SOUTH BASIN

1. On drawing 17D83_S96_C251 (02) the Water Quality Plan for pad 1 refers to primary treatment by either Enviropod or GPT. This option is not acceptable as Enviropods do not treat oils or hydrocarbons. . This is done only in the GPT. Plus the Enviropods in the carpark will not generally treat roof flows and will make the MUSIC model invalid so the CDS GPT is required. Amend note. Noted, drawings have been updated accordingly.
2. The GPT is required to treat approximately the 6 month flow. Based on a catchment of 3.869 Ha this equates to a 6 month flow of about 344 l/s. The Rocla CDS 1518 is required to treat this flow. The CDS 1009 is unacceptable. Noted, drawings have been updated accordingly.
3. The strategy for pad 1 is to convey the 100 year flows to the basin via the pipe system alone. The proposed 3 x 525 mm pipes at 0.5% to drain the 100 year flows from pad 1 to the detention basin appears undersized. (approximate capacity = 0.95 m3/s). Based on a catchment of 3.869 Ha this equates to a 100 year flow of at least 1.4 m3/s. Estimate that 3 x 600 mm pipes at 0.5% is required as a minimum. Flows have been updated for latest documentation available for lot 1. 100-year Flow is estimated at 1.36m3/s, 20-year flow at 1.12 m3/s. Refer to email from AT&L for flows. Refer to drains model "Line N sizing 5m weir" for sizing of lot 1 outlet pipes. Line "N' stormwater longsection has been updated accordingly.
4. On drawing 17D83_S96_C220 (02) Line N amend longsection based on point 3 above including flows. The HGL is to refer to the 100 year HGL. Review the HGL based on the 2.9 m long weir at pit N2 the depth of 100 year flow over the weir is near 450 mm deep. The K value noted for pit N2 in the aforementioned drains model for lot 1 has been manipulated to raise the HGL in the pit to simulate the HGL increase caused by energy losses over the weir. The diversion weir width has been increased to a width of 5m to reduce HGL jump across weir to 0.327m in the 100 year and 0.259m in the 20 (refer to submerged weir calculation of 100 year, "Calculation 2". Using a weir height of 40.366m (refer comment 5 & 6) upstream water levels in Pit N2 must be RL40.693 in the 100 year and 40.625 in the 20. K-Values for 20 year and 100 year can be found in the aforementioned drains file (refer to response in point 3 above).
5. In reviewing the pdf document "Off take pit South" used to size the twin 300 mm pipes to the bioretention the incorrect values for Ho and Hu have been used. Based on a weir level of 40.25 Ho is 0.284 (invert N-2 is 39.966) and Hu is 1.05 based on an overflow water level of 40.25 and pipe invert of 39.20. Check sizes and amend document. To reduce the height of the diversion weir twin 375dia pipes, rather than twin 300dia pipes, are required to divert treatable flows. Weir RL is required to be RL40.366 (RL 40.316 + 50mm as per comment 6 below). Refer to 'Calculation 1' for offtake calculation. Drawings updated accordingly.
6. Review the HGL losses in the bioretention system including the pipe losses, pit losses including losses in the upflow pits as the level of the weir at 40 25 cannot overcome the losses based on a TWL of the bioretention of 40.15 plus a depth of overflow of at least a 0.1m i.e. 40.25. ie. There is no head in the weir level at 40.25 to drive the design flow through the system against a head of 40.25. To assist the filter media level could be lowered by 150 mm. Considering the difficulties of modelling a completely submerged distribution system, (and following discussions and agreement with Tony Merrilees [BCC]), 50mm of height will be added to the diversion weir to ensure adequate flow can be achieved to drive the distribution system. This has been updated on the drawings.
7. On drawing 17D83_S96_C240 (02) the layout of the bioretention overflow pits are based on Detail 13 of Council's WSUD drawings. This layout is based on a stand-alone bioretention basin design and not as part of an OSD system. As proposed this

arrangement creates substantial bypass causing the OSD to become ineffective. Only the underdrain subsoil line flows are to go direct to the outflow headwall. Where this is part of an OSD basin these three pits are to have sealed lids and a flat weir overflow provided across the 4 m wide maintenance path set at the basin edge to the 300 mm bioretention extended detention level with reverse crossfall directed to the OSD basin (possibly near the scour protection for the pipe outlet). Provide scour protection and a concrete seepage barrier across the weir overflow or build this in concrete. Check weir width to limit depth to 0.1 m maximum. Noted and drawings have been updated to reflect the revised strategy described in this point.

