

## **Longbarrow Junction | QS-8B |** Delivery Methodology | Detailed Construction Methodology for Longbarrow Junction, including Green Bridge Three

4. Your construction methodology for Longbarrow Junction shall the following information as a minimum:

- 4.1. a detailed breakdown and description of the stages of construction of the junction;
- 4.2. the temporary works and temporary structures required for the construction of the junction, including for the intersection and interaction of the A360 and the existing, and new, A303 in order to maintain traffic flows during construction;
- 4.3. protective measures which will be implemented for environmental and heritage assets and the wider historic landscape of the WHS during construction;
- 4.4. the construction risks, the proposed mitigation and any emergency plans or interventions.



## 4. Our construction methodology for Longbarrow Junction

The purpose of this Construction Methodology for Longbarrow Junction is to describe how BADGER will build the Longbarrow Junction and the Green Bridge 3, using the best construction methodology to reduce time and security risks during the construction project, and at the same time minimising the impact of the works on the road users.

### 4.1 Detailed breakdown and description of the stages of construction of the junction

The new Longbarrow Junction will be designed and executed as a Junction with 2 roundabouts, North and South, in two different stages:

1. **Completion Section 1:** with the construction of the total junction, but only the East Bound Carriageway working with one lane for each bound, east and west. For the construction of this stage, two temporary roads with two temporary bridges will be needed to divert the existing A303 and the A360. Another temporary road connecting the new North Roundabout with the existing Longbarrow roundabout will be needed. An internal haul road underneath the two temporary bridges would be available to support the constructions works in the western tunnel approach and in the western tunnel portal.
2. **Final Completion:** The junction will be in full operation.

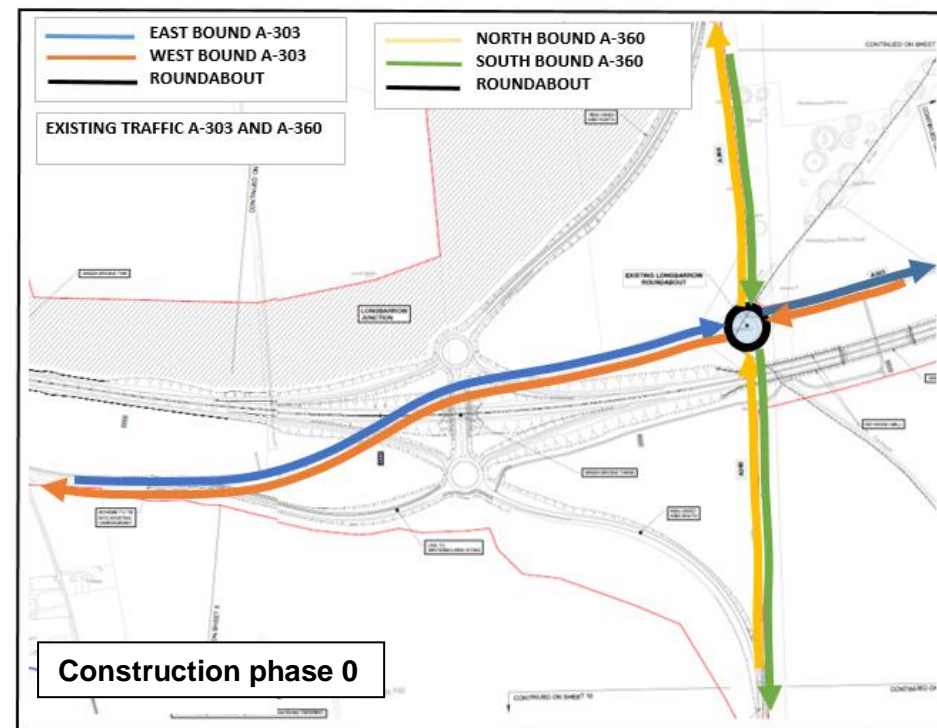
**Keynote 1:** BADGER's intention is to have an internal connection East-West for construction flow and to avoid interface with other roads

**Keynote 2:** An assessment of the impacts of the key traffic management phases is undertaken and can be checked in QS-13B.

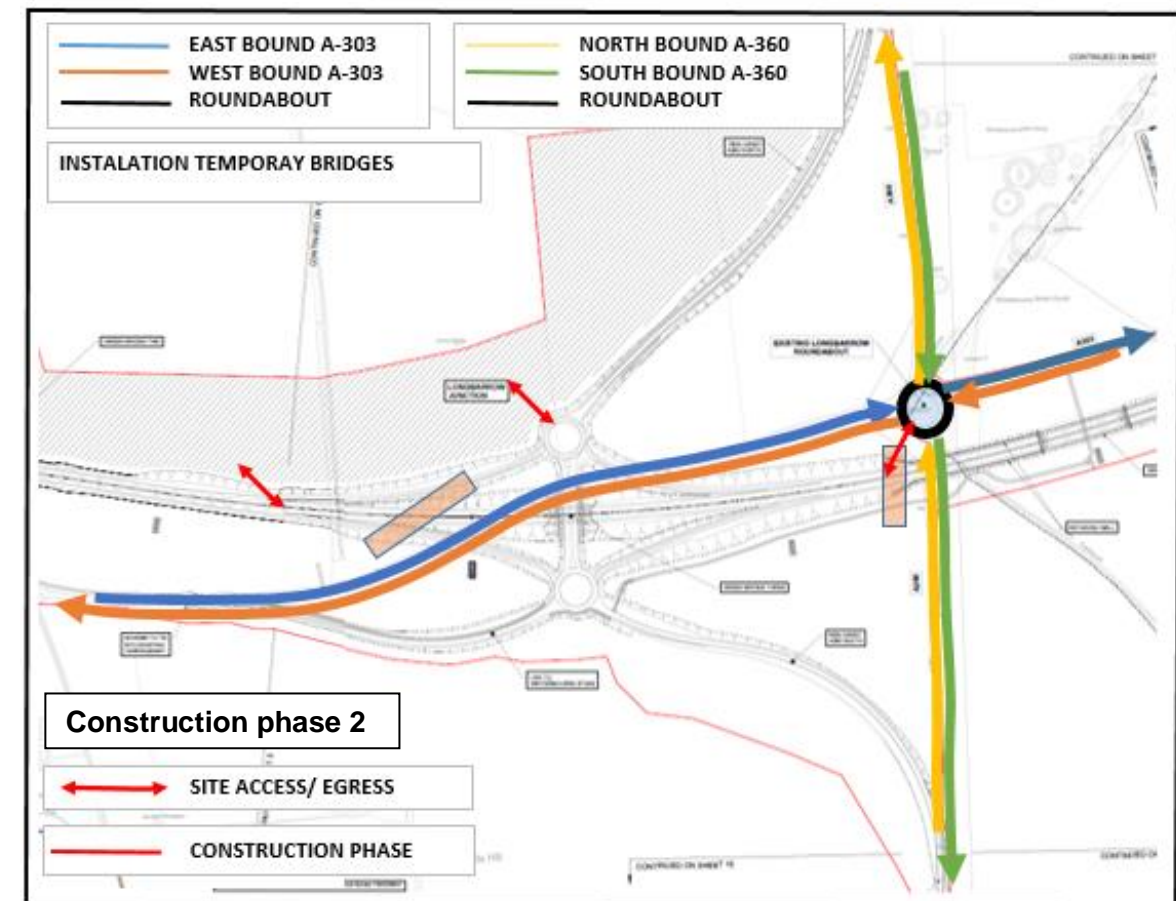
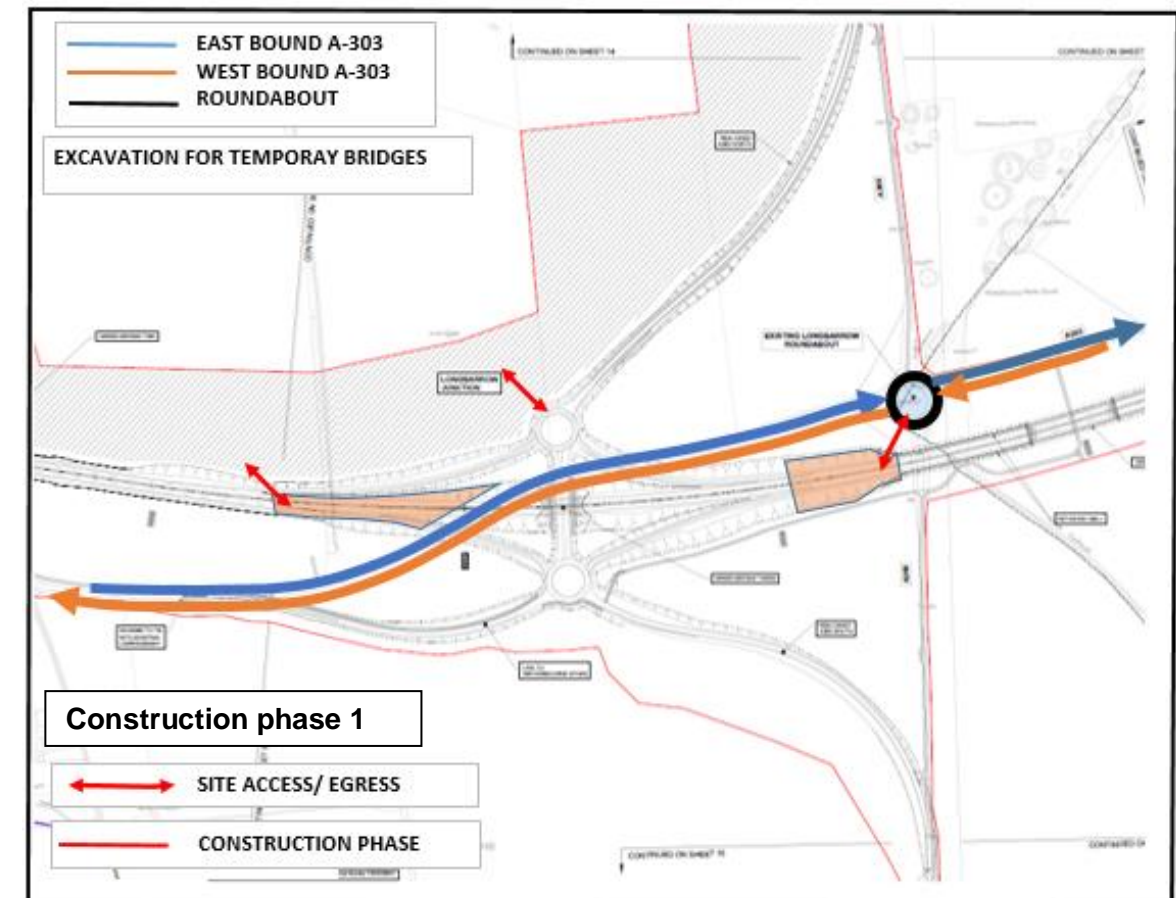
**Keynote 3:** Lane and Junction details for the different traffic phases are shown in the QS-13C traffic management arrangement drawings, and at the end of the document.

### Sequence of construction:

A detailed breakdown and the construction sequence is explained in the sketches below:



The first sketch (**Construction Phase 0**) shows the existing situation on the A303 and A360 with the current traffic flow. This will be our departure point.



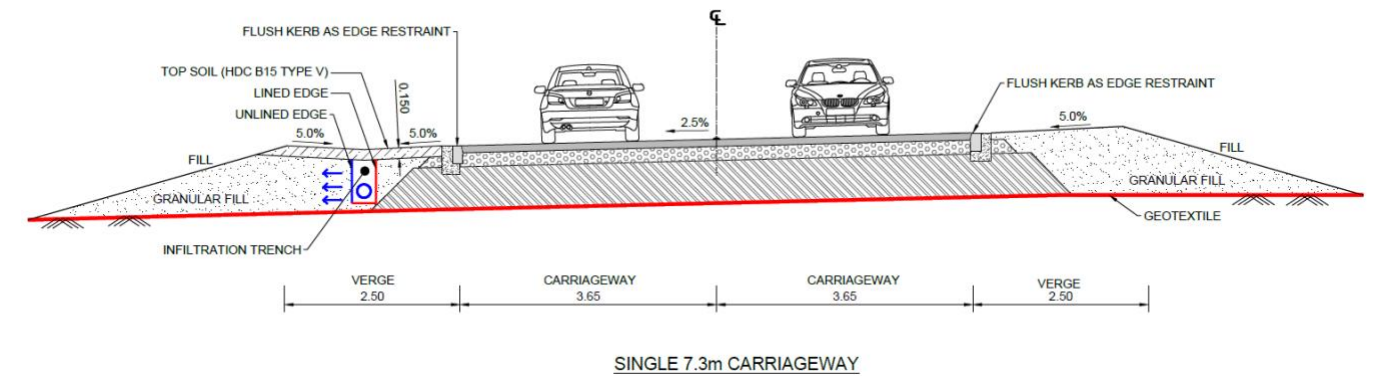




In order to keep traffic open along both the A303 and A360, temporary bridges will be installed for the construction of the temporary road's diversion.

