Technical Note - Surface Water Strategy

Arup, Arup 2020

Technical Note

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1 Introduction

Ove Arup & Partners Limited ('Arup') was commissioned by Argent LLP ('the Client') to undertake a Stage 3 design for the Kings Cross Bridge 2 (hereafter referred to as the 'Site').

The purpose of this technical note is to detail the preferred surface water strategy for the proposed Kings Cross Bridge 2 in support of the planning application. The bridge is being consented as a reserved matters application from the wider Kings Cross Development outline planning submission.

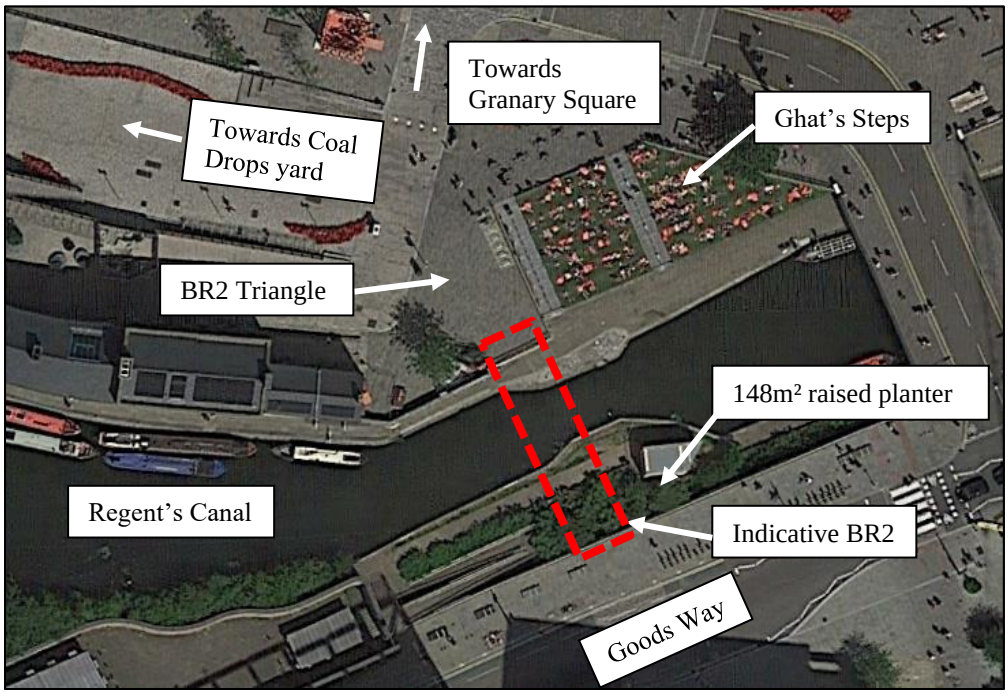

Figure 1: Site location Plan (Courtesy of Google Earth Pro 2020)

2 Bridge deck drainage

The 26m (L) x 3.6m (W) bridge has a crest at mid span, falling north (Catchment A) and south (Catchment B) at varying longitudinal falls (Refer Figure 2).

The bridge deck is to drain via gravity and hence will be shaped so that a transverse fall of 1:40 to the eastern and western edges of the deck is achieved. A shallow dished channel will run along each edge to collect the runoff and gullies fitted with silt traps will be located at either end, off the bridge (4No. in total). The bridge bearing shelf on the south side will be drained to the 2No. proposed downpipes on the north side of the Goods Way retaining wall. The bearing shelf on the north side will drain to a new surface water drainage pipe. This pipe drains at an approximate gradient of 1:35 via a new manhole, to an existing chamber to the west of the BR2 triangle. The bridge does not require foul connection.