Considering a treatable flow rate of 180l/s a weir width of 3.4m will be required. The weir will be located adjacent to the pipe inlet to the basin to hare the scour protection available. Refer to drawing C240 for details of these changes.

8. On drawing 17D83_S96_C240 (02) the outlet from the OSD is shown as 600 mm pipe at 0.5% and the 100 year outflow from drawing 17D83_S96_C241 (02) details a 100 year orifice discharge of 842 l/s. It is good practise to design the outlet pipe from the orifice for about twice the orifice flow or at least substantially more than the orifice flow itself. The 600 mm pipe @ 0.5% conveys about 460 l/s and is substantially undersized. Increase the pipe size accordingly. Pipe has been resized to a 750mm dia RCP which conveys approx. 920l/s at 0.5%. Drawings updated accordingly.
9. On drawing 17D83_S96_C240 (02)

   a) reduce in size the pipeline from the bioretention to the headwall as only conveying underdrain flows. We have checked the pipe capacity monographs and still recommend that a size of 375mm be used to convey the flows. If Council specifically require a different size, we suggest that this be made into a formal consent condition.

   b) provide a cut off wall through the rock weir overflow for the OSD basin. Noted, drawings have been updated to include a cut off wall through the rock weir.

   c) Refer to the 2 pipes within the bioretention basin as 300 mm permeable pipes laid flat Noted, drawings have been updated accordingly.

   d) The berm width around he OSD should be increased to a minimum of 2 m based on Council experience and the 1.2 m if used should be justified by a geotechnical engineer. Set top of berm to a minimum of 39.40 to match the 300 freeboard shown on the northern basin. Noted, drawings have been updated accordingly. We note that the level of RL39.40 is incorrect as the berm level of this basin is RL40.405 based on a 100ARI water level of RL40.105.

   e) On Section A the top of OSD berm is to be 39.40 minimum to give at least 300 freeboard. Following further discussion with council engineer Tony Merrilees (BCC), the south basin top of OSD berm level will be increased to RL40.405 to provide 300mm freeboard to the emergency overflow weir at RL40.105.
10. On drawing 17D83_S96_C241 (02) at the Discharge Control Pit

    a) the pits should have surcharge style grates. Noted, drawings have been updated accordingly.

    b) Provide a minimum 375 mm pipe from the small orifice to the larger pit. Noted, drawings have been updated accordingly.

    c) Increase the width of the 1.5 year orifice pit as it is too small to contain the minimum 1.13 m2 Weldlok screen (20 x orifice area). Pit has been enlarged to 1.2 x 1.8m.

    d) Detail how the 4.9 m2 Weldlok screen in the 100 year orifice pit can be contained and accessed in a pit with 3 x 1200 x 1200 grates. Pit has been enlarged to 3.6 x 1.2m

    e) Show the new outlet pipe size from the 100 year control pit. Pipe size updated. Refer to comment 8.
11. On drawing 17D83_S96_C241 (02)

    a) At the bioretention System Inlet Pit amend the invert of the 300 mm permeable

pipes to 39.15. Noted, drawings have been updated accordingly.
b) At the bioretention System Inlet Pit show the concrete top of pit as 200 mm above the apron level. Noted, drawings have been updated accordingly.
c) Provide a detail of the weir overflow across the access track. Overflow weir has been updated to be noted as being constructed out of concrete.
d) Show the 3 pits at “Outlet for large Bioretention System” with sealed lids. Noted, drawings have been updated accordingly.