With the installation of these temporary bridges (please refer to section 4.2 of this document for more details), BADGER will ensure an internal haul of traffic site vehicles involved in the different operations of the construction phase does not interfere with the road users.

The **Construction Phase 1** will be the execution of the excavation that will allow for the installation of the temporary bridges. In the next phase (**Construction Phase 2**), temporary bridges will be installed in the position shown.

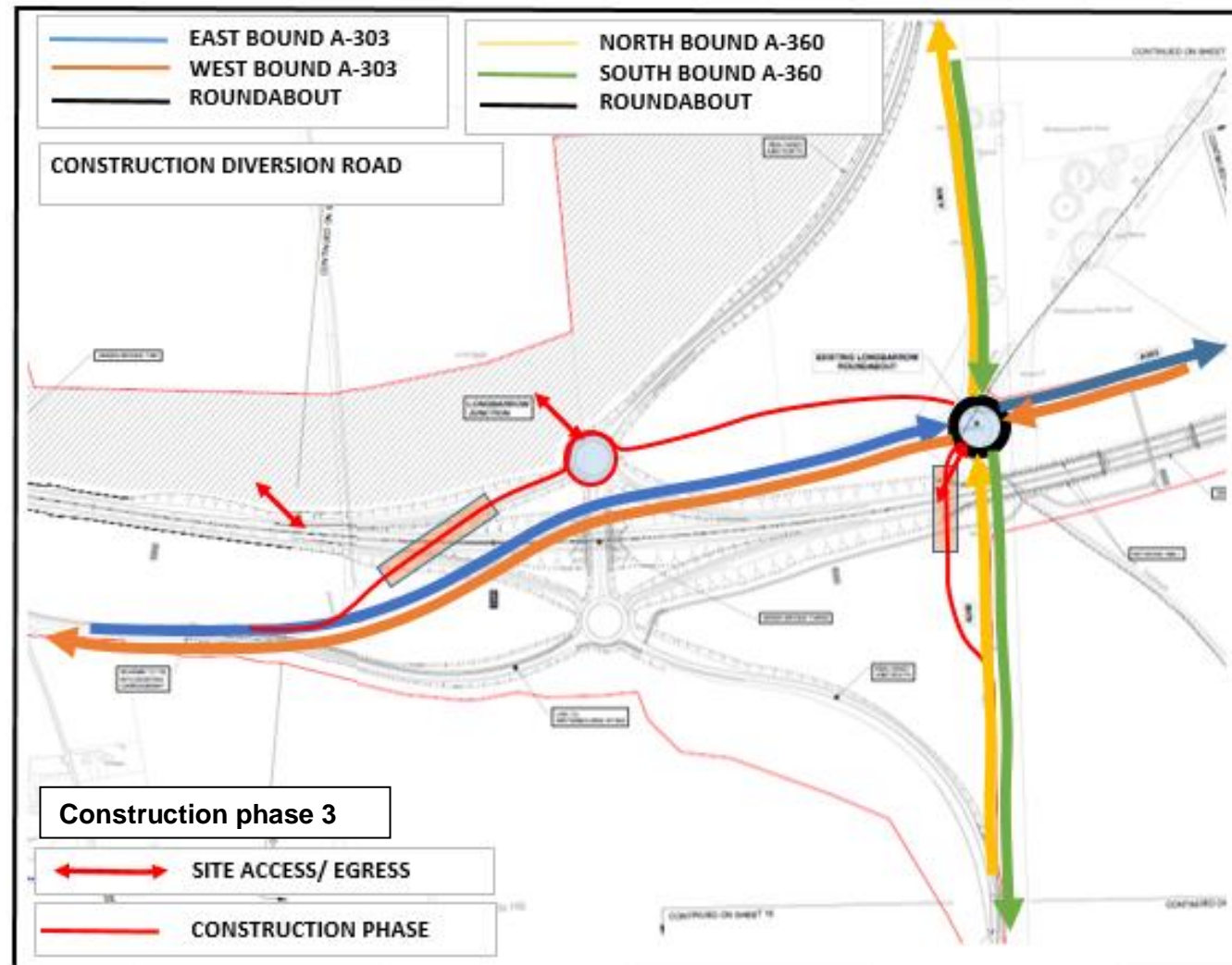


Cross section for the temporary road diversions will be as shown above.

The A360 temporary diversion will be located in the DAMS area 48.1 and not encroaching DAMS areas X13 or X14.

Once the new temporary roads are finished the traffic flow on the existing A303 and A360 will be diverted through the new temporary roads as shown in **Construction Phase 4**.

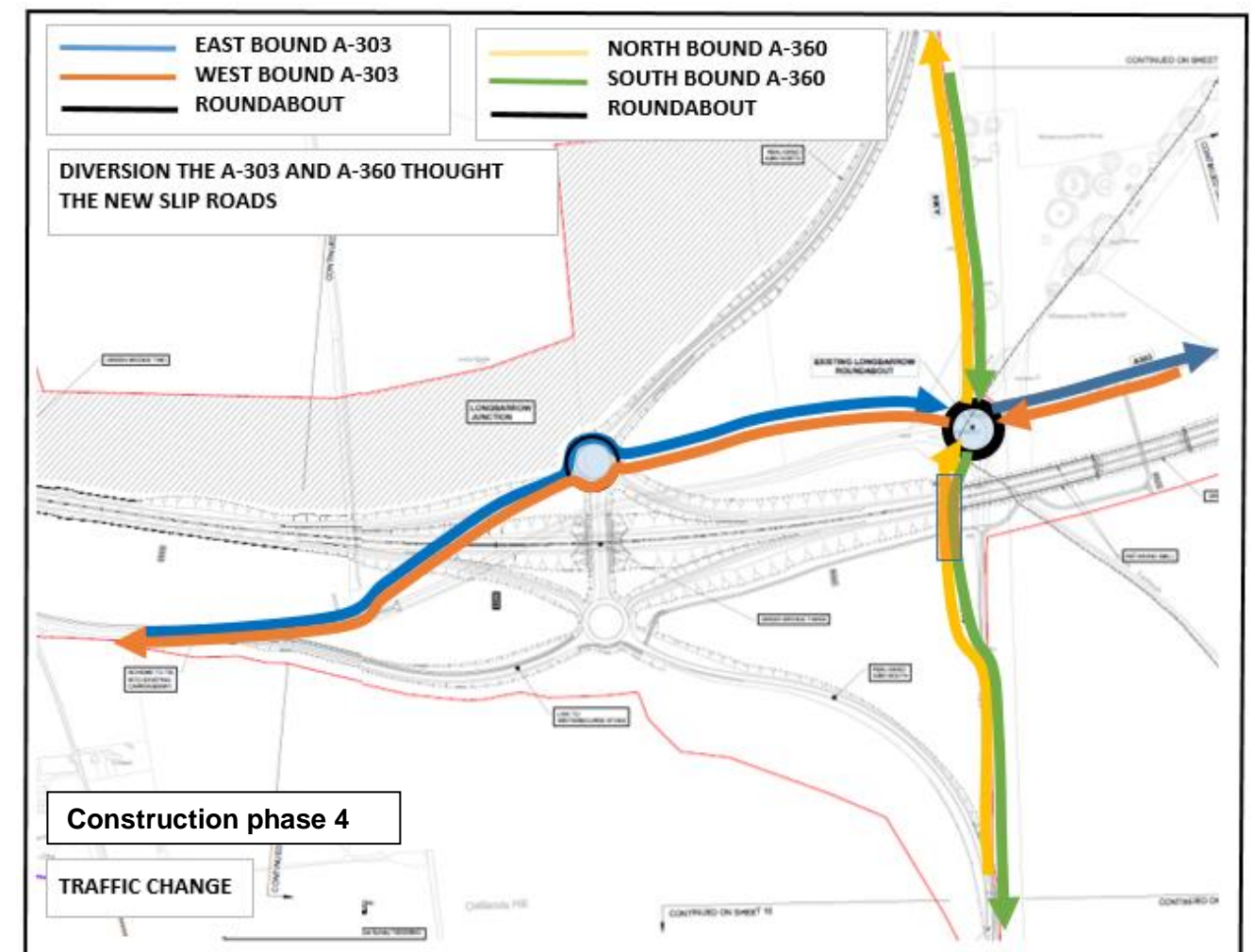
This traffic change will permit the construction team the demolition of the existing A303 and A360 as shown in the **Construction Phase 5**.