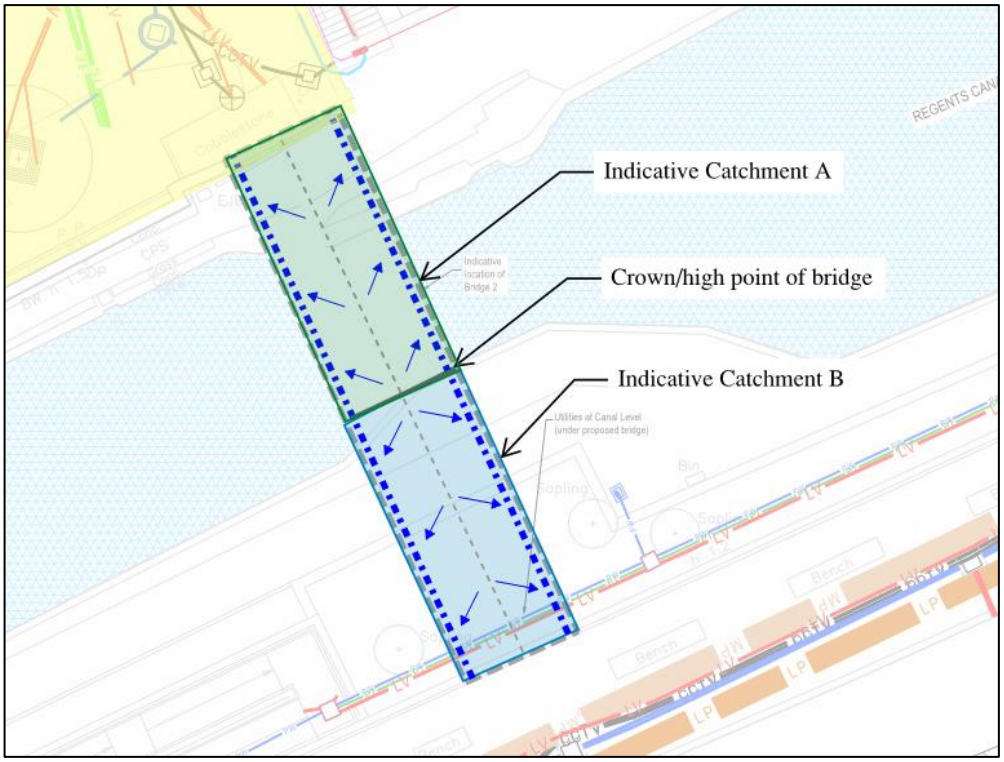

Figure 2: Indicative catchment areas

3 Existing Drainage

The existing site, essentially the area beneath the proposed bridge, is currently understood to have no specific drainage strategy in place, with all rainwater draining either to the canal, BR2 Triangle surface water network or to the vegetated raised planter on the southern side of the canal.

Catchment A, as defined in Figure 2, is approximately 48m² in total with 37m² currently draining directly to the canal and 11m² draining to the BR2 Triangle.

Catchment B, also approximately 48m², is currently split with 21m² draining to the canal and 27m² draining to an existing raised planter of the south side of the canal.

4 Proposed Surface Water Strategy

Refer to Arup civil engineering drawing KXC-ARP-BR2-XX-DR-CD-20001 for details.

4.1 SuDS Appraisal

Using policy recommendations and design best practice, a preliminary SuDS appraisal was created at RIBA Stage 2 to determine opportunities for the incorporation of SuDS features into the development. The appraisal has been undertaken with consideration to the Draft New London Plan SuDS Hierarchy.

The SuDS appraisal has been refined at RIBA Stage 3 following additional site investigations and consultation. A revised appraisal has been undertaken in Table 1 below.

