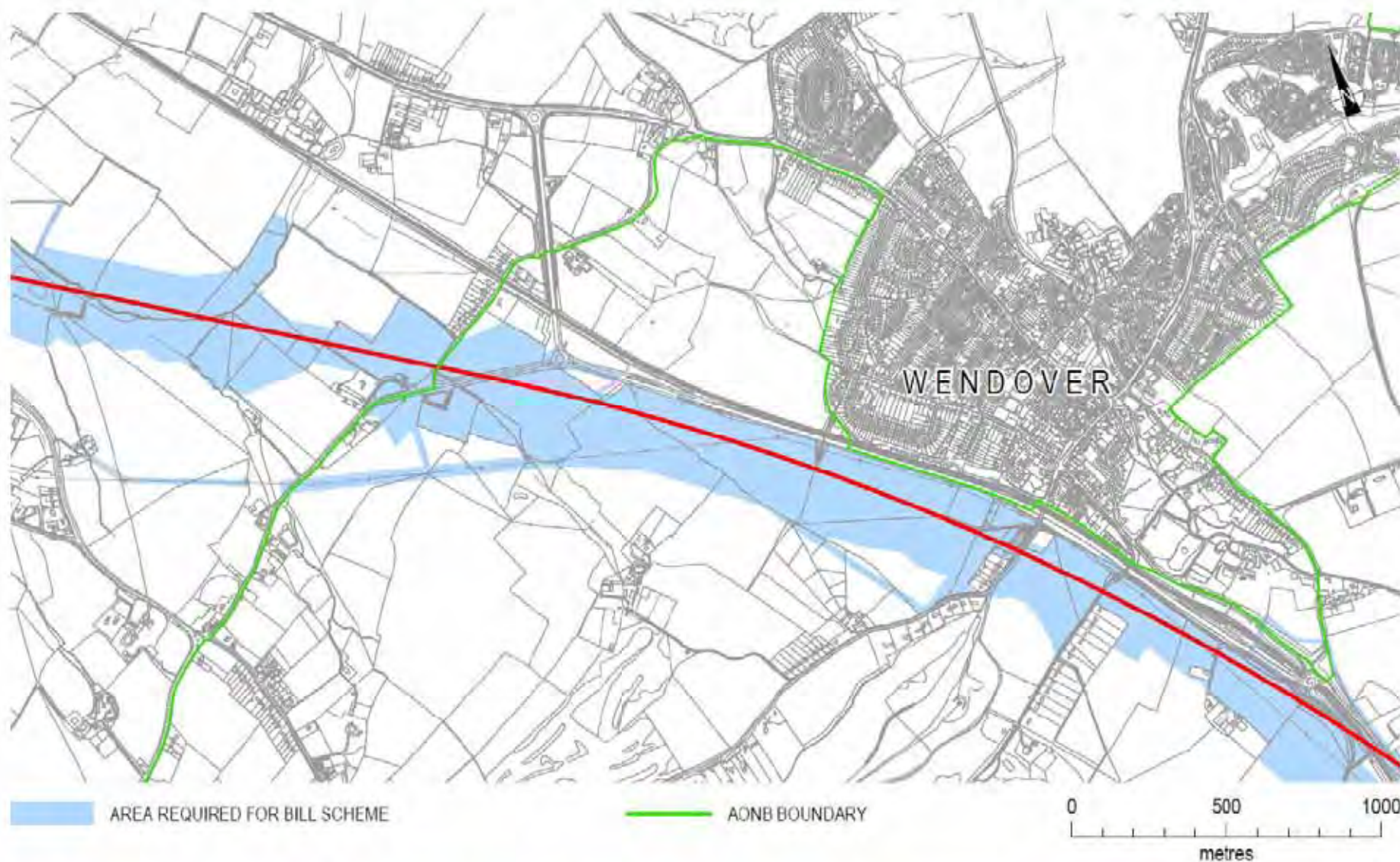
# Construction of CLT

- Next few slides show the North Portal construction area in relation to the AONB boundary (green line)
  - For Governments Proposed Scheme
  - Chilterns Long Tunnel

# Construction of Government's Proposed Scheme

- Next slide shows the North Portal construction area
- Government's Proposed Scheme- in blue