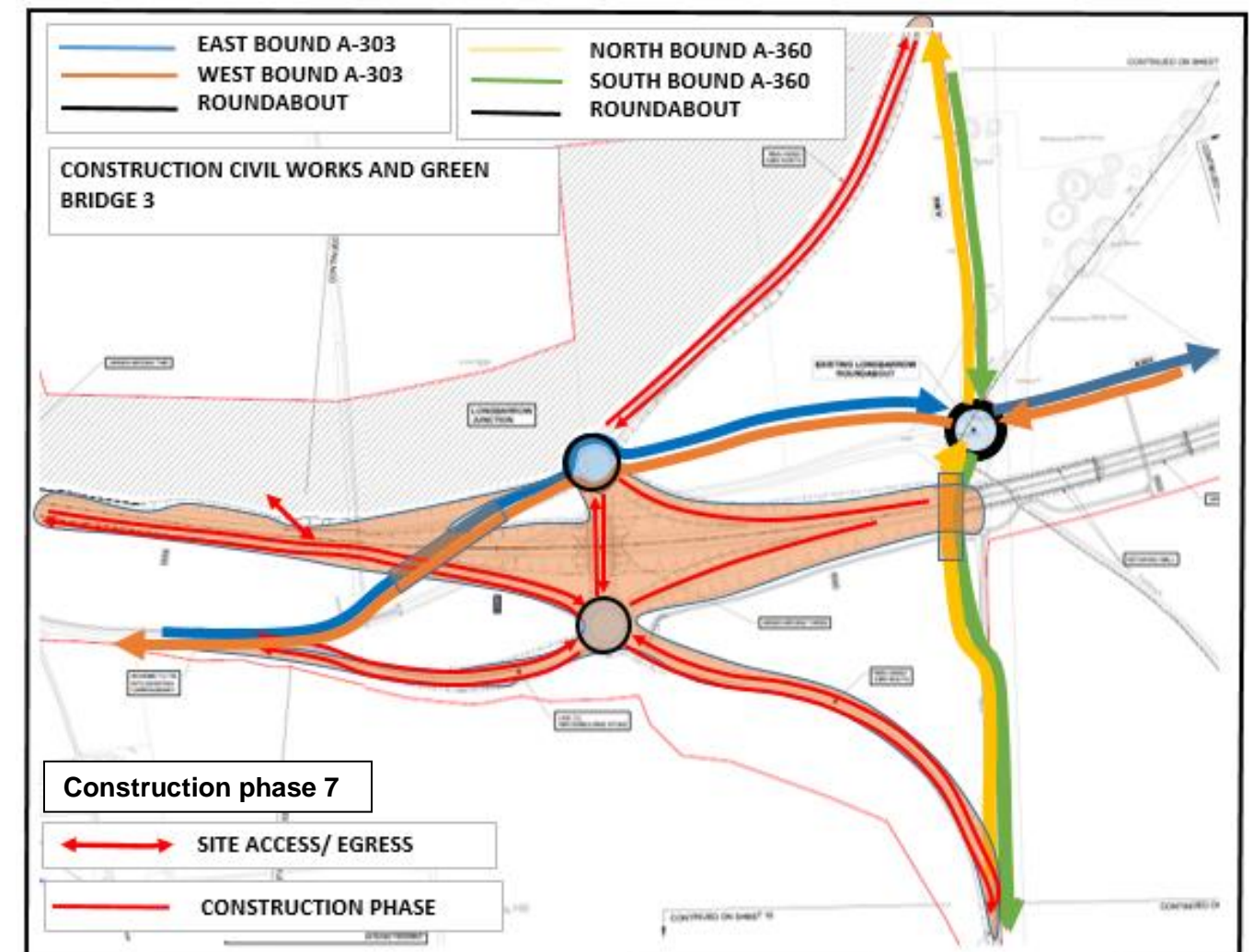
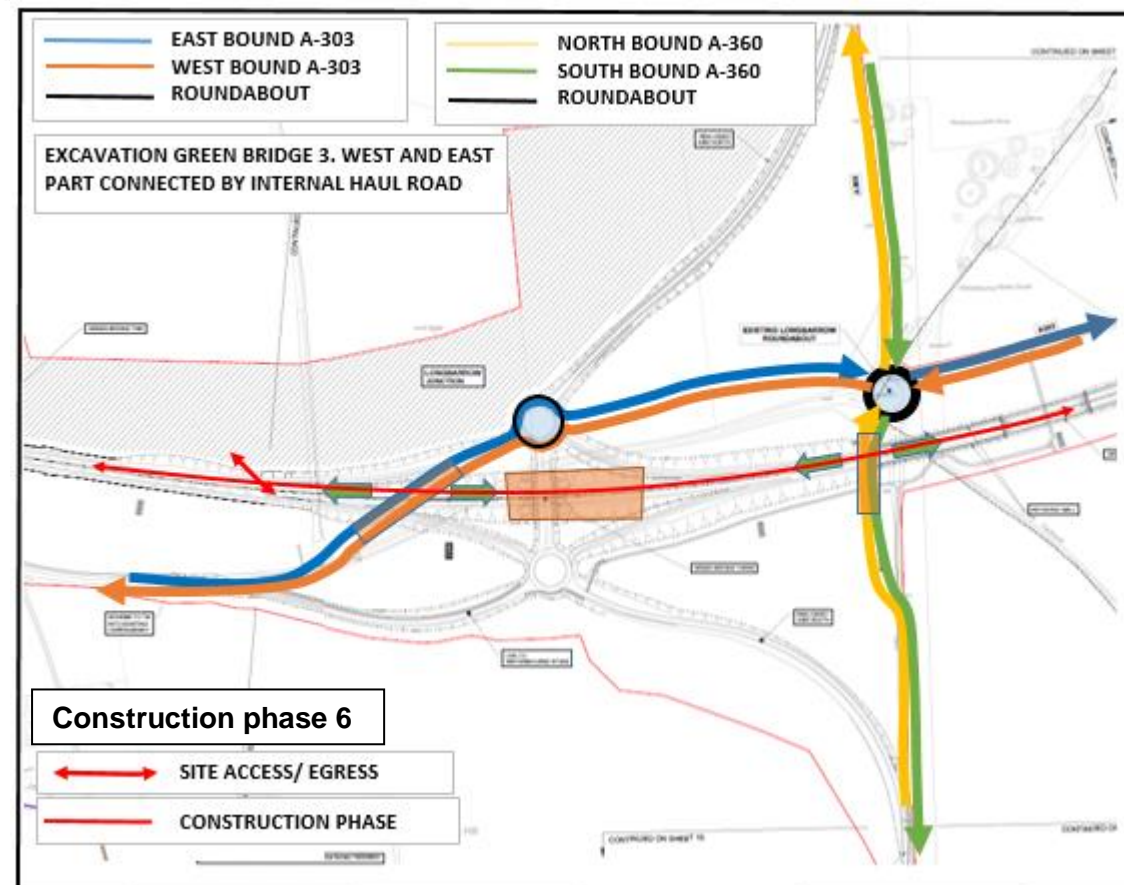
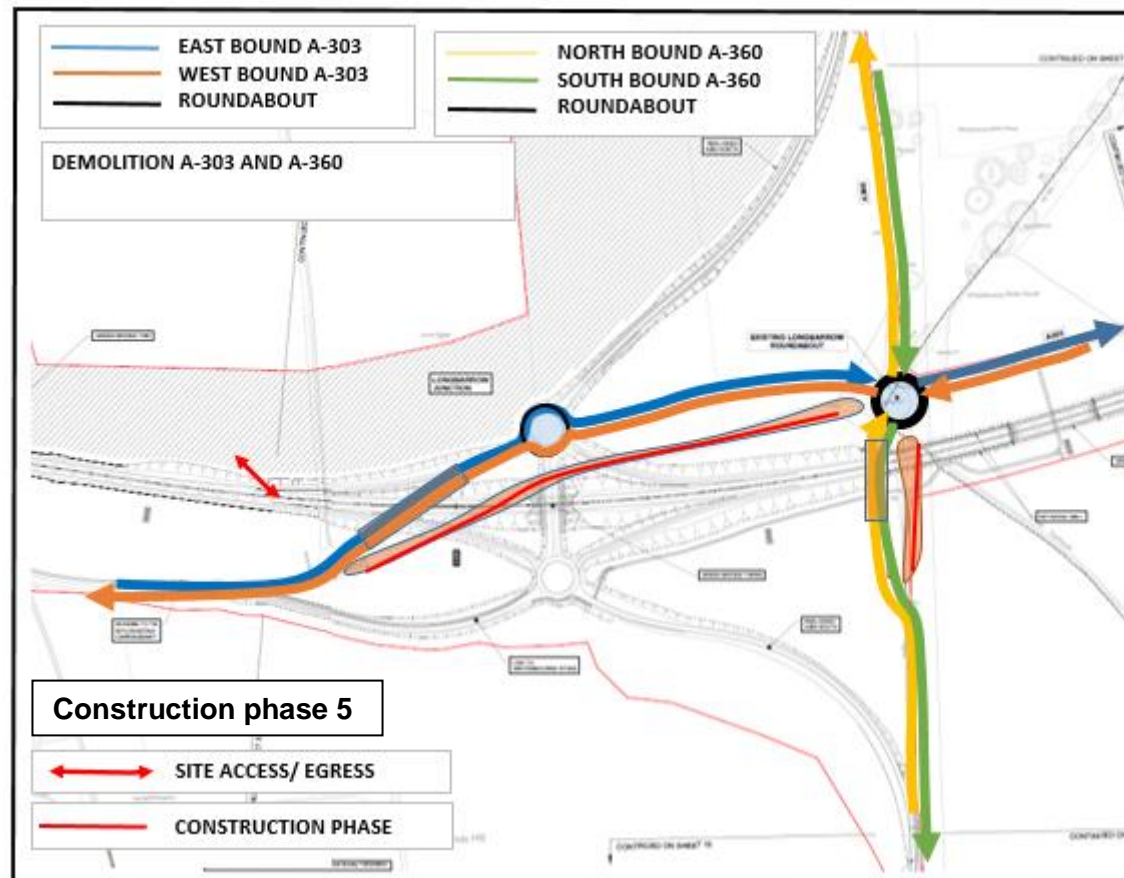
The installation of the temporary bridges will be followed by the construction of the diversion roads for the A303 and the A360, as is represented in the **Construction Phase 3**. The new northern roundabout of the Longbarrow Junction will be also constructed. This will allow for the installation of the site access to the Longbarrow Main Compound.

The temporary diversion for the A303 and A360 will be located outside the permanent earthworks outline and any archaeological remains that it crosses will be protected and preserved. The temporary road would be formed above existing levels, with topsoil retained in situ and the road sub-base placed on the existing topsoil, separated by a layer of High-Viz Orange Geotextile. The required depth of stone will be determined in accordance with item MW-TRA9 of the OEMP. (**DAMS Paragraph 5.2.54**)

The temporary diversion will comply with DAMS requirements for 'no-dig solutions in areas of no-scheme impact and construction working areas'. Archaeological mitigation will be also applied as required in the DAMS.







With the live traffic running along the new temporary roads, the construction team will focus on the excavation and earthworks of the remaining parts to be constructed at the Longbarrow Junction, giving priority to the excavation for the Green Bridge 3 (**Construction Phases 6 and 7**).

West and East areas of the junction will be connected by an internal haul road running below the temporary bridges previously installed.

#### Construction of Green Bridge 3:

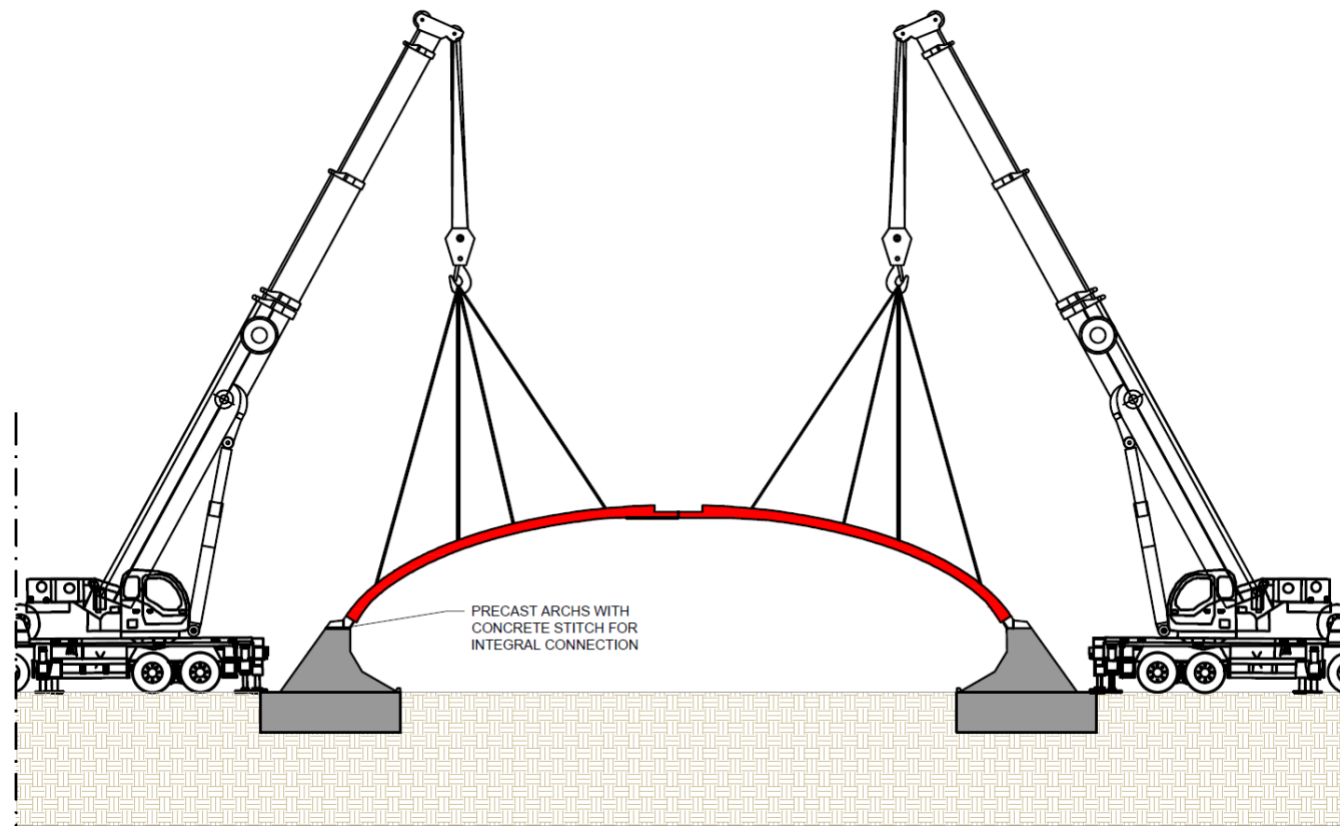
Once the excavation of Green Bridge 3 is finished and the working area has been established, we will start with the construction of Green Bridge 3.