NORTH BASIN

12. On drawing 17D83_S96_C251 (02) the Water Quality Plan for pads 2, 3 and 4 refers to primary treatment by either Enviropod or GPT. This option is not acceptable as Enviropods do not treat oils or hydrocarbons. This is done only in the GPT. Plus the Enviropods in the carpark will not generally treat roof flows and will make the MUSIC model invalid so the CDS GPT is required for each pad. Amend note. Noted, drawings have been updated accordingly.
13. The GPTs are required to treat approximately the 6 month flow.
    a) Pad 2 based on a catchment of 4.063 Ha this equates to a 6 month flow of about 361 l/s. The Rocla CDS 1518 is required to treat this flow. The CDS 1009 is unacceptable. Noted, drawings have been updated accordingly.
    b) Pad 3 based on a catchment of 2.244 Ha this equates to a 6 month flow of about 199 l/s. The Rocla CDS 1015 is required to treat this flow. The CDS 1009 is unacceptable. Noted, drawings have been updated accordingly.
    c) Pad 4 based on a catchment of 4.110 Ha this equates to a 6 month flow of about 365 l/s. The Rocla CDS 1518 is required to treat this flow. The CDS 1009 is unacceptable. Noted, drawings have been updated accordingly.
14. The strategy for pad 2, 3, 4 and remaining upstream catchments is to convey the 100 year flows to the basin via the open channel system. The proposed 5 m wide appears slightly too small allowing for manning n of 0.08 (little to low maintenance) and should be at least 6 m wide and provide some freeboard. The crest width needs to be a minimum of 1.2 m throughout, preferably more to provide stability once overtopped. The 0.3 m crest width is totally unacceptable. Refer to response below point 16.
15. On drawing 17D83_S96_C230 (02) a 300 mm bund is proposed to divert 870 l/s (shown as 870m/s) to the bioretention. There is no section provide but (for a 6 m base width) estimating a diversion channel base width of 1.2 m and a 300 mm high mound at 1V : 4H batters and a 1.2 m crest width with n = 0.08 then Q = 172 l/s (Mannings Equation) << 870 l/s. The design of the diversion weir does not work. In addition the EDD of the bioretention is 39.10 and allowing 0.1 m overflow the backwater level is 39.20, however the plan shows a top of diversion weir as 38.85 near the inlet pit < 39.20. Consequently the proposed strategy here is compromised. The long lateral weir does not appear to work in this circumstance. A more conventional weir set at say 45 degrees to the flow across a widened section of channel may give a better outcome. The weir needs to be in concrete or otherwise protected from scour. The channel needs to be widened and weir length extended so that the total 100 year peak unrestricted flow can overtop the weir without overtopping the crest (Including freeboard). Provide calculations. Refer to response below point 16.
16. The current proposal to try and adapt the Council WSUD drawings to suit the open channel is problematic. There will be substantial losses in water entering the collection pits in the channel and discharging to the bioretention, pipe losses, pit losses including losses in the bioretention and particularly in the upflow pits, all to try and overcome a backwater level of 39.20. If this is continued with then an HGL check needs to be to undertaken to ensure that it actually works. In addition the diversion inlet pits and pipe system needs to be extended further upstream before

the weir begins. The weir needs to be sufficiently higher. To assist the filter media level could be lowered by 200 mm. We will be adopting an alternate strategy which is more aligned to Council's suggestion below.

Alternatively consider the following to minimise the head loss through the bioretention. Provide through the embankment from the channel a shallow box culvert sized to convey the 870 l/s to the bioretention with the invert at the bio set to the filter media level. At the outlet to the bioretention provide a very large concrete silt trap say 600 mmm deep and wider than the culvert as part of the scour protection. Delete the bioretention internal pipes and upflow pits. Provide from the silt trap two concrete flow spreaders each say 900 mm wide around both sides of the basin and meeting at the other end to ensure flows can be equally distributed throughout the basin. The base area of the basin is to allow for the design filter area (900 m2) plus area of flow spreaders and pits.

We are proposing to adopt the strategy of having an open channel with a diversion weir and culvert to the bio-filtration basin. We have provided 3 DRAINS models along with calculation and summary sketches. These sketches and models have been amended several times over the period between the 4th February and the 27th February based on discussions over the channel and basin calculations between Tony Merrilees (Blacktown Council) and Tom Dempsey (Henry & Hymas). The following is a description of the proposed amendments and design. Note that each number below, correlates to the marked up location on the submitted sketch "*Updated channel calculations – north basin 27.02.2019"*. The final amendments on the attached sketch/proposal are shown marked up in green.

In his email dated 27th February 2019, Tony Merrilees has agreed, in principle, to the strategy described below.