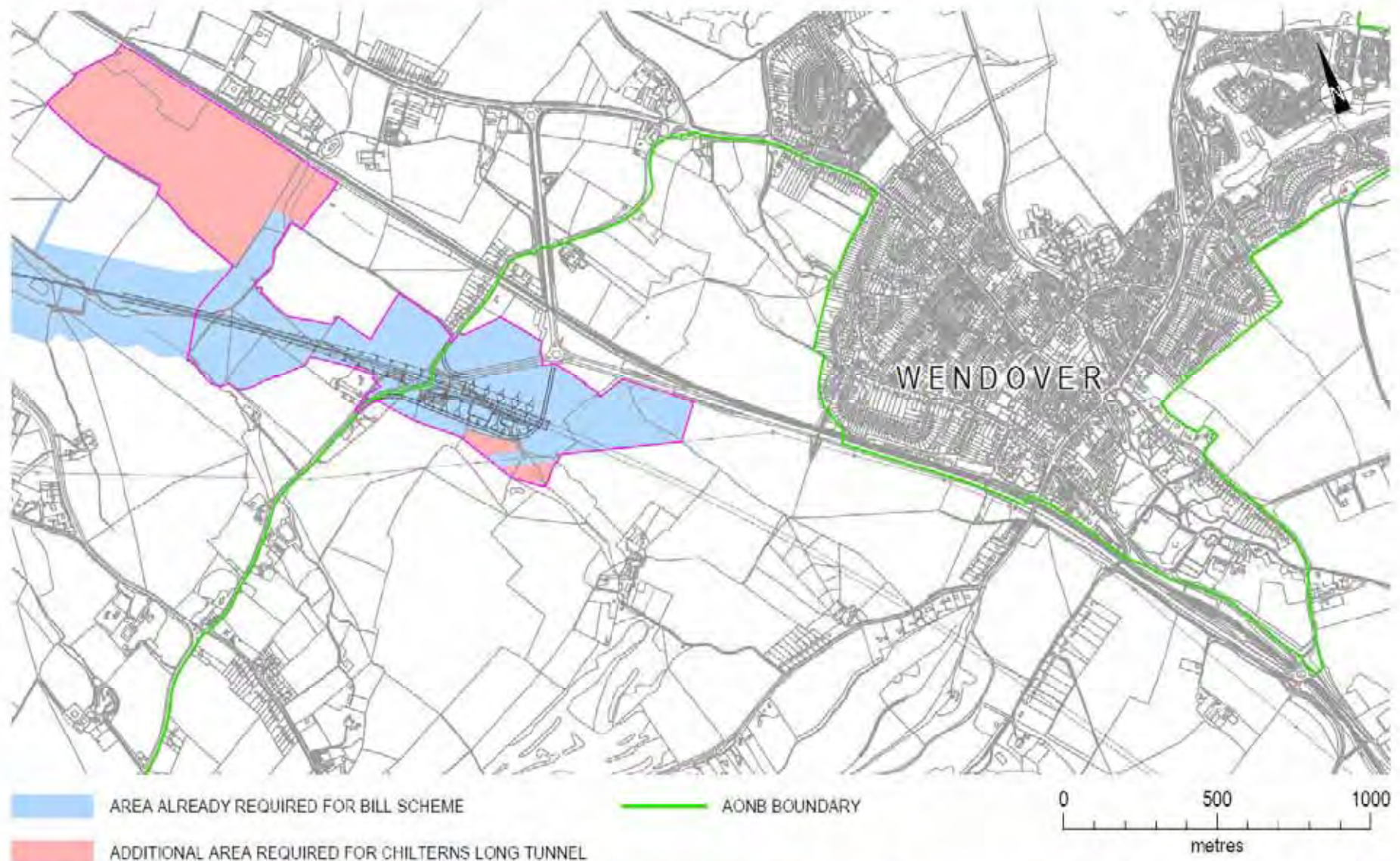
# Construction area at Wendover - GPS



# Construction of CLT

- Next slide shows the North Portal construction area
  - CLT - in blue
  - Indicative additional area outside AONB - in pink
  - Note the area in the AONB avoided due to CLT