##### CONSTRUCTION SEQUENCE FOR GREEN BRIDGE 3

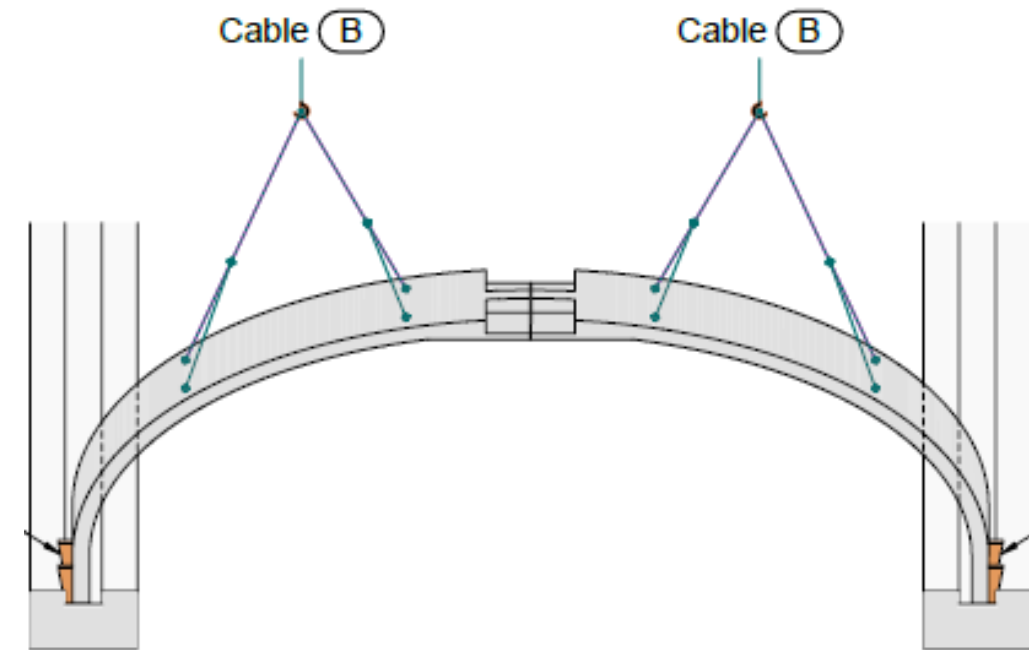
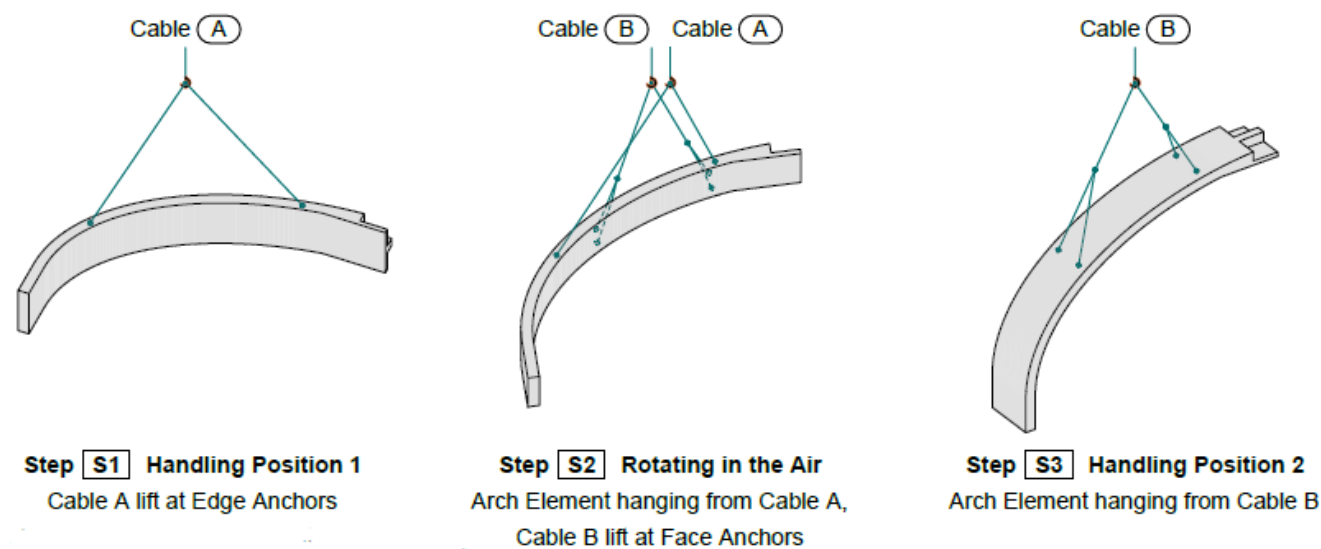
- BASE FOUNDATION EXECUTION INCLUDING UPSTAND
- INSTALLATION OF PRECAST ARCH SEGMENTS
- CAST IN-SITU OF CONCRETE STITCH BETWEEN PRECAST ARCHES AND UPSTAND, CROWN JOINTS AND LOOP JOINTS BETWEEN ARCH RINGS, PLACING OF DRAINAGE PIPES AND WATERPROOFING.
- BACKFILLING PLACED SIMULTANEOUSLY FROM BOTH SIDES
- INSTALLATION OF PRECAST LATERAL PIECES
- EXECUTION OF ROAD PAVEMENT AND FINISHING



Stage 1. In-situ foundation execution, including upstand



Stage 2. Placing of precast arch pieces. (This phase is repeated for each arch ring)

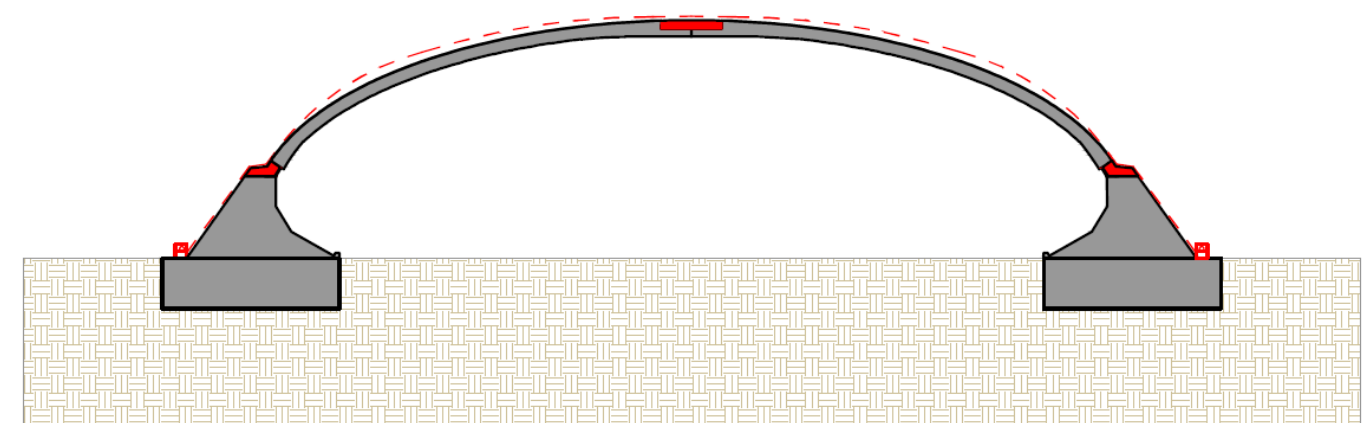


**Step S4 Installation**  
Lowering Element into final Position

Placement of the arch elements will be as shown on project drawings. An approach can be seen in the sketches above. Special care will be taken in setting the elements to the true line and grade. The recommended method for installing the precast elements utilises one or two double drum cranes with equal capacity on each drum. If double drum cranes are not available, alternative installation procedures will be researched and implemented. BADGER will ensure that cranes of correct lifting capacity are available to handle the precast elements. This will be accomplished by using the weights given by the manufacturer and by determining the lifting reach for each crane.

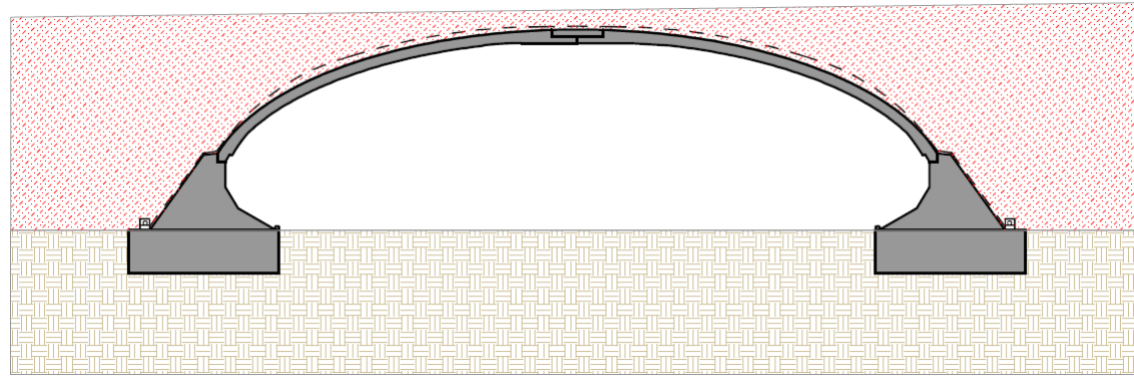
BADGER will also ensure that the cranes are correctly positioned on the ground. Site conditions will be checked well in advance of shipping to ensure proper crane location and to avoid any lifting restrictions.

Appropriately sized rigging cables and snatch blocks will be available on site. Cables of wrong lengths cause the arch to hang incorrectly and can cause not only problems on site but can damage the element. Ropes will be at hand to control the arch during installation.

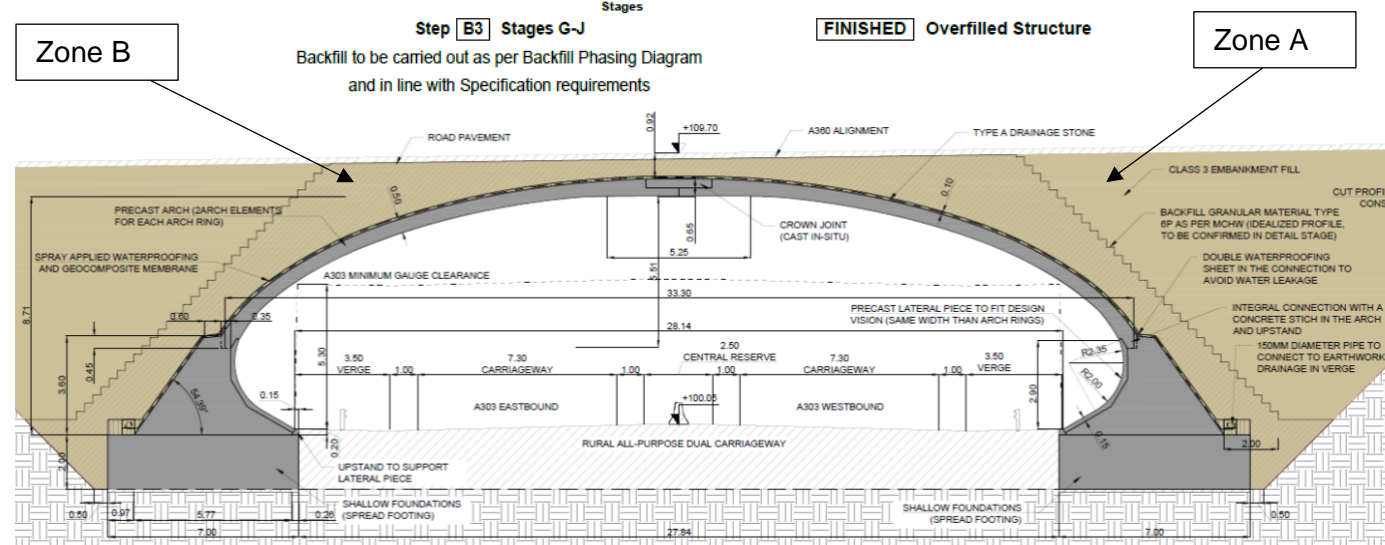
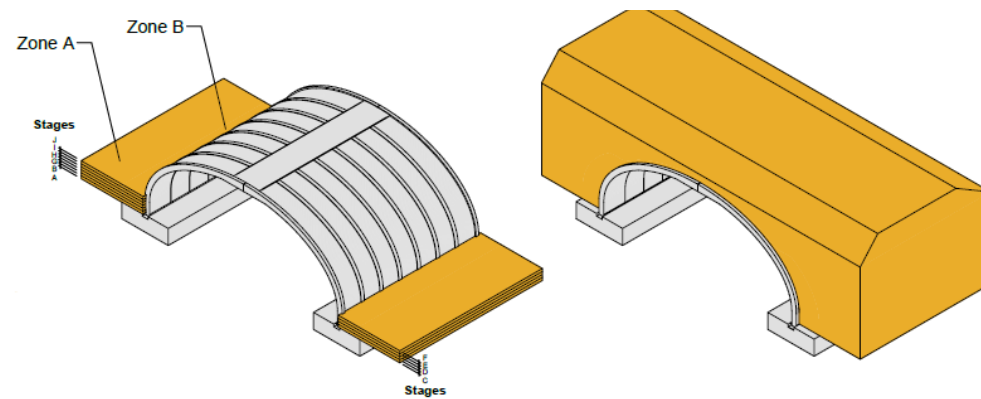
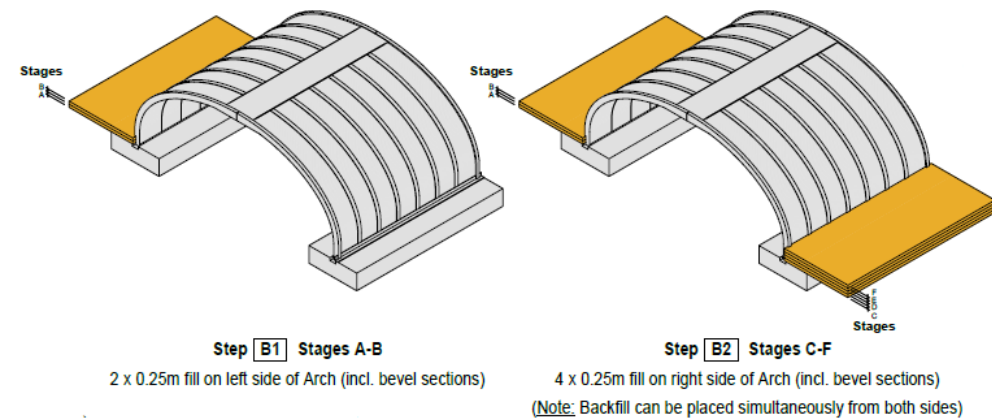


Stage 3. Cast in-situ of concrete stitch between precast arches and upstand, crown joints and loop joints between arch rings, placing of drainage pipes and waterproofing.