1. A 1.2 x 0.6m RCBC culvert will be used to convey the 870L/s of treatable flow rate to the bio basin. This culvert was modelled in the DRAINS model *17D83 Diversion Drainage System – north basin – with bio modelled – rev2.drn.* Refer to culvert named "Box culvert to bio" in the model. To allow for a 50% blockage, we originally nominated that this culvert be a 2.4m x 0.6m RCBC. However, based on discussions with Tony Merrilees (BCC), it was agreed that this culver be reduced in size to 1.2m x 0.6m and that a trash screen be placed at the inlet to prevent blockages to the culvert.
2. The downstream water level in the model is RL39.20 which allows for 100mm of overflow over the bio basin weir which will be 15m long and constructed completely out of concrete. The proposed box culvert will convey the treatable flow rate and a water level of RL39.23 is produced at the upstream end (culvert). It is at this location that the diversion weir and emergency overflow point will be located. The diversion weir is to be set at RL39.25.
3. The top water level over the proposed 14.5m long overflow weir is RL39.79. This is based on the maximum 100ARI flows of 7m^3/s of flow passing over it from the upstream channel(s). Because of the height of the tail water levels in the overflow channel, a submerged weir is created. Refer to submitted *HYD-COMPUT-LARS-17D83-SUBMERGED WEIR EQN* spreadsheet for overflow weir calculations at this point. This water level was then used as the tailwater level in assessing the capacity of the channel(s) leading to the culvert and bio basin.
4. In the DRAINS model *17D83 Diversion Drainage System – north basin – with bio modelled – rev2.drn,* refer to the channel named "Channel with low flow". This has been modelled as a 7m wide, with vertical walls channel. This is a conservative approach as this portion of the channel that leads to the culvert will have 1:4 batters

on either side of the base that will increase the capacity from what is modelled. The maximum height of flow for this treatable flow rate of 870L/s is 380mm which is well below the top berm of the channel. Note that we have adopted a manning's n = 0.07. This is in-line with a channel, excavated in earth that allows for grass, some bends, and weeds. We expect these channels to be well maintained without any large planting in them.

5. The main channels that convey water from the Lot 2 outlet culvert and also a northern culvert passing under the access road have been conservatively modelled as one channel with dimensions that would be applied to both in reality. We have conservatively applied the maximum 7m³/s flow to this modelled channel that has a base width of 7m and side batters (1:4) that would extend for a width of 4.92m on either side. This width would allow for a maximum flow depth of 930mm with a freeboard to the berm of 300mm. The modelling of this channel is presented in the DRAINS model *17D83 Diversion Drainage System – north basin – with bio modelled – rev2.drn* as channel "Channel with 100ari flow". The downstream tailwater level that has been used is RL39.79 which is the maximum depth of flow over the 14.5m long weir. To be conservative, we have tested the capacity of the channel using the manning's equation and to achieve this same water level in the channel we have found that a base width of 8.10m is required. It has been agreed with Tony Merrilees (BCC) that the main channel base width should be 8.1m. Refer to calculation sheet *HYD-COMPUT-LARS-17D83-MAINS CHANNEL COMPARE* for this assessment.
6. Beyond the emergency overflow weir at the end of the channel(s) is another channel that will convey the 100ARI flows to the main basin area in the event of an emergency overtopping. Because this is a relatively short length of restricted channel, we have assessed the flow depths in this using a simple channel calculation. Refer to calculation sheet *HYD-COMPUT-LARS-17D83 – CHANNEL BEHIND WIER.xls.* The flow depth in this channel area is 850mm. The top berm in this area will be set at 300mm above the 850mm flow depth.
7. The upstream water levels as calculated in the channel "Channel with 100ari flow" were used in checking the capacity of the Access Road Drainage system. This model is *17D83 Road Rev3 – option to flatten pipes – with adjusted channel numbers – rev1.drn*. The tailwater levels used in this model at the 2.7x0.6 RCBC are;

   - 100ARI – 40.14
   - 20ARI – 40.06

8. The tailwater levels used for the Lot 2 site drainage system are based on the upstream levels at the upstream end of the 2.7x0.6 RCBC and are as follows;

   - 100ARI – 40.26
   - 20ARI – 40.13

   The DRAINS model for the Lot 2 site has been submitted for review and is named as *17570 rev15 DP collection lines rev1.drn*