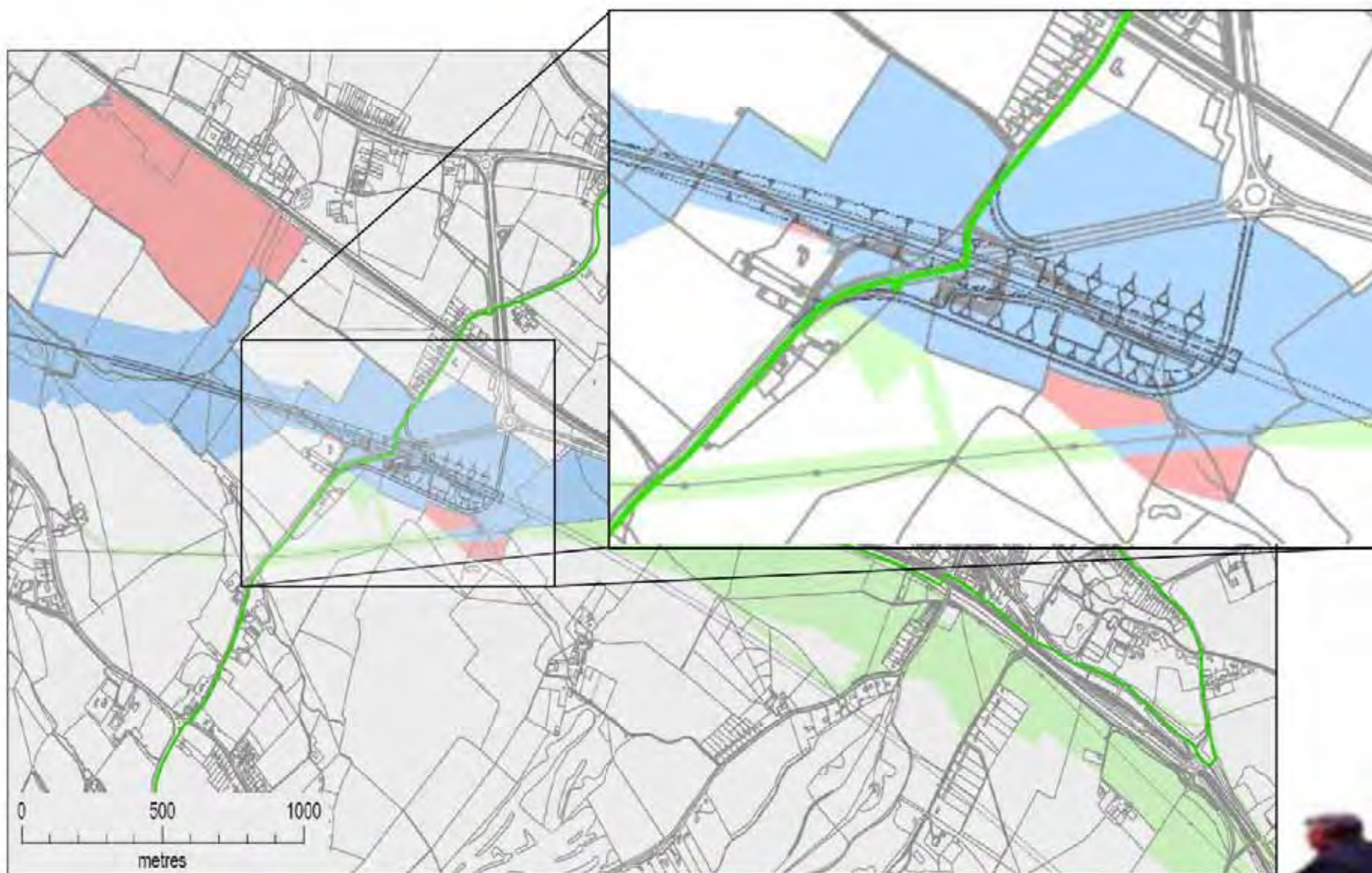
# Construction area at Wendover - CLT



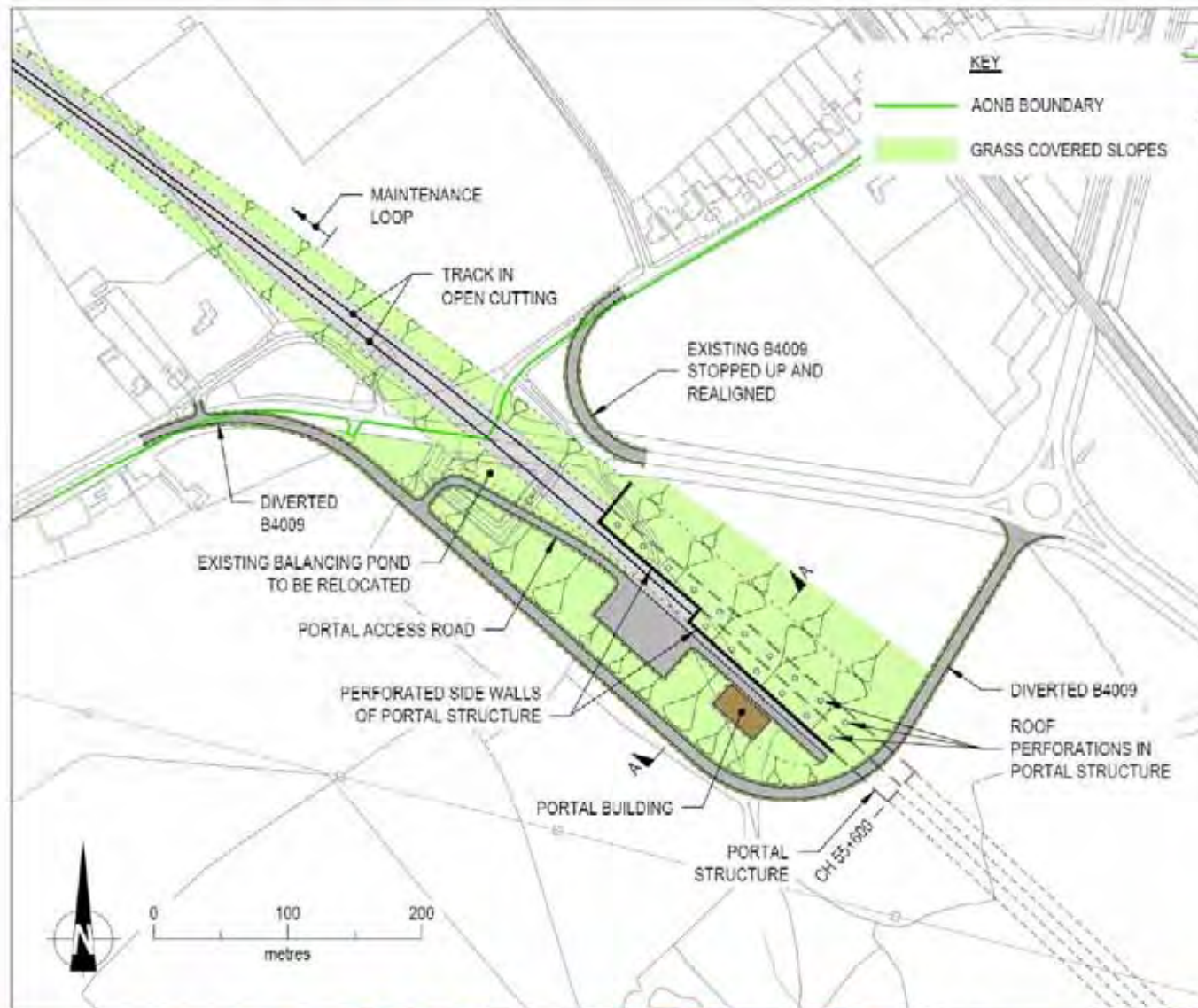
# Construction of CLT

- Next three slides show the indicative North Portal in more detail
  - General plan
  - Indicative Plan
  - Indicative Section