Stage 4. Backfilling placed simultaneously from both sides.



The backfilling operation creates one of the most important series of loads experienced by the structure. The backfill is an integral, load carrying part of the structure. It must permanently fulfil its purpose. Severe damage to the structure can result if proper procedures are not followed. Critical zones for backfilling as indicated below:

#### ZONE A

Zone A material shall be **Class 3** as per DMRB – specification for road works – series 600 earthwork. Natural ground is to be sufficiently stable to allow effective support to the precast concrete arch units. As a guide, the existing natural ground should be of similar quality and density to zone a material for a minimum lateral dimension of one arch span outside of the arch footing.

#### ZONE B

Zone B material shall be **class 6P** material in compliance with the specification for highway works from the manual of contract documents for highway works (MCHW) vol.1 series 600, BS EN 14475: 2006 and BS 8006 1: 2010.

#### ZONE C

Zone C is the road section of gravel, asphalt or concrete built in compliance with DMRB – specification for road works - series 700 road pavements – general. Minimum overfill height is 600mm over the crown of the arch, including the pavement. There should be at least **100mm of select fill** between the arch extrados and the bottom of the pavement.

Unless otherwise specified, backfilling operations shall not begin until the grout of the arch key has achieved the design strength and the concrete of the crown joint has reached the specified design strength.

Dumping for backfilling is not allowed any nearer than 1 meter to a vertical plane through the arch key. The fill must be placed and compacted as per DMRB – specification for road works – series 600 earthwork fill to structures in layers not exceeding 250mm. The maximum difference in the surface levels of the fill on opposite sides of the arch must not exceed 500mm.

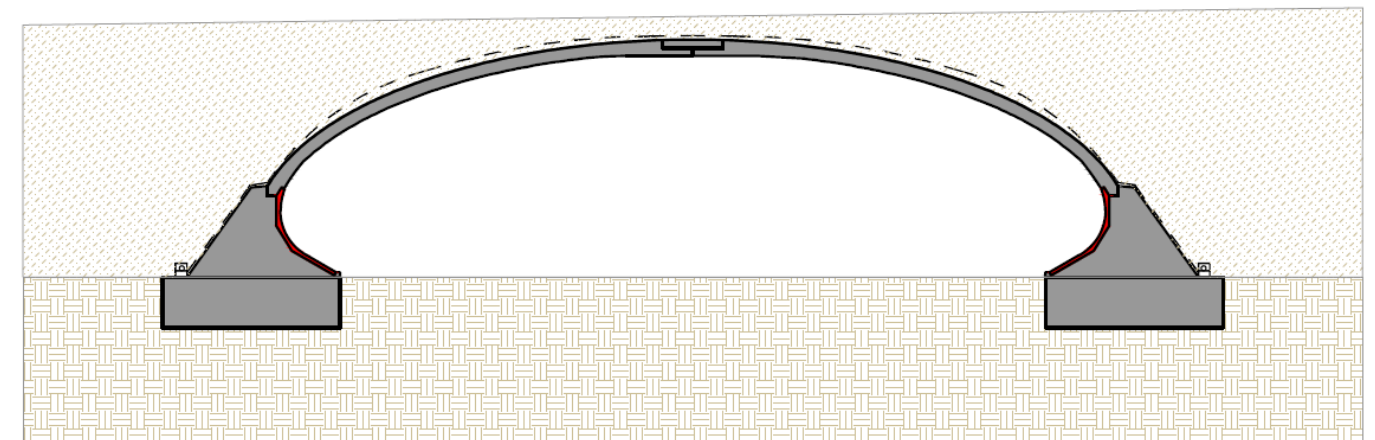
The backfill of Zone B must be compacted to a minimum of 98% of the maximum dry density determined by the Proctor Standard test.

To avoid damage, fill within 300mm of concrete surfaces shall be hand-compacted (i.e., using hand-operated equipment vibro-tamper having a mass not exceeding 500 kg).

After the compacted fill level has reached a minimum of 0.3m over the crown of the arch, construction equipment with a maximum weight of 30 tonnes may cross the arch.

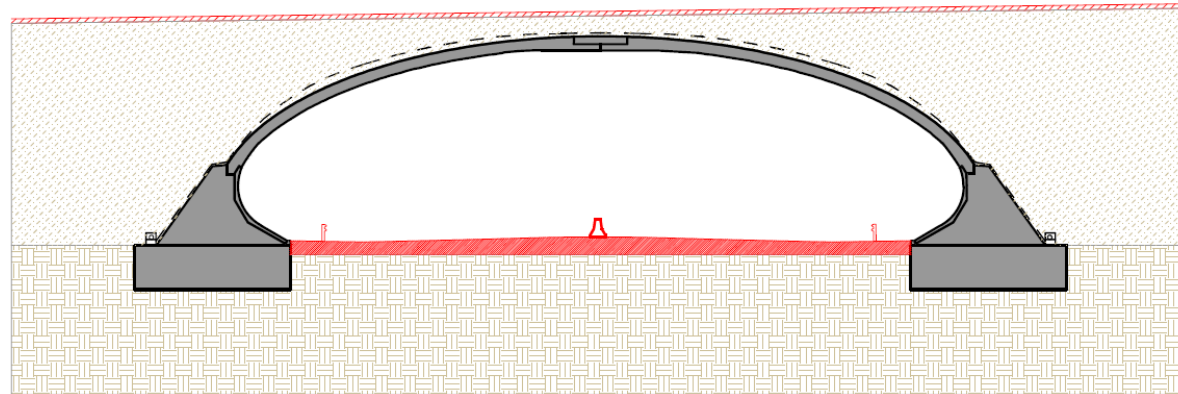
After the compacted fill level has reached 0.5 m over the crown of the arch, construction equipment within the design load limits for the road may cross the arch.

An adequate compaction will be achieved for each different type of material.



Stage 5. Placing of precast lateral pieces (same width than the arch rings)

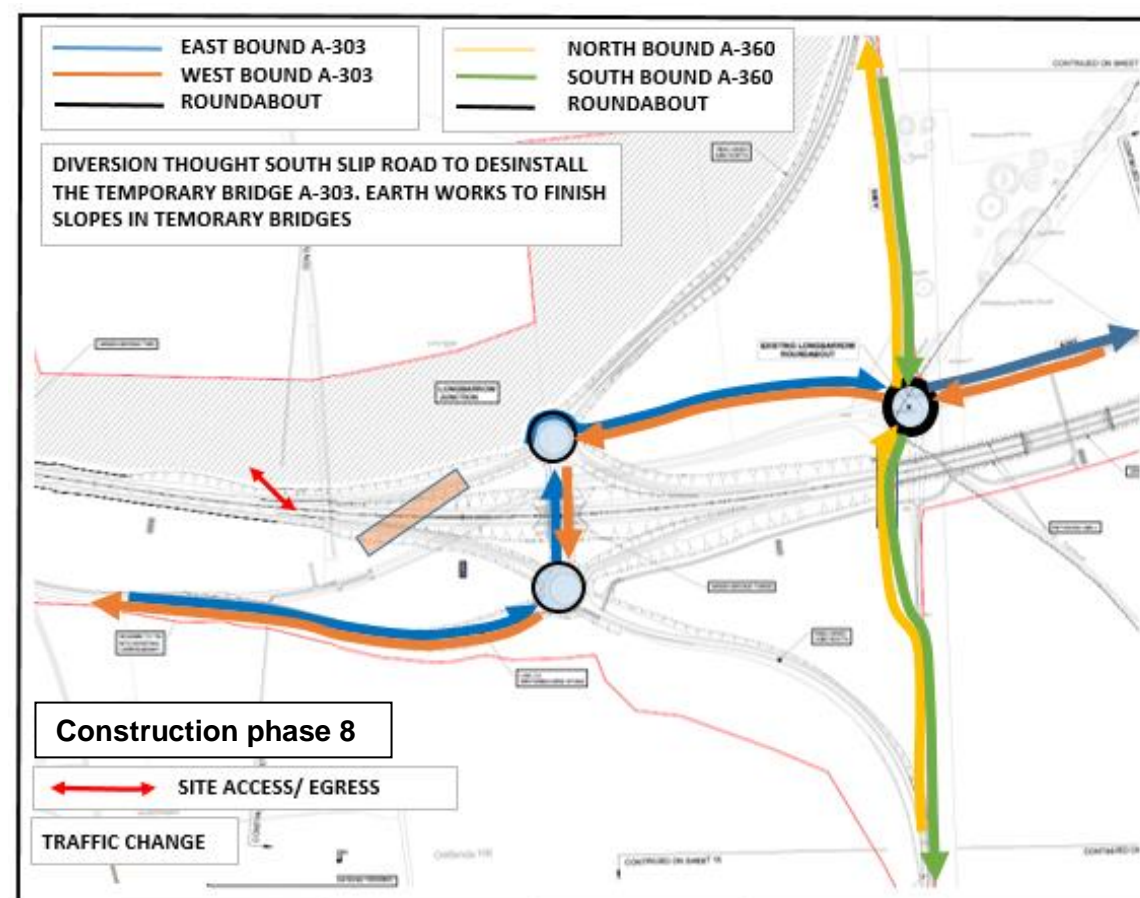




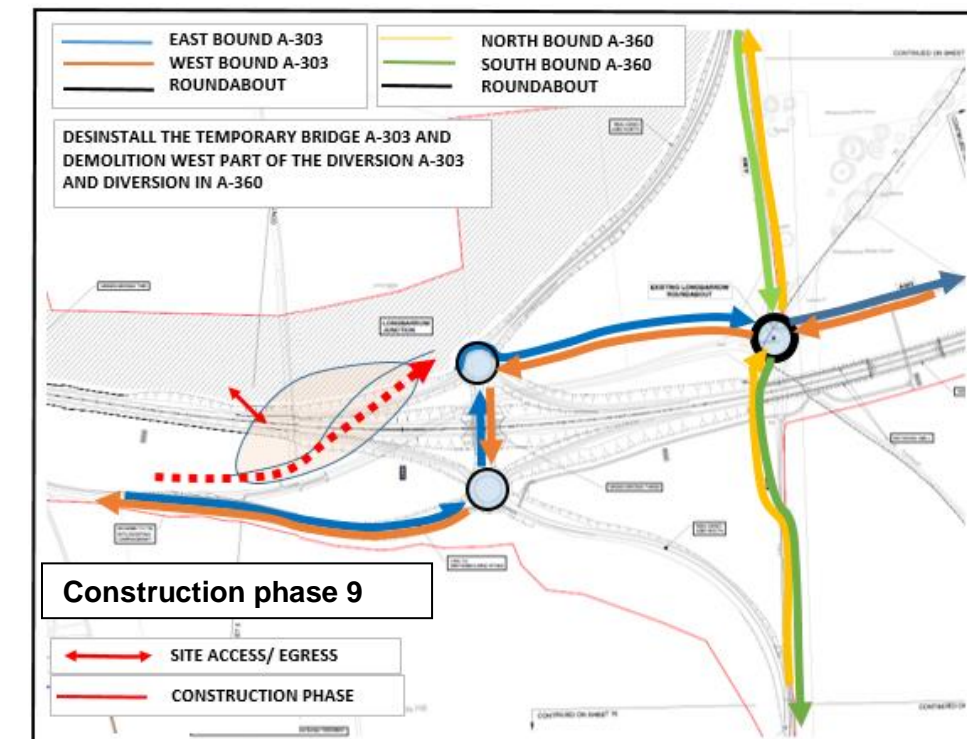
Stage 6. Execution of road pavement and finishing

With the Green Bridge 3 and the new link to Winterbourne Stoke finished, the live traffic can be diverted into the new road sections according to the traffic arrangement shown in **Construction Phase 8**.