17. On drawing 17D83_S96_C230 (02) the layout of the bioretention overflow pits are based on Detail 13 of Council's WSUD drawings. This layout is based on a stand-alone bioretention basin design and not as part of an OSD system. As proposed this arrangement creates substantial bypass causing the OSD to become ineffective. Only the underdrain subsoil line flows are to go direct to the outflow headwall. Where this is part of an OSD basin these three pits are to have sealed lids and a flat weir overflow provided across the 4 m wide maintenance path set at the basin edge to the 300 mm bioretention extended detention level with reverse crossfall directed to the OSD basin (possibly near the scour protection for the pipe

outlet). Provide scour protection and a concrete seepage barrier across the weir overflow or build this in concrete. Noted, drawings have been updated accordingly to show a concrete overflow weir.

18. On drawing 17D83_S96_C230 (02) the twin outlets from the OSD are 900 mm pipe at 0.41% and the 100 year outflow from drawing 17D83_S96_C231 (02) details a 100 year orifice discharge of 1,424 l/s for each pipe. Pipe nomographs indicates that the pipe capacity cannot achieve this flow rate. It is good practise to design the outlet pipe from the orifice for about twice the orifice flow or at least substantially more than the orifice flow. Increase the pipe size accordingly. Noted, drawings have been updated accordingly to show a 1050mm pipe which is capable of conveying twice the orifice outflow (2.8m³/s).
19. On drawing 17D83_S96_C230 (02)
    a) reduce in size the pipeline from the bioretention to the headwall as only conveying underdrain flows. A 525mm pipe is required to convey the flows in the subsoil. So we suggest that this size should be used. We have nominated this on our drawings.
    b) provide a cut off wall through the rock weir overflow for the OSD basin. Noted, drawings have been updated accordingly.
    c) Refer to the 2 pipes within the bioretention basin as 300 mm permeable pipes laid flat where this system is retained. Because we are adopting a different strategy for the bio filtration basin (refer to detailed explanation above), we will no longer be using these permeable pipes.
    d) The berm width around he OSD should be increased to a minimum of 2 m based on Council experience and the 1.2 m if used should be justified by a geotechnical engineer. Noted, drawings have been updated accordingly
    e) On Section B the top of OSD berm is to be 39.25 minimum. Noted, drawings have been updated accordingly.
20. On drawing 17D83_S96_C231 (02) at the Discharge Control Pit
    a) the pits should have surcharge style grates. Noted, drawings have been updated accordingly.
    b) Review pipe size from the small orifice to the larger pit. Noted, drawings have been updated accordingly to show 2 X 450 voids.
    c) Increase the width of the 1.5 year orifice pit as it is too small to contain the Weldlok screen based on 20 x orifice area. Noted, drawings have been updated accordingly with pit upsized to 2.4 x 1.2m
    d) Detail how the 18 m2 Weldlok screen in the 100 year orifice pit can be contained and accessed in the proposed pit. Noted, drawings have been updated accordingly with pit updated to 9 x 1.8m.
    e) Show the new outlet pipe size from the 100 year control pit. Noted, drawings have been updated accordingly.
21. On drawing 17D83_S96_C231 (02)
    a) At the bioretention System Inlet Pit amend the invert of the 300 mm permeable pipes to 38.10 (if still applicable). Because we are adopting a different strategy for the bio filtration basin (refer to detailed explanation above), we will no longer be using these permeable pipes.
    b) At the bioretention System Inlet Pit show the concrete top of pit as 200 mm above the apron level (if still applicable).. No longer applicable as we will not be using permeable pipes.
    c) Provide a detail of the weir overflow across the access track. Noted, drawings have been updated accordingly and concrete weir noted.
    d) Show the 3 pits at "Outlet for large Bioretention System" with sealed lids Noted, drawings to be updated accordingly
22. A vehicular access track (maximum grade 10%) needs to be provided for both the southern and northern basins to enable vehicles to reach both the bioretention basin and into the detention basin for maintenance and exit in a forward direction. We have provided a 4m wide access track with grades no greater than 10%. Vehicles will need

to use the basin floor to turn in order to exit the basin/track in a forward direction if required. We will be providing pavement details for this track at the CC/tender stage, but we would envisage this to a spray-seal type pavement.