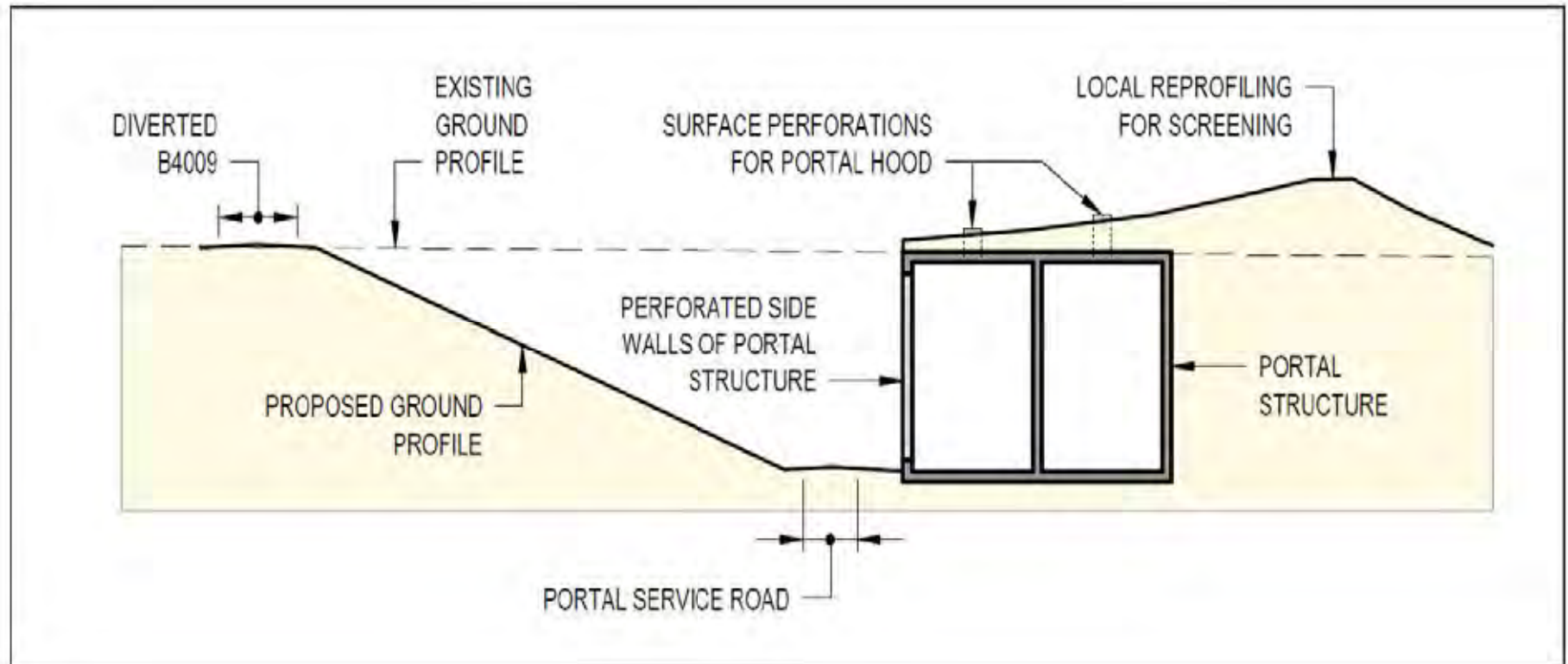
# Construction area at Wendover - CLT



# North Portal – Indicative Plan



# North Portal – Indicative Section:



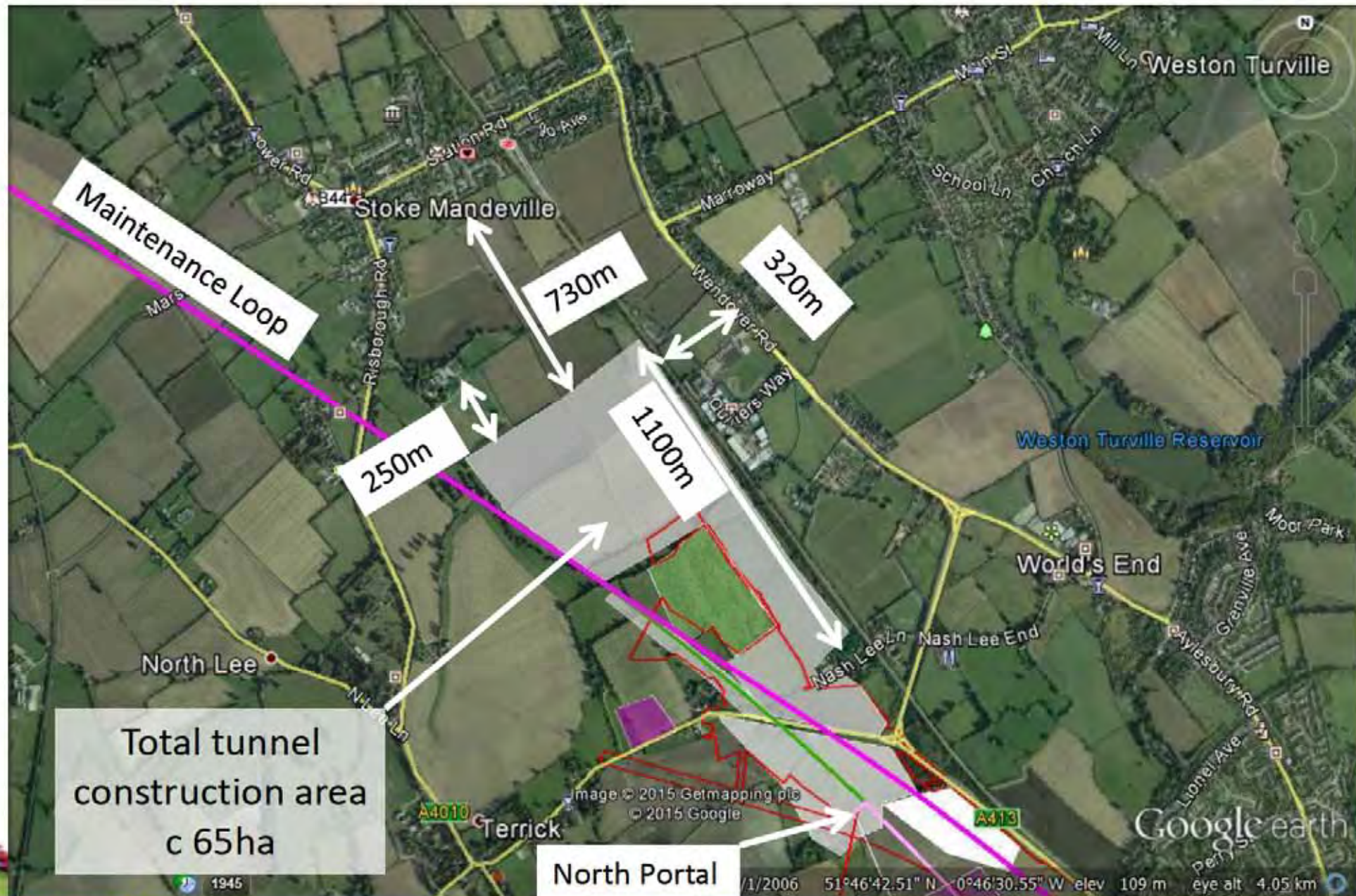
## Construction of CLT

- North Portal construction compound
  - Covers about 50ha straddling the AONB boundary (20ha in AONB)