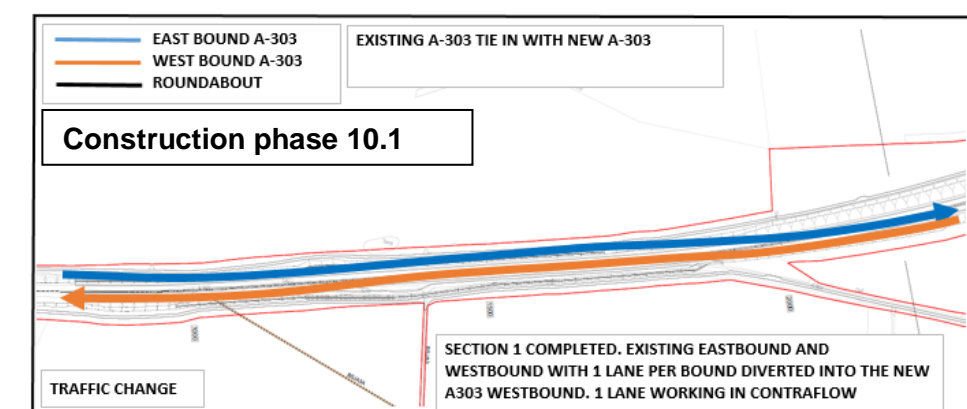
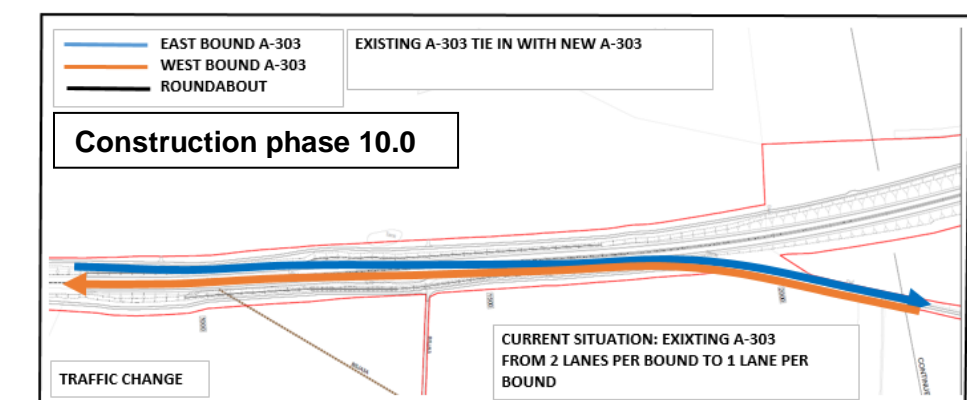
Our Traffic Management Team will divert the traffic from the arrangement shown in the **Construction Phase 7** to the new link to Winterbourne Stoke through the new South Roundabout and above the Green Bridge 3. The new northern and southern roundabouts at the new Longbarrow Junction will be opened. The traffic from the existing A360 will be kept as per the original arrangement, running through the temporary bridge. Temporary bridge over the A360 will be kept in place until the tunnel is finished and the construction team start the execution of the remaining sections of the new A303 (**Construction Phase 12**). Traffic users will have all directions on A303 and A360 opened.



All the traffic will be running with one line opened per bound, except for Green Bridge 3 where we will allow for 2 lanes opened per bound. Please refer to **QS-13C** Traffic Management Drawings for "Lane and Junction details for the different traffic phases" for graphic reference.



Once the traffic is running according to the arrangement previously explained, BADGER construction team will allow for the removal of the temporary bridge on the A303 and the demolition of the foundations. Temporary road used in the previous construction phases on the A303 will be also demolished, keeping in operation the temporary road used as connection between the existing Longbarrow roundabout and the new northern roundabout. This will allow our construction team to finish the earthworks and pavement works on the new westbound merge slip road (**Construction Phase 9**). With the new westbound merge slip road finished, we will proceed for a new traffic change. We will connect, at the western end of the road scheme, the existing A303 with the new A303 as shown in **Construction Phase 10.0 and 10.1**.

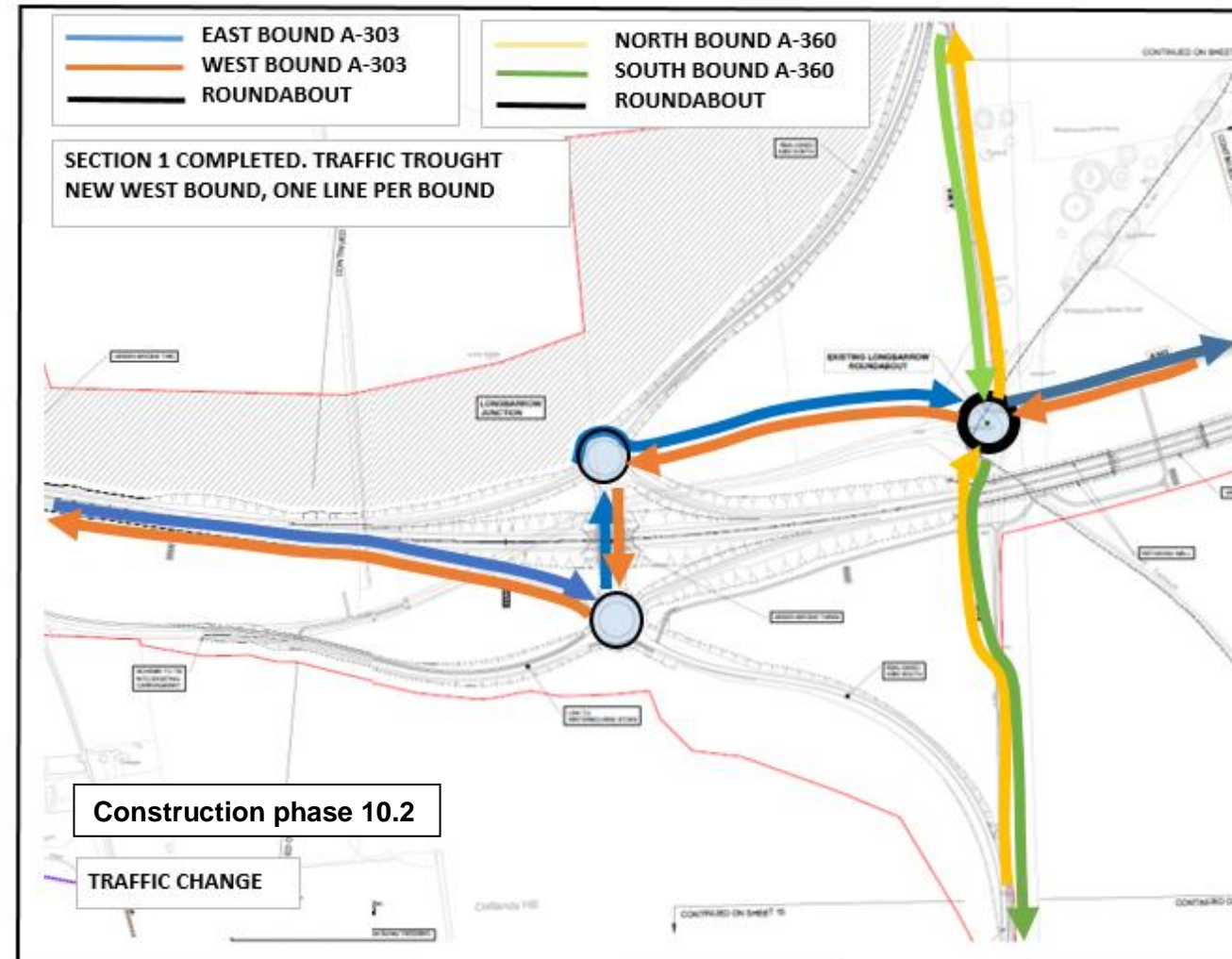






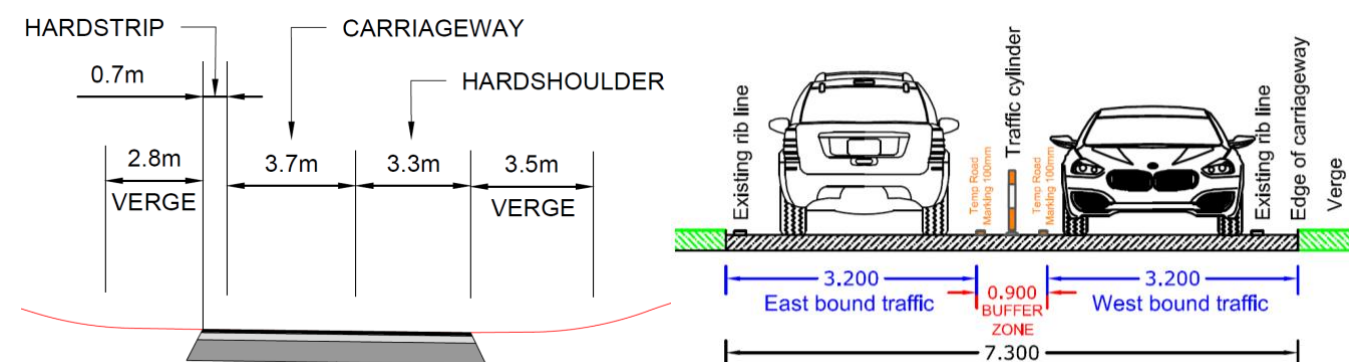
The traffic on the existing A303 flows in 2 lanes per bound and it is reduced to 1 lane per bound (**Construction Phase 10.0**). With the traffic running in 1 lane per bound through the existing A303, we will implement the new tie in connecting the existing A303 and the new A303 westbound, with one lane of the new A303 westbound working in contraflow. (**Construction Phase 10.1**).

Final traffic arrangement of Longbarrow Junction can be seen in **Construction Phase 10.2**.



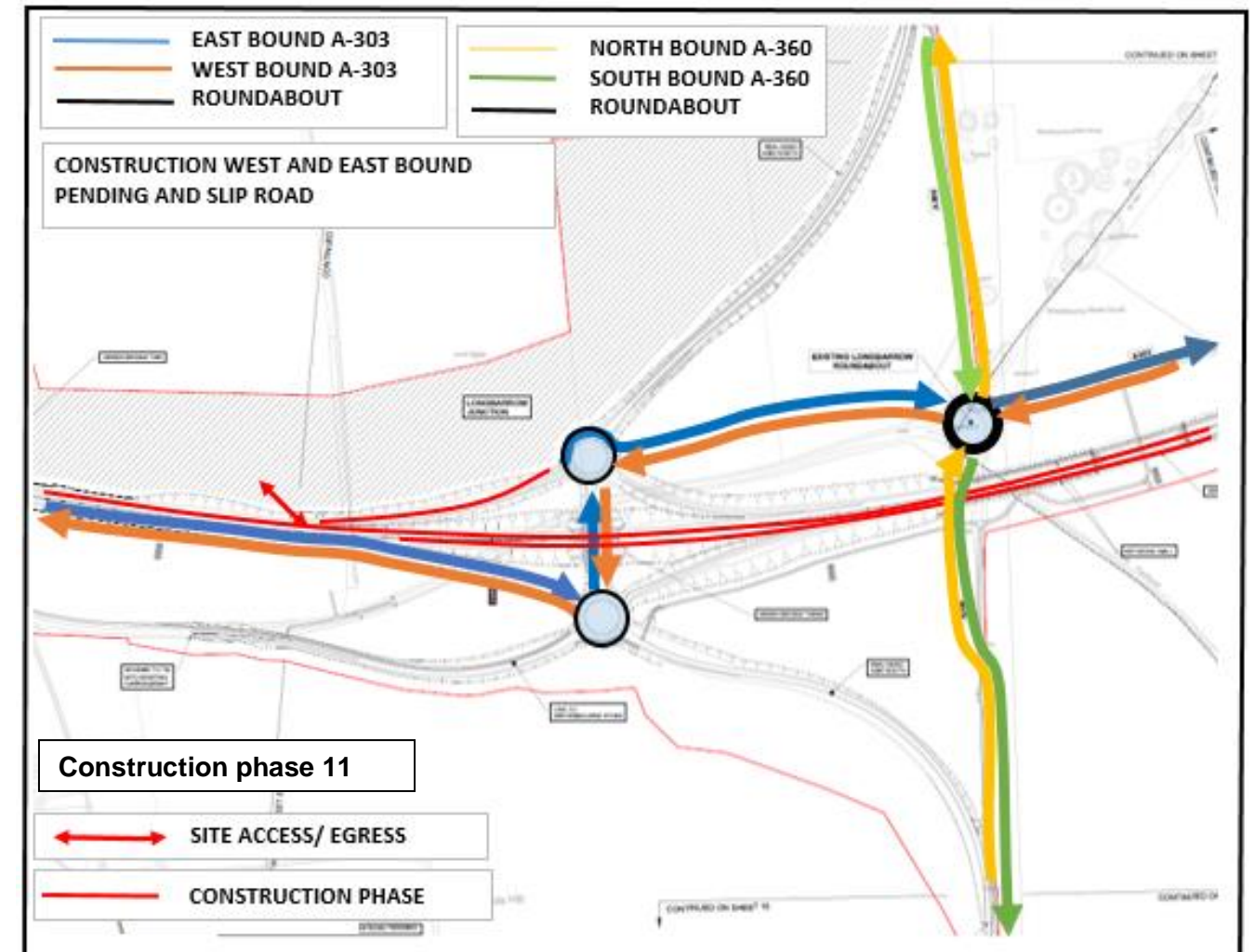
With this traffic arrangement, **Section 1 is completed**.