Table 1: Draft new London Plan SuDS Hierarchy Appraisal

Surface Water Management	**Considered viable for inclusion within the design?**	**Design Comments**
1 – Store Rainwater for later use	Limited	The proposal does not involve any buildings in which water re-use might be achievable. The opportunity for soft landscaping irrigation is considered negligible however the client may wish to include a rainwater butt adjacent to the raised planter on the southern side of the canal.
2 - Use of Infiltration Techniques	Yes	Deep infiltration will almost certainly not be appropriate due to the Site being underlain by London Clay (British Geological maps) and the limited available space. However, the raised planter on the southern side of the canal drains naturally via infiltration, evaporation and plant uptake and therefore this suggests there is an opportunity for infiltration in this location. This solution also encourages biodiversity which is another key SuDS consideration. **This is the most appropriate drainage outfall for Catchment B.**
3 - Attenuate Rainwater in ponds or open water features for gradual release	No	There is not enough available space to accommodate any new large open water features and there are no existing offline open water features in close proximity suitable for attenuation. The canal is not considered a water feature that can be used for attenuation as any attenuation would have to occur prior to discharging to the canal.
4 - Discharge rainwater direct to a watercourse	No	Catchment A: Due to the presence of UKPN HV cables within the northern towpath of the canal, it is not considered viable to install a drainage outfall on the northern side of the canal. The runoff from Catchment A cannot viably drain to the canal.
	Potentially viable	Catchment B: There are no existing surface water outfalls to the canal that can be utilised for this project and so a new canal outfall would be required. Discharging the runoff from Catchment B to the canal would involve extensive drainage infrastructure including manholes, attenuation, a stilling chamber and a new outfall to the canal. Given the very small catchment area, this is not the most viable solution.

5 - Attenuate rainwater above ground	No	Catchment A: There is no space available to attenuate the runoff above ground.
	Potentially viable	Catchment B: It may be possible to attenuate within an existing raised planter.
6 - Attenuate rainwater below ground	Yes	Catchment A: An attenuation tank may fit within the BR2 Triangle area although it has been confirmed that this is not needed.
	Unlikely	Catchment B: The site is extremely constrained and therefore it is unlikely an attenuation tank can be accommodated within the Clients land.
7 - Discharge rainwater to a surface water sewer/drain	Yes	Catchment A: There is a surface water network located in the BR2 Triangle. **This is the most appropriate discharge point for catchment A.**
	No	Catchment B: There are no public surface water sewers nearby.
8 - Discharge rainwater to the combined sewer	No	Catchment A: There is no nearby combined sewer.
	Yes	Catchment B: Thames Water have confirmed that discharging to the combined sewer within Goods Way would only be acceptable if all other options were unachievable.

4.2 Catchment A Drainage Strategy

4.2.1 Proposed Drainage Strategy

Following the SuDS appraisal in Section 4.1, it is proposed that Catchment A, the northern half of the bridge, will drain to an existing surface water network in the BR2 Triangle which drains to the wider Kings Cross Estate (‘the Estate’) surface water network. This network is in the process of being adopted by Metropolitan.

Details of the existing surface water network within the BR2 Triangle have been sourced from Maylim drawing ‘MAY AB 001-BR2 Triangle – As-built survey Complete as-built’, dated 19.01.18 and PBA drawing 20227/2026/500/01 Rev B. The proposed gully on the western side of the bridge would drain to the existing manhole, FD01, within the BR2 Triangle. The eastern gully would drain to a new manhole on the existing 150 diameter surface water clay pipe which drains from FD01 to FD02 to the north. This existing pipe between FD01 and FD02 is laid at an approximate gradient of 1:80. Refer to the Arup Stage 3 civil engineering drawings for further details.

Peter Brett Associates drawing 20227/007/500/10 Rev B details the Estates’ drainage strategy which includes flow controls in the form of Hydrobrakes, limiting the discharge rate into the Camden Sewer. Specifically, the network into which the BR2 Triangle, and hence the Catchment A of the proposed bridge drains, includes an oversized 1500mm diameter pipe utilised for attenuation and a downstream Hydrobrake restricting the discharge rate into the public sewer to 40 L/s.

The predicted unattenuated flows from Catchment A, into the existing surface water network in the BR2 Triangle, are summarised in Table 2 below.

Table 2: Predicted Catchment A flow rates

Storm event	Duration, minutes	Flow rate, l/s
1 in 1 year	15	1
1 in 30 year	15	2.4
1 in 100 year + 40% climate change	15	4.3

4.2.2 Outline Planning - Condition 45

Condition 45 of the Outline Planning permission for the wider Kings Cross Estate stated the following:

The new drainage infrastructure within the site shall be designed to achieve a combined (storm and foul) peak discharge to the existing combined sewers of 2,292 l/s or less.

Reason: To protect future occupiers of the development, services and utilities, and prevent the pollution of the water environment, in accordance with policy SD9 and KC8 of the London Borough of Camden Replacement Unitary Development Plan 2006.