But as next slide shows

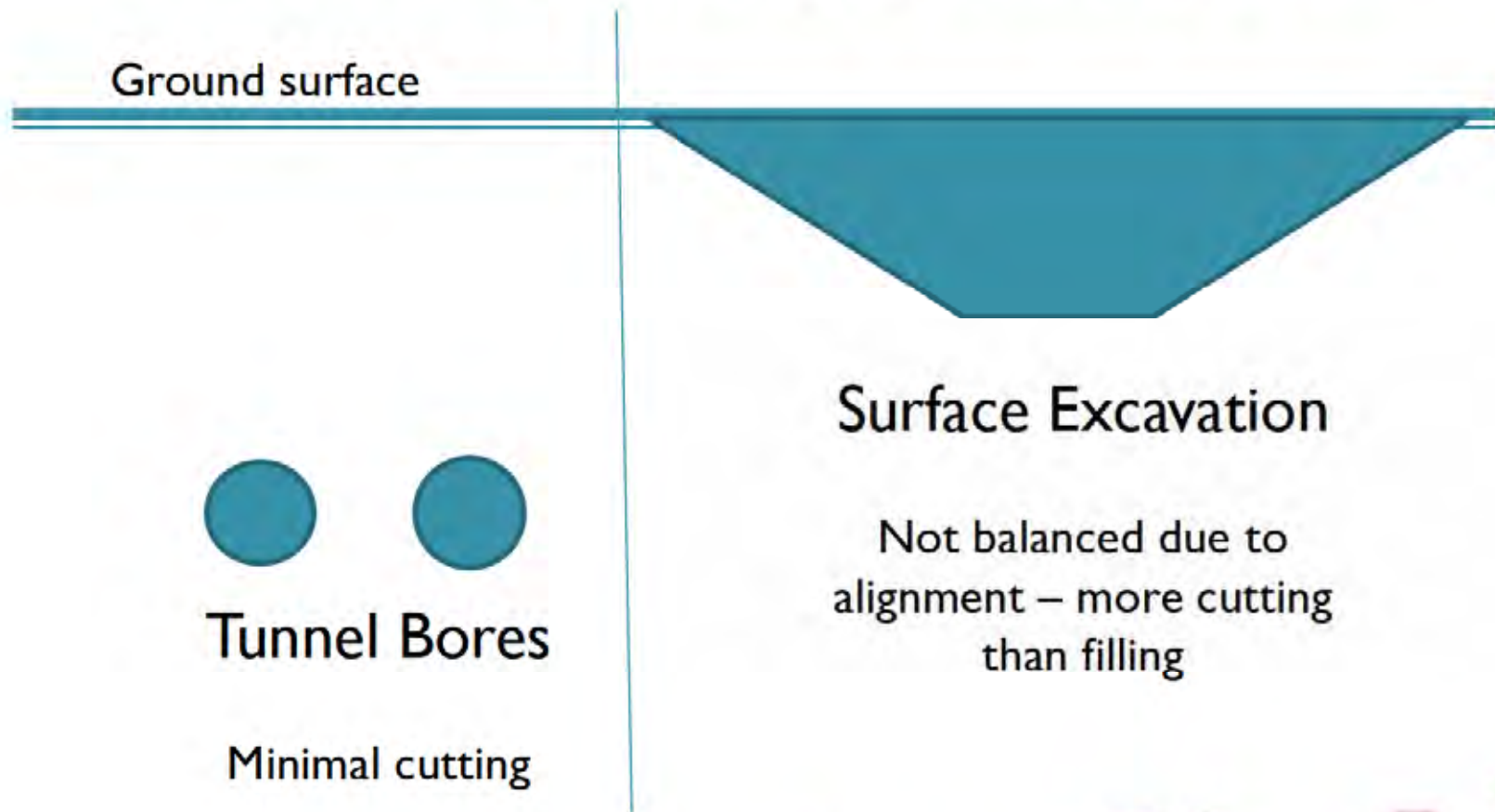
- could go up to about 65ha
- but not too close to Stoke Mandeville and overlaps with the GPS

# Compound proximity to Stoke Mandeville



# CLT tunnel arisings

*Less than the arisings from the GPS*



## Government Proposed Scheme (Mantles Wood to Nash Lee Road)

- Total 7million cubic metres of soil to be moved

(about 12 million Tonnes of material as quoted in  
E.S. CFA 9 & 10)

- *ALL by road or along the Trace*



# Government Proposed Scheme (Mantles Wood to Nash Lee Road)

- 6 million cubic metres
  - in embankments and landscaping mounds
  - changes the profile of the AONB topography
- 1 million cubic metres
  - dumped at Hunts Green.
  - loss of agricultural land for  $\pm 10$  years
  - permanent change to local land character

# Construction of CLT

## All tunnel arisings at North Portal

- Predominantly chalk slurry
- Approx. 3.2m Tonnes (2m cubic metres)
- Can be a source of concern
- Can be disposed of productively

## Government Proposed Scheme (Mantles Wood to Nash Lee Road)

- GOOD MATERIAL likely to be EXPORTED for use elsewhere in works
- POOR MATERIAL likely to be IMPORTED from elsewhere in works
  - *ALL by road*

# CLT tunnel arisings

Can be disposed of by:

- Rail
  - Dewatering required
  - Railhead can also bring in materials
  - To wide range of destinations

There is capacity to do so – a rail freight operator has confirmed this

# CLT tunnel arisings

QUOTE from DB Schenker letter dated 6 July 2015

*“Using the current capacity assumptions there is a theoretical possibility in the current timetable to deliver 3 – 4 trains in any 24 hour period.”*

And

*“The site layout for the loading of trains will ..... have to have two 500m lengths of internal sidings with a crossover at the dead end”*



# CLT tunnel arisings

Can be disposed of by:

- Pipeline
  - Minimal treatment on site
  - Pump to reception site for use in:
    - Cement making
    - Quarry restoration

# CLT tunnel arisings

Can be disposed of by:

- Road
  - Least desirable
  - Dewatering required
  - Approx 300 hgvs per day in two directions