Only the new A303 westbound will be opened to traffic with one lane working per bound. When the traffic running through the new A303 is approaching the new Longbarrow junction, it will be diverted through the new westbound merge slip road, working as a temporary bidirectional road (1 lane per bound) from the new southern roundabout.



The proposed cross section with the disposal of the eastbound and westbound carriageway for the new west slip road working as a temporary bidirectional road is shown at the end of the opposite column. Width of lane and buffer zone may vary and to be increased to fit and accommodate the traffic into the slip road.

The new eastbound carriageway will be kept closed to traffic. This eastbound carriageway will be used by the construction team as an internal haul road in order to support the works of the tunnel being executed as part of the Section 2.

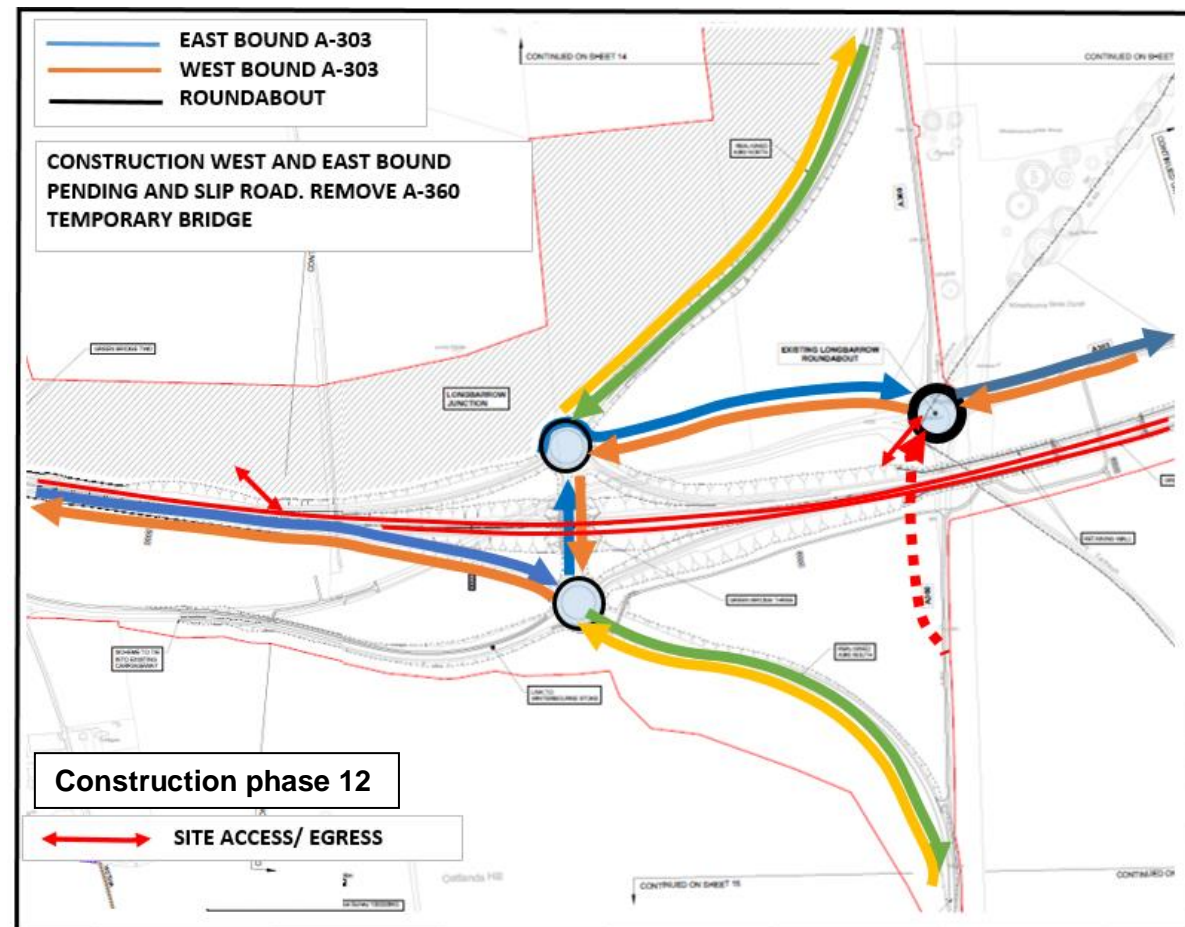


With Section 1 completed, the construction team will carry on with the remaining works of the junction, eastbound carriageway, remaining area of the westbound carriageway and new eastbound slip road (red lines in **Construction Phase 11**).

As stated before, these pending sections to be constructed will support the tunnel works as internal haul roads. These works will be finalised after the completion of the tunnel.

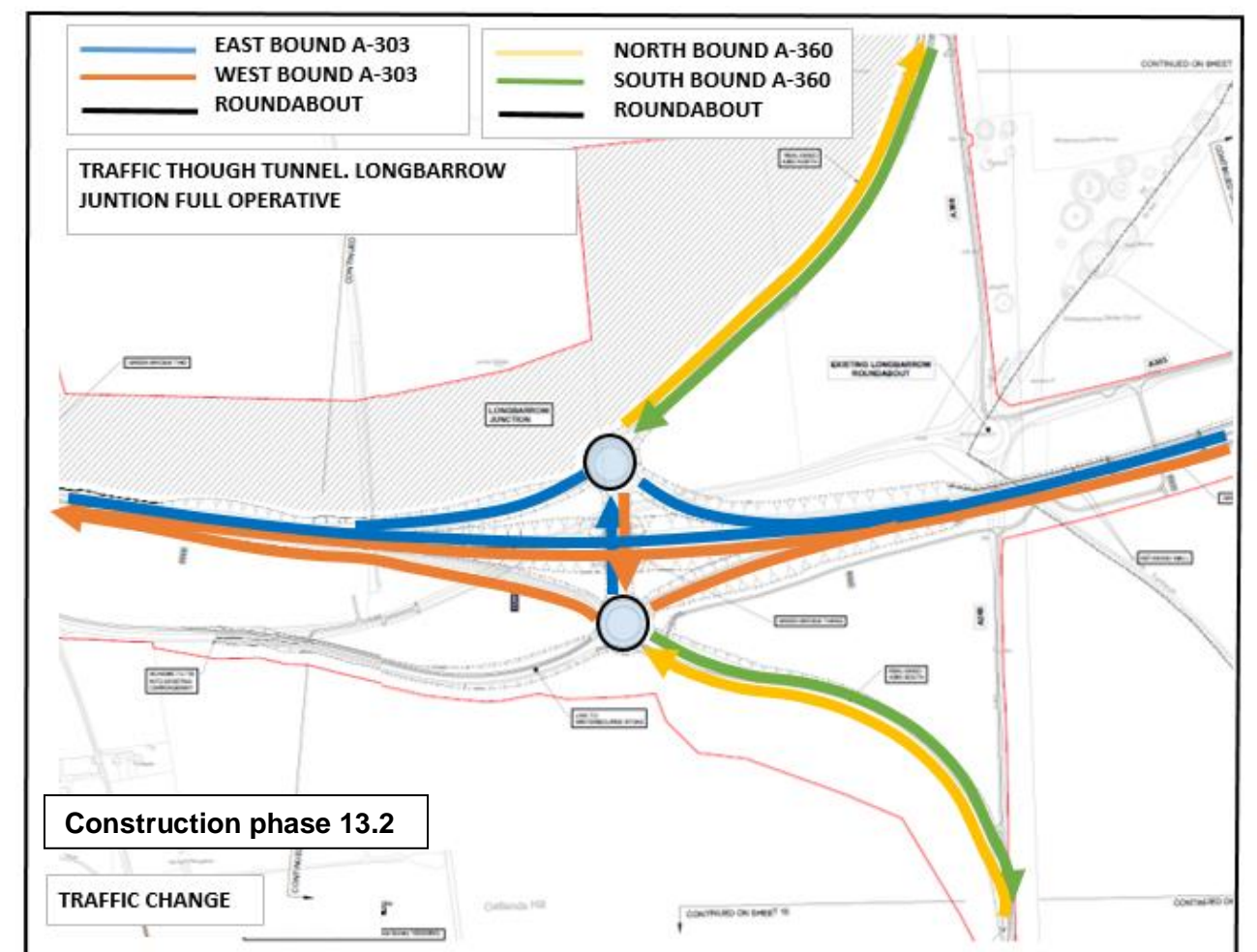
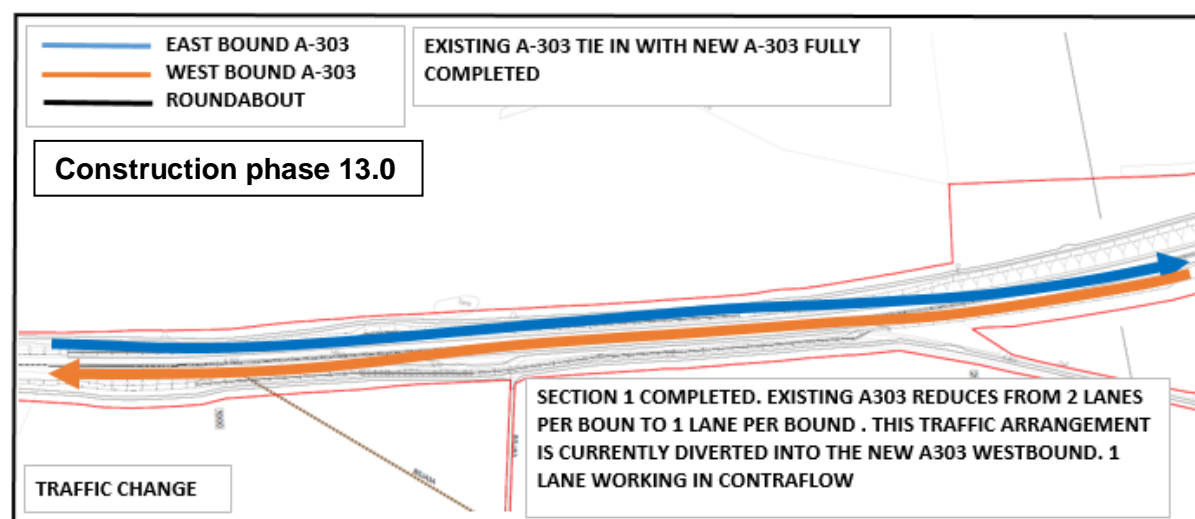
Once the tunnel is finished, our Traffic Management Team will allow for a new traffic change (**Construction Phase 12**).





The traffic running on the A360 will be diverted into the new realigned A360 North and the new realigned A360 South, connected by the new roundabouts and the green bridge 3. Traffic running on the A303 will be kept with the same arrangement stated in **Construction Phase 11**.

This new traffic arrangement will allow the construction team to remove the temporary bridge over the A360 and to finish the remaining sections of the new A303, which are the new eastbound and the connection with the western tunnel portal (red lines in **Construction Phase 12** shown above).



When the works stated in the **Construction Phase 12** have been completed, our Traffic Management Team will then allow for the final traffic change (**Construction Phase 13**). The tie in of the existing and the new A303 will be fully implemented, with the new 2 lanes working per each bound. The full new Longbarrow junction will be opened to the traffic, and the construction team will demolish the temporary road from the New North Roundabout to the existing Longbarrow roundabout.

Traffic on the new A303 will be running through the new tunnel and connected with the Countess Junction.