4.2.3 Consultation

As the Kings Cross Estates' drainage network has not yet been adopted by Metropolitan, the Client advised that Stantec, the designer of the wider surface water network, should be consulted regarding capacity.

Stantec confirmed that the runoff from proposed Bridge 2, as summarised in Table 2, was included when the Outline Planning Drainage Condition (Condition 45) was drafted and therefore the peak discharge of 2292l/s did include the predicted runoff from Catchment A. It was confirmed that the current predicted peak discharge rate from the Estate is 2041.8l/s which includes 1597.7l/s of surface water peak flows and 444.1l/s of foul water peak flows. It has therefore been confirmed that there is capacity within the existing network for the unattenuated Catchment A of the proposed Kings Cross Bridge 2.

4.3 Catchment B Drainage Strategy

4.3.1 Consultation

Thames Water

Thames Water were contacted for preliminary advice regarding discharging surface water runoff from Catchment B to the combined sewer in Goods Way. A response was received 13.01.20, with the following key points:

- A surface connection to a public combined sewer is not permitted where other discharge options are available, such as to a watercourse.
- A connection to a public sewer may be considered only if all other options have been exhausted, with necessary evidence provided to support.
- Developments within the London area must comply with Policy 5.13 of the London Plan.

- If soakaways, or similar, are not achievable and there is no nearby watercourse to which you can feasibly discharge, then we'll require evidence of this in the form of a letter from your building control officer. This is also a requirement under Building Regulations Part H.
- If it is not possible to discharge the runoff from the southern portion of the bridge to the canal, further consultation with Thames Water will be required including a Section 106 application for official connection approval.

Considering the above, and in line with the SuDS Hierarchy, alternative drainage strategies have been investigated.

Canal and River Trust

Preliminary discussions have been held with the Canal and River Trust (CRT) to investigate the possibility of discharging to the canal. The CRT Code of Practice requires that any outfall to the canal should typically be restricted to 0.3m/s and the outfall must be submerged.

The above would require significant drainage infrastructure including a stilling chamber, manholes and attenuation. In addition to the infrastructure required, a new outlet to the canal, likely a diamond drilled hole in the existing historic canal wall, would be required.

As the catchment area being drained is very small, the above works are disproportionately extensive. Therefore, an alternative drainage strategy has been proposed, aiming to mimic the existing drainage at the site more closely.

4.3.2 Proposed Drainage Strategy

The runoff from Catchment B would be collected in 2No. catch pits, at the southern end of the bridge. From the catch pits, a rainwater pipe would carry the runoff through the southern abutment, to the northern side of the Goods Way retaining wall. A rainwater downpipe will bring the runoff down to a controlled outlet into the approximately 148m² raised planter bed. It is proposed that the outlet will be fitted with a diffuser unit or a perforated pipe to ensure that the runoff is dispersed in a controlled way throughout the planter to prevent erosion.

Currently, 27m² of Catchment B drains naturally to the raised planter. It is proposed that the additional 21m², which currently drains directly to the canal, will drain to the raised planter. The Microdrainage Quick Storage Estimate tool has been used to determine the resultant additional volume of water into the raised planter, assuming no outflow to provide a conservative result. Table 3 summarises the results below.

Table 3: Approximate additional water depth within the raised planter

Storm Event	Storage required for additional 21m² into planter, m³	Depth of water across entire planter, mm
1 in 1	0.8	5
1 in 30	1.5	10
1 in 100	1.9	13
1 in 100 + 40% for climate change	2.6	18

The above depths of water are considered negligible when dispersed across the planter as a whole. To increase the storage within the raised planter, it is proposed that an additional brick will be added to the perimeter wall, approximately resulting in 100mm of available storage depth, or approximately 14.8m³. This additional storage volume aims to ensure the water is contained within the planter even in large storm events.

The Client may consider enhancing the raised planter soil build up and plant species when replanting following the works to further promote this solution.

Refer to the Arup Stage 3 civil engineering drawings for further details.