From:	Tony Merrilees
To:	Thomas Dempsey; Holly Palmer
Cc:	Kelly Coyne; Christophe Ferguson; Sarah Sheehan; Nicky Blenkhorn; Mark Cleveland; Nick Wetzlar
Subject:	RE: Eastern Creek Business Hub Subdivision Industrial MOD 2019-02-25.docx
Date:	Wednesday, 27 February 2019 5:12:01 PM
Attachments:	image004.png image001.png

Hi Thomas

I have had a quick check and all appears OK in principle. Just need to ensure the freeboard is achieved in the channel embankments.

Blacktown City Council

Tony Merrilees
Senior Engineer (Drainage) Developments

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From: Thomas Dempsey [mailto:tdempsey@hhconsult.com.au]
Sent: Wednesday, 27 February 2019 3:24 PM
To: Tony Merrilees; Holly Palmer
Cc: Kelly Coyne; Christophe Ferguson; Sarah Sheehan; Nicky Blenkhorn; Mark Cleveland; Nick Wetzlar
Subject: RE: Eastern Creek Business Hub Subdivision Industrial MOD 2019-02-25.docx

Hi Tony,

Thanks for the review. I've had a look and updated the following for the North Basin.

- The channel downstream of the basin was incorrectly using a n value of 0.045. I have updated it to 0.07 and re-looked at the channel sizing using the manning's equation spreadsheet – *"HYD-COMPUT-LARS-17D83-CHANNEL BEHIND WEIR"*. By widening the base to 7m, the flow depth for the 100ARI (7m^3/s) is 0.77m which is higher than the offtake diversion weir. The water level is 39.62 and the weir level is 39.25 so it drowns the weir in the 100ARI event.
- To see what level the 100ARI (7m^3/s) flow depth is over the diversion weir is, I used a submerged weir equation (see spreadsheet *"HYD-COMPUT-LARS-17D83-SUBMERGED WEIR EQN"*). The flow over the weir is 0.54m which is RL39.79. This RL was used as the tailwater level to assess the flow depths in the main channel. The DRAINS model *"17D83 Diversion Drainage System – north basin – with bio modelled – rev2.drn"* was used to assess the main channel (still with the 7m wide base) and we found that the water levels in channel flattened out throughout the channel length so that at the upstream end the change in level to what we previously had was only 20mm. The water level is 40.16 (100ARI).
- Using the straight manning's equation to size the channel produces a more conservative

result. I would assume the reason why DRAINS produces lower water levels is that it does not use the manning equation and rather uses the energy equation so the results would be more "fine-tuned". In any case, and to be conservative, we have checked the main channel capacity using the Manning's equation. We want to keep the water levels in the channel as we currently have them (i.e a maximum of 0.93m in depth). So using a prismatic channel, with n = 0.07 and a slope of 0.3%, with 1:4 side batters, the base width of the channel would need to be increased to 8.1m as calculated in the spreadsheet *"HYD-COMPUT-LARS-17D83-MAIN CHANNEL COMPARE"*. I'm not sure how this compares to your manning's calculator, but I would expect a similar result in flow depth (0.93m) if you increased the base width to 8.1m? We want to keep the flow depth to approximately 0.93m max because the upstream road design and Lot 2 site has already been designed based on these water levels.

We have marked up in green on the attached the general changes that would need to be made to the channels (widening). Would you be able to review and let me know if you concur with our design approach and levels/channel widths based on the above?

Regards,

Thomas Dempsey
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From: Tony Merrilees [mailto:Tony.Merrilees@blacktown.nsw.gov.au]
Sent: Tuesday, 26 February 2019 2:15 PM
To: Holly Palmer <Holly.Palmer@blacktown.nsw.gov.au>
Cc: Kelly Coyne <Kelly.Coyne@blacktown.nsw.gov.au>; Christophe Ferguson <Christophe.Ferguson@blacktown.nsw.gov.au>; Thomas Dempsey <tdempsey@hhconsult.com.au>; Sarah Sheehan <Sarah.Sheehan@blacktown.nsw.gov.au>
Subject: Eastern Creek Business Hub Subdivision Industrial MOD 2019-02-25.docx

Hi Holly

See comments on the amended sketch plans. We are making progress however there is still further work to be done, however the plans are sufficiently advance to progress to the final plan set.

Blacktown City Council

Tony Merrilees
Senior Engineer (Drainage) Developments

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