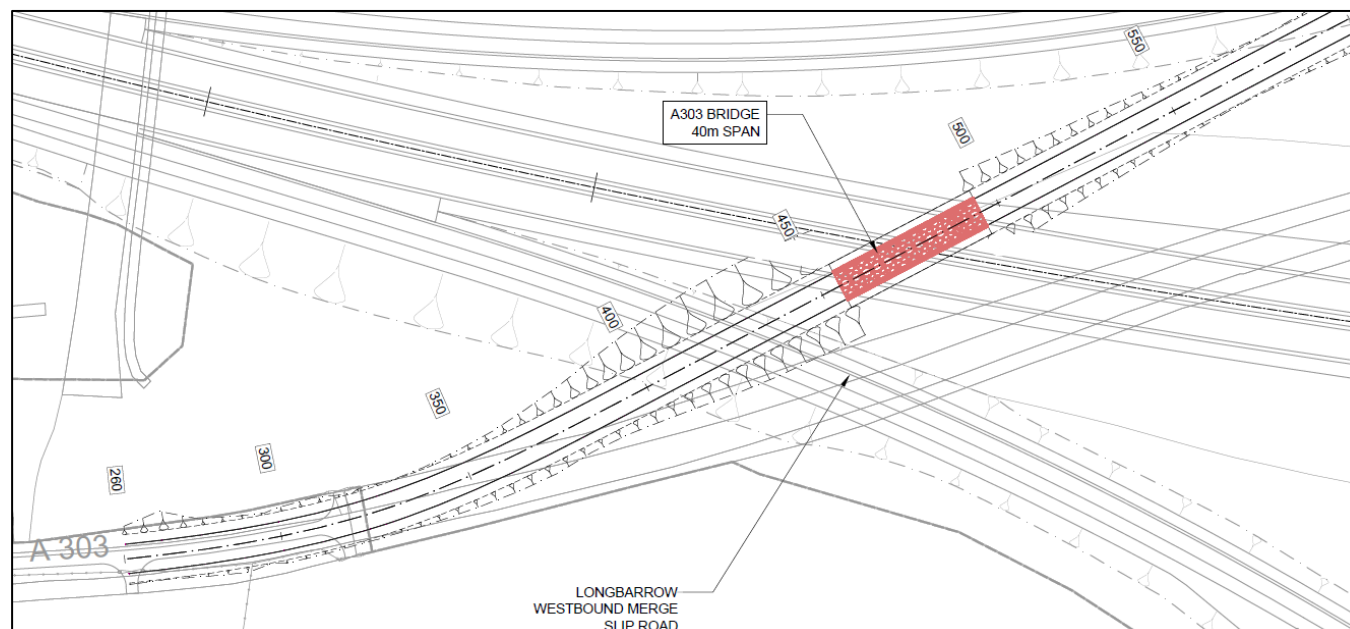


## 4.2 Temporary works and temporary structures required for the construction of the junction, including for the intersection and interaction of the A360 and the existing, and new, A303 in order to maintain traffic flows during construction

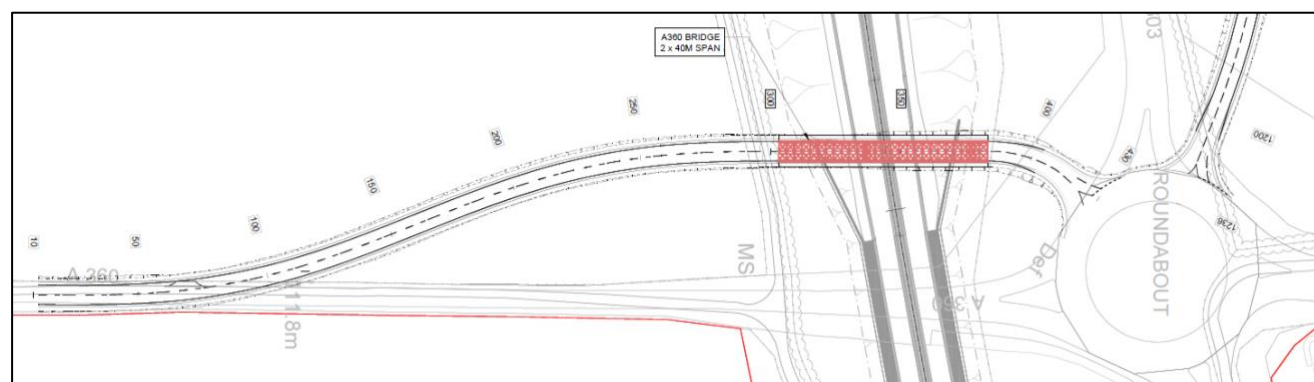
In order to keep the traffic open along both A303 and A360, BADGER will implement the installation of temporary structures along the temporary diversions of these roads. With the installation of these temporary structures BADGER will allow for an internal haul of the traffic site vehicles involved in the different operations of the construction phase not interfering with the road users. Different options are considered for this purpose:

### Temporary Bridges

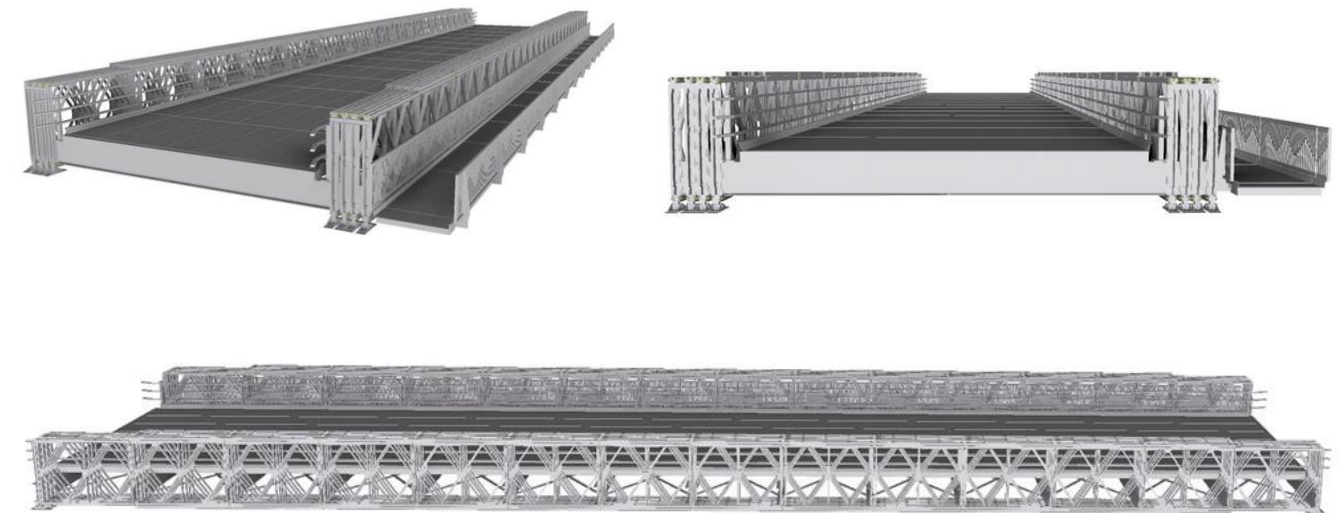
- The temporary bridge to be installed for the diversion of the A303 will consist of one temporary bridge for the mainline with 40m span. The bridge will be placed on a bank seat abutment. Temporary bridge for A303 will be installed in the shown position:



- The temporary bridge to be installed for the diversion of the A360 will consist of a two span bridge (40m + 40m) placed on a bank seat abutment. Due to the total length of the bridge an intermediate support will be considered. Temporary bridges for the A303 will be installed in the position shown:



A twin carriageway (7.35m Wide) by each bridge will be available for traffic, one per bound. If it would be needed, a pedestrian path could also be included.



The full panel height of the temporary bridges will be around 2.5m.

## 4.3 Protective measures which will be implemented for environmental and heritage assets and the wider historic landscape of the WHS during construction;

BADGER will prepare for the delivery stage, a Construction Environmental Management Plan in accordance with the OEMP, with the approval of The Authority and will consult with Wiltshire Council, the Environment Agency, Historic England and Natural England on those aspects of the CEMP that are relevant to their functions and with Heritage Monitoring and Advisory Group (HMAG) for Heritage Management Plan for issues relating to archaeological proactive measures.

For the protection of the environmental and heritage assets, BADGER will develop at least, the following plans:

- Site Waste Management Plan.
- Emergency Preparedness and Response Plan.
- Heritage Management Plan.
- Ground Movement Monitoring Strategy.
- Landscape and Ecology Management Plan.
- Arboricultural Mitigation Strategy.
- Noise and Vibration Management Plan.
- Noise Insulation and Temporary Rehousing Policy.
- Soils Management Strategy.
- Water Management Plan.
- Groundwater Management Plan.
- Materials Management Plan.
- Traffic Management Plan.

Specific Method Statements will be released at the start of the construction works to describe specific construction measures to be developed to the site works and area of interest in compliance with OEMP and HMP.

BADGER will prepare Archaeological Method Statements in respect of works that may affect potentially sensitive archaeological remains prior to the start of the work. The Archaeological Method Statements will address, in compliance with the provisions of the DAMS and the approved HMP measures including:





- a) How the main works contractor intends to preserve in situ sensitive archaeological remains and prevent deformation of topsoil / subsoil horizons (including no-dig solutions);
- b) Measures for monitoring continued protection of in situ archaeological remains;
- c) Where appropriate, how the measures would be reversed following the end of construction, e.g., at compound locations, the ground and the surface returned to its original shape and condition.

Areas to be addressed in the Archaeological Method Statements include:

- All access routes, haul roads and traffic diversions
- Compound locations
- Cycle-ways between the realigned A360 north to the Stonehenge Visitor Centre and from the realigned A360 south to Druid's Lodge
- East Parsonage Down
- Profiling on the Winterbourne Stoke bypass
- Profiling at Longbarrow roundabout.

BADGER will have a close coordination with the Archaeological Clerk of Works (ACoW) (The Authority). BADGER will ensure that environmental controls are in place and working effectively. We will undertake site inspections to monitor compliance with the environmental licences/consents for the works and the measures within the CEMP.

ACoW will monitor BADGER'S compliance with our obligations to ensure that protection measures are in place and maintained appropriately throughout the construction period in compliance with the contractor's HMPs and the DAMS.

BADGER will liaise with the ACoW to ensure compliance with the DAMS. From the start of the mobilisation works, all the assets and archaeological features potentially affected or disturbed by the earthworks along the corridor and in all the identified areas by BADGER for the works, will be identified.

All the risks associated with these works will be identified and any mitigation measures will be implemented during the works to avoid any damage (vibration, noise, dust, ground movement visual impact, contamination etc). The measures of protection will be built by BADGER and managed during the delivery stage. The assets on the sitework will be clearly indicated with specific signage and protected by fence or bounds. All operators and drivers will receive a specific training and induction to identify and preserve the archaeological assets.

BADGER will have the responsibility to manage, monitor and maintain all the protective measures installed along the site works throughout the main works construction period.

4.4 The key construction risks that are uniquely associated with the construction of this Scheme area and the proposed mitigation.

BADGER will apply a strategy to proactively manage risk from the outset, which will enable us to safeguard the integrity of Highways England's goals and objectives for the project.

The key construction risks that are uniquely associated with the construction of the Longbarrow Junction, including Green Bridge 3 and the proposed mitigation measures are shown in the table below:

KEY RISK	PROPOSED MITIGATION MEASURE
Compliance with the DAMS and related mitigation measures during the construction works.	We will ensure that key objectives and procedures outlined in the DAMS are communicated to all site personnel initially via Site Induction and then by regular toolbox talks. Only trained personnel will manage particular tasks in terms of preservation of archaeological remains. Our trained people will ensure that all site personnel are aware of the importance to respect this measures before starting any type of activity and earthworks.
Risk of delay in design packages approval for temporary roads diversion.	Close coordination and interaction between BADGER Design Team, Highways England and all the involved stakeholders during the preconstruction design phase to achieve final design approval and permissions on time.
Risk of not achieve 6N/6P material with chalk class 3 for the Green Bridge 3 filling	Additional geotechnical investigation of the in situ material, laboratory test, mock-up simulations, stabilisation and trial embankment test will be done in order to achieve a suitable fill material.
Risk of stress increased in the road users due to the different diversions	Traffic management and diversions design to minimise the effect on road users and will be implemented through our traffic management strategy.

Lane and Junction details for the different traffic phases

- Longbarrow Junction showing lane details:
- **Link to Winterbourne Stoke:** 1 Lane per Bound
  - **Green Bridge 3:** 2 Lanes per Bound
  - **Realigned A360 North:** 1 Lane per Bound
  - **Realigned A360 South:** 1 Lane per Bound