4.3.3 Climate change impacts

To allow for the anticipated effects of climate change, the National Planning Policy Framework (NPPF) Planning Practice Guidance states that increased rainfall intensities should be used for surface water drainage design. Table 4 is an extract from the updated government guidance in relation to climate change allowances. It is recommended that the 'upper end' climate change allowance of 40 % should be used in line with the NPPF.

Table 4: Peak rainfall intensity allowance in small and urban catchments (use 1961 to 1990 baseline) (Source: Environment Agency Climate Change Guidance (February 2016))

Applies across all of England	**Total potential change anticipated for the '2020s' (2015 to 2039)**	**Total potential change anticipated for the '2050s' (2040 to 2069)**	**Total potential change anticipated for the '2080s' (2070 to 2115)**
Upper end	10%	20%	40%
Central	5%	10%	20%

By using the 40% climate change allowance within the design calculations, the estimated effects of climate change up to the year 2115 will be stored within the raised planter and not increasing flood risk elsewhere.

4.3.4 Maintenance

The proposal includes manholes and rodding eyes for access as well as gullies and/or silt traps for sediment removal.

Although the network has been designed to be largely self-maintaining, the maintenance strategy shall be carried out by an appointed management company. The maintenance and management plan is to be incorporated into the wider site's "Operation and Maintenance Manual". The as-built drainage system shall be maintained in accordance with the requirements set out below as well as specialist manufacturers requirements, to prevent a reduction in the performance over the lifetime of the development.

The responsibility to maintain the drainage system and any overland flow routes will lie with the Client. The Client has an obligation to appoint a specialist contractor to carry out any maintenance works. The appointed contractor shall provide a Risk Assessment and Method Statement that adopt best practice health and safety policies for maintenance operatives throughout the duration of any maintenance works.

Table 5 provides typical maintenance policies and schedules for each component of the drainage system which should be considered.

Table 5: Typical Maintenance Details

Ref:	Maintenance Item	Required Action	Frequency
01	Manholes (generally)	To be inspected for debris and integrity of chambers and covers. Any entry into manholes should be by trained personnel with adequate personal protective equipment. Approved safety procedures must be followed.	5-yearly inspections
		Remove sediment and debris from inspection chambers/manholes.	Annually or as needed after storm events.
02	Gullies (generally)	To be inspected for debris and integrity of chambers and covers. Any entry into gullies should be by trained personnel with adequate personal protective equipment. Approved safety procedures must be followed.	5-yearly inspections and after large storm events. De-sludge as required. Refer to manufacturers' requirements for details.
		Remove sediment and debris from gullies and silt traps.	Annually or as needed after storm events.
03	Surface water drainage system (pipework)	Access points provided to clear blockages via rodding – monthly visual inspections for manifestation at ground surface.	5-yearly visual inspections of pipes and manholes; CCTV/cleanse/de-sludge every 10 years
04	Rainwater down pipes	Clearance of leaves/ debris.	Annually
05	Raised Planter	Remove litter and debris	Regular maintenance (monthly or as needed)
		Manage vegetation and remove nuisance plants	
		Inspect inlets	
		Check health of trees/plants appropriately	Annually
		Water	As required (in periods of drought)
		Inspect silt accumulation rates and establish appropriate removal techniques	Half yearly

It is intended that a detailed maintenance strategy will be created by the Clients' designated maintenance contractor that builds on the above table and includes specialist manufacturers recommendations and any site-specific requirements.

5 Conclusion

The purpose of this technical note is to detail the preferred surface water strategy for the proposed Kings Cross Bridge 2.

The catchment areas of each half of the bridge are very small and as such, the design aims to minimise the new drainage infrastructure required, to provide a sustainable design. The drainage

strategy for Catchment A utilises the available surface water network within the Estate, in which there is available capacity to accommodate the additional flows. The proposal to discharge the runoff from Catchment B to the raised planter at canal level aims to promote natural drainage mechanisms such as infiltration, evaporation and uptake by plants. The additional water depth within the planter in a 1 in 100-year storm +40% for climate change is expected to be 19mm which is considered a negligible increase on the existing situation.

The details of this proposal will be refined at RIBA Stage 4.

DOCUMENT CHECKING (not mandatory for File Note)

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