# Does a tunnel protect the environment?

## **Government's Proposed Scheme**

*12 million Tonnes* of soil to be moved within AONB

*370 ha* of AONB disturbed

*incl 100 ha* of AONB near Bacombe Hill



# Does a tunnel protect the environment?

## **Government Proposed Scheme**

*10 ha* Ancient Woodland lost

*1* Scheduled Ancient Monument lost

*Permanent* operational noise within AONB



# Does a tunnel protect the environment?

## **Chilterns Long Tunnel**

*3.2 million T* of arisings at North Portal

*c 50 ha* of AONB disturbed

*incl 20 ha* of AONB near Bacombe Hill



# Does a tunnel protect the environment?

## **Chilterns Long Tunnel**

*0 ha* Ancient Woodland lost

*0* Scheduled Ancient Monument lost

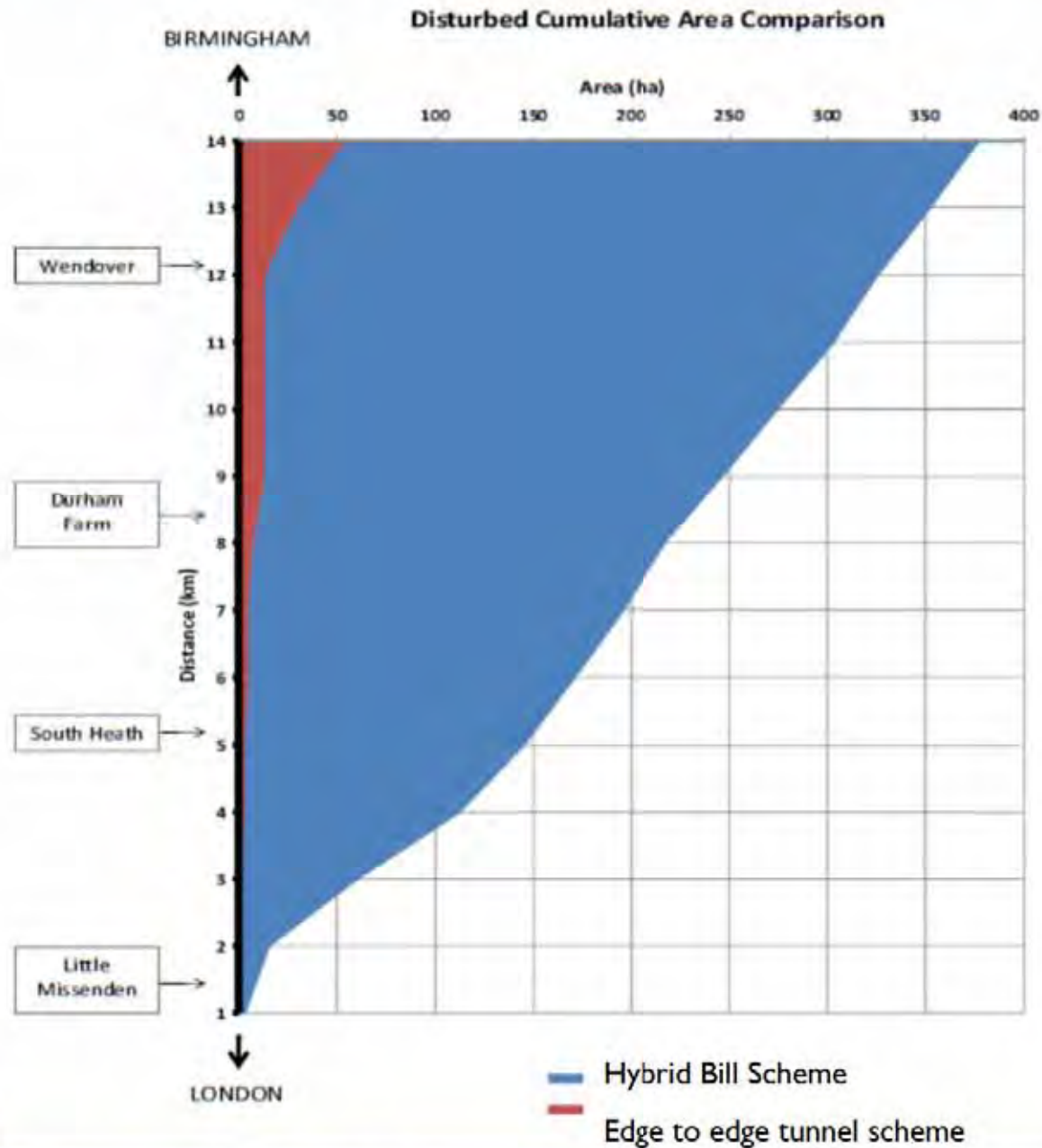
*No* operational noise within AONB



# Summary of earthworks

| Item                          | Government proposed scheme | Chilterns Long Tunnel | Resulting effect |
|-------------------------------|----------------------------|-----------------------|------------------|
| Earth moving                  | 12 m tonnes                | 3.2 m tonnes          | -73%             |
| Area of surface works in AONB | 370 ha                     | 50 ha                 | -86%             |
| Ancient woodland lost         | 10 ha                      | 0 ha                  | -100%            |

# Comparison of area disturbed in AONB



Does a tunnel protect the AONB?

**YES – as much as it can!**



## Comparative cost estimates – HS2 Ltd May 2015

| Item                             | Government proposed scheme | Chilterns Long Tunnel (incl u/g FFP) | Diff £m    |
|----------------------------------|----------------------------|--------------------------------------|------------|
| Tunnels, portals and vent shafts | £115 m                     | £729 m                               | 614        |
| Surface works                    | £137 m                     | Nil                                  | -137       |
| Rail systems                     | £46 m                      | £111m                                | 65         |
| Road, Utility diversions         | £48 m                      | Nil                                  | -48        |
| Other items (Indirect, ECP/VE)   |                            | 38                                   | 38         |
| <b>TOTAL</b>                     | <b>£346 m</b>              | <b>£878 m</b>                        | <b>532</b> |

# Cost Estimates

- Using latest HS2 Ltd figures
- Chilterns Long Tunnel about £530m more expensive

BUT

# Cost Estimates

This ignores:

- Land, and compensation costs of Government Proposed Scheme.
- Socio-economic costs on the community
- Non-market effects of damage to the AONB

# ADDITIONAL cost of continuous tunnel options

|                                                                          | gPS    | CLT    | CLTi    | CRAG T3i |
|--------------------------------------------------------------------------|--------|--------|---------|----------|
| <b>Cost of construction compared to the government's Proposed Scheme</b> | £0     | £ 485m |         | £350m    |
|                                                                          |        |        |         |          |
| <b>Our estimate of these cost differences</b>                            | £0     | £532m  | £465m   | £396m    |
|                                                                          |        |        |         |          |
| <b>Acquisition of land costs</b>                                         | +£50 m | +£3 m  | +£3.3 m | +£3.3 m  |
|                                                                          |        |        |         |          |
| <b>The non market effects</b>                                            |        |        |         |          |
|                                                                          |        |        |         |          |
| <b>The direct economic effects in the Chiltern District</b>              |        |        |         |          |
|                                                                          |        |        |         |          |
| <b>Likely net cost</b>                                                   |        |        |         |          |

# Cost Estimates

- This also ignores:
  - Programme risks of Government Proposed Scheme.

