From:	[redacted]
To:	Lower Thames Crossing
Cc:	[redacted]
Subject:	Stuart Mee - Joint Statement between the Applicant and Mr Mee
Date:	05 December 2023 14:44:15
Attachments:	Stuart Mee LTC Options report V2 - Nov 23.pdf

Dear LTC team

We would be grateful if you could pass the joint statement below together with the attached report to the Examiners today, please.

Joint Statement between the Applicant and Mr Stuart Mee of Manor Farm, North Ockendon,

For the Attention of the Examining Authority,

This is a joint statement between the parties following the joint response at Deadline 5 (REP5-125) on an update of the Applicant's discussions with Mr Mee regarding the Project's impact on the farm irrigation system.

Feedback was received from the Applicant on 21st September 2023 that it is in broad agreement with the content of the draft *"Manor Farm Options Report"* commissioned by Mr Mee dated July 2023. The July 2023 report was submitted by Mr Mee before Compulsory Acquisition Hearing 5 (REP7-259) as evidence in support of his representations. In addition, a summary of that report ('Manor Farm Options Summary') dated 15 November 2023 was also submitted at Deadline 7 (REP7-262).

Mr Mee now attaches an updated version of the July 'Manor Farm Options Report' dated November 2023 following further feedback from the Applicant. The Applicant has not yet had time to review nor comment on the attached updated report.

Whilst noting the Applicant's commitments within the Register of Environmental Actions and Commitments, both parties are working together to see if a side legal agreement to protect Mr Mee's operations can be agreed prior to the conclusion of the examination process. Until this legal agreement is agreed and completed, Mr Mee will be maintaining his current position in requiring certain protective provisions within the DCO.

Thank you.

Karen Howard
Partner
for Gateley Legal
[redacted]

Gateley Legal

15 November 2023 | Version 2.0

Manor Farm Options Report for Lower Thames Crossing

Prepared for Stuart Mee

This report sets out the water balance issues facing Stuart Mee at Manor Farm, and some potential options to present to the Lower Thames Crossing Project Team. All options are presented without prejudice and to aid discussion between all the parties involved. No party should be held to account based on the recommendations.

1. Background

The proposed Lower Thames Crossing (LTC) requires the construction of a cutting which will intercept the spring-flows supplying Stuart Mee's irrigation system. Abstraction for his irrigation system is authorised under licence no. 8/37/55/76, which provides for up to 150,000 m3/yr, 182 m3/hr, to be taken via a gravity feed sump between Nov and Mar to fill a reservoir (fishing lake) for subsequent irrigation. The main irrigation pump and controls are located at the reservoir with irrigation water piped throughout the farm during the summer.

In this report we consider the finding of LTC's water balance work and look at the possible options for ensuring that Stuart Mee's supply of water is maintained after the construction of the new road.

The amount of water that Mr Mee uses each year varies depending on which crops are being grown and the weather conditions. Climate change predictions suggest that agricultural demand for water will increase in the years ahead as summers get dryer and winters get wetter. Therefore, the future viability of irrigated agriculture on Mr Mee's Farm will depend on maintaining his supply. However, it should be noted that this report is not addressing the justification of Mr Mee's licence quantities, but the options for maintaining his access to the available water for which he has the right to abstract.

2. Review of the Water Balance Work

To summarise, the water balance report produced by LTC concluded that runoff is the main source of water to the reservoir and that over the three years of monitoring the reservoir the water balance ranged between +29,505m3 and -37,478m3 (see Table 1).

There are a number of issues with the data which mean that we have low confidence in the runoff figures calculated in the report. We will consider each of these in turn.

2.1 Catchment size

The LTC's work was based on a catchment size of **0.593km2**. This is a lot smaller than the original catchment area calculated by Paul Bradford (1.6km2) and is also much smaller than the catchment defined by the FEH catchment boundary and the LIDAR data. The reasons the LTC give for reducing the catchment area relate to the roads acting as a hydrological boundary and the fact that catchment size used gave the best fit for the recorded peak flows

Table 1: Water balances as reported in the LTC water balance report.

Inflow	2020	2021	2022
Precipitation, m3	18,803	18,800	13,875
Runoff, m3	68,170	51,202	46,049
Total inflow	**86,973**	**70,002**	**59,924**
Outflow	2020	2021	2022
Evaporation, m3	28,318	22,931	27,276
Abstraction, m3	45,969	17,566	70,126
Total outflow	**74,287**	**40,497**	**97,402**
Balance	**12,686**	**29,505**	**-37,478**

However, there is no evidence to suggest that the roads are acting as a barrier. Road drainage will usually add to the local hydrological inputs unless it is culverted into another catchment, which seems unlikely. In addition, using the data they collected to inform the catchment size is something we would challenge because of the issues we have with the quality of the data, as set out in section 2.2 below. Therefore, I don't see any reason not to include some of the wider catchment. Keeping to the LIDAR and FEH boundaries, we get a catchment size of **1.03km2** (see Figure 1). This is still smaller than the area defined by Paul Bradford. However, Paul did not have access to the LIDAR data.

It is noted that LTC have included an alternative catchment area in their updated water balance report, with an area of 0.992km2. This is very similar to the catchment area we have defined in Figure 1. Therefore, we dispute LTC's conclusion that the most appropriate catchment