# Cost Estimates

- This also ignores:
  - Economic and non-economic impacts Government Proposed Scheme.

# Cost Estimates

- This also ignores:
  - Major environmental impacts of Government Proposed Scheme.

## Would a tunnel delay delivery of HS2?

***No it doesn't***

| Activity                             | Duration  |
|--------------------------------------|-----------|
| Preliminary work including TBM order | 19 months |
| Government Proposed Scheme           | 63 months |
| Chilterns Long Tunnel                | 64 months |

## Has the work been done to answer the key questions?

- ***Yes it has***
- Comprehensive studies have been done
- A tunnel route is technically feasible
- A Chilterns Long Tunnel has less risks
- A Chilterns Long Tunnel will not delay the programme
- A Chilterns Long Tunnel will be operationally superior
- A Chilterns Long Tunnel will conserve the AONB

Thank you

DB Schenker Rail (UK) Ltd  
310 Goswell Road  
Islington  
London  
EC1V 7LW

Peter Brett Associates LLP  
Caversham Bridge House  
Waterman Place  
Reading  
RG1 8DN

6 July 2015

RECEIVED

Peter Brett Associates

Dear Bruce,

There are currently no timetabled freight services over this route. Passenger services are 2 trains an hour, 30 minutes apart, 'off peak'. During the morning and evening passenger 'peak' hours the service is enhanced to roughly 4 trains per hour, 15 minutes apart. This means that there is capacity on the line during all off peak times.

Beyond Aylesbury towards Calvert and Claydon LNE. In the line is singled with a roughly hourly passenger service from Aylesbury Vale Parkway (approximately 2 miles from the main Aylesbury station). There is existing freight traffic to/from Calvert over this route. The future development of the East West Rail (Phase 2) timetable will see this part of the route redoubled and the introduction of a twice hourly service to Milton Keynes from December 2018. Future capacity for an hourly freight path has been protected over this route.

As part of the development of East West Rail (Phase 2) the line beyond Claydon to Bletchley will be re-opened as a doubled track electrified railway with connections to both the WCML at Bletchley and MML at Bedford from December 2018 - (Bletchley-Bedford not electrified at this point). Future capacity for an hourly freight path has been protected over this route.

Wendover to Calvert is approximately 15 miles

Wendover to WCML at Bletchley is approximately 27 miles

Wendover to MML at Bedford is approximately 43 miles

Using the current capacity assumptions there is a theoretical possibility in the current timetable to deliver 3-4 trains in any 24 hour period. The services would have to be managed through the peak and the best assumption on train delivery would be through the period of 2300 to 0500 taking into account any planned Network Rail planned engineering works.

The site layout for the loading of trains will have to be fully designed, however to give you a starting point the site will have to have two 500 metre lengths of internal sidings with a cross over at the dead end for running around if necessary. The land take up for the stocking of material for loading will have to be the equivalent length of the sidings plus a depth from rail of 40 metres to give you sufficient stocking areas and loading capability.

Yours sincerely

David Legge  
Business Manager  
DB Schenker Rail UK

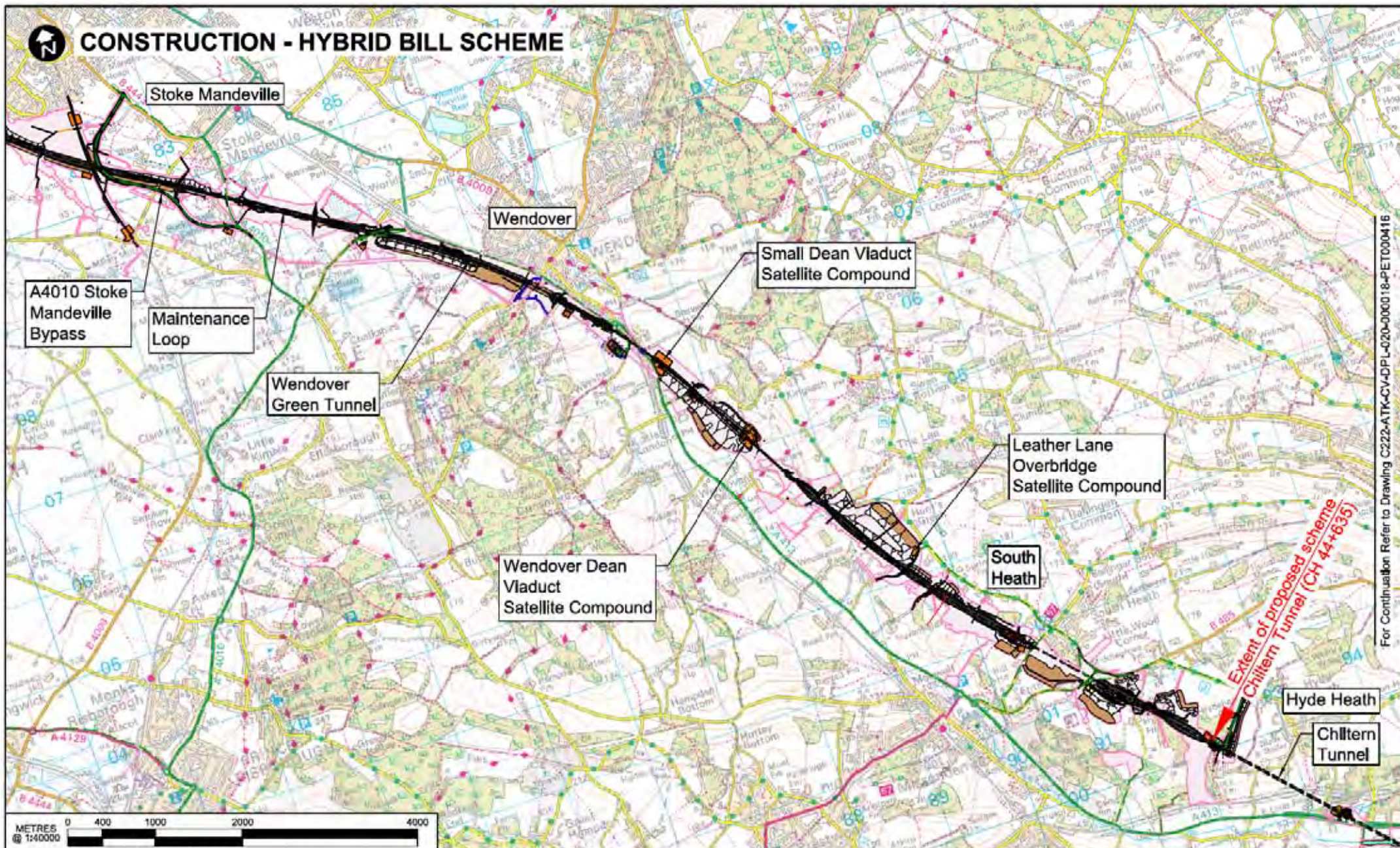
# Effects on Ancient Woodland within the Chilterns AONB

| Total area of Ancient Woodland within Chilterns AONB                                | Area of Ancient Woodland (AW) within the Chilterns AONB, affected by Proposed HS2 Scheme |                   |                                |                   |                                |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|-------------------|--------------------------------|-------------------|--------------------------------|
| Size (hectares)                                                                     | Location                                                                                 | Hybrid Bill       |                                | AP Proposal       |                                |
|                                                                                     |                                                                                          | Size of loss (ha) | Size of loss (% of AW in AONB) | Size of loss (ha) | Size of loss (% of AW in AONB) |
| Approximately <b>11,000 ha</b> of the Chilterns AONB is designated Ancient Woodland | Mantle's Wood                                                                            | 6.2 ha            | 0.056%                         | 5.9 ha            | 0.054%                         |
|                                                                                     | Farthings Wood                                                                           | 0.5 ha            | 0.005%                         | 0.5 ha            | 0.005%                         |
|                                                                                     | Sibley's Coppice                                                                         | 2.5 ha            | 0.028%                         | 2.5 ha            | 0.028%                         |
|                                                                                     | Jones' Hill Wood                                                                         | 1.0 ha            | 0.009%                         | 0.7 ha            | 0.006%                         |
| <b>TOTAL</b>                                                                        |                                                                                          | <b>10.2 ha</b>    | <b>0.098%</b>                  | <b>9.6 ha</b>     | <b>0.093%</b>                  |





# CONSTRUCTION - HYBRID BILL SCHEME



For Continuation Refer to Drawing C222-ATK-CV-DPL-020-000018-PET000416

| POS. | REF. NUMBER |  |  |  |  |
|------|-------------|--|--|--|--|
| 1    |             |  |  |  |  |
| 2    |             |  |  |  |  |
| 3    |             |  |  |  |  |
| 4    |             |  |  |  |  |
| 5    |             |  |  |  |  |
| 6    |             |  |  |  |  |
| 7    |             |  |  |  |  |
| 8    |             |  |  |  |  |
| 9    |             |  |  |  |  |
| 10   |             |  |  |  |  |

HS2 accepts no responsibility for any consequences which arise from the reproduction of this document after alteration, amendment or adaptation or if it is used in part or in whole for any purpose.

© Crown Copyright and database right 2015. All rights reserved. Ordnance Survey Licence number 100049190

© Crown Copyright material is reproduced with the permission of 1 and 2. This material was last updated in 2015 and may not be current. Distribution and use of this material is limited to the purpose of the project. Only an official copy of a plan or map obtained from the Land Registry may be used for legal or other official purposes.

Scale will reduce as distance increases.

| Legend/Notes                                            |                                                       |
|---------------------------------------------------------|-------------------------------------------------------|
| Orange box: Satellite construction compound             | Yellow line: Temporary site access route / haul route |
| Yellow box: Main construction compound                  | Green line: Construction traffic route                |
| Blue line: Tunnel portal                                | Blue line: Existing public right of way (PRoW)        |
| Grey line: Rail alignment formation                     | Orange line: New, diverted or realigned PRoW          |
| Grey line: Tunnel external extent                       | Orange line: Stopped-up PRoW                          |
| Black line: Rail alignment                              | Orange line: Temporary PRoW                           |
| Blue line: Engineering earthworks                       | Brown box: Temporary material stockpile               |
| Blue line: Landscape works                              |                                                       |
| Pink box: Land potentially required during construction |                                                       |

High Speed Rail  
England  
Regional Office  
One Canada Square  
London, E14 5AB

Contract Number: A036

| Zone          | Country South                                                                       | Project/Contract                                         | Country South Design                       |
|---------------|-------------------------------------------------------------------------------------|----------------------------------------------------------|--------------------------------------------|
| Design Stage  | DESIGN-FOR-PETITION                                                                 | Drawn/Checked/Approved                                   | CMH                                        |
| Drawing Title | Chiltern Tunnel<br>Petitioned Tunnel Extension<br>Hybrid Bill Scheme - Sheet 2 of 2 | Drawn: TD<br>Date: 06/07/2015<br>Drawing No.: C222-ATK-C | Checked: AS SHOWN<br>Scale: A3<br>Rev: 003 |

# Chiltern Tunnel Extension – Chiltern Long Tunnel

## Operation and Maintenance – slide 1 of 2

|                                    | Bill scheme                                                                                   | Chiltern Long Tunnel                                                                                                                                                                                                                    |
|------------------------------------|-----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Smoke control / ventilation</b> | <ul style="list-style-type: none"><li>• Ventilation fans at portals and vent shafts</li></ul> | <ul style="list-style-type: none"><li>• Increased requirement for tunnel ventilation equipment and maintenance due to long tunnel length.</li><li>• similar sized and capacity ventilation fans and shafts as the Bill scheme</li></ul> |
| <b>cooling equipment</b>           | <ul style="list-style-type: none"><li>• No cooling required</li></ul>                         | <ul style="list-style-type: none"><li>• Greater tunnel length will increase heat generation and will need addition of cooling equipment including chillers at vent shafts.</li></ul>                                                    |
| <b>passenger air quality</b>       | <ul style="list-style-type: none"><li>• No requirement for additional measures</li></ul>      | <ul style="list-style-type: none"><li>• Additional measures required to maintain passenger air quality through longer tunnel.</li></ul>                                                                                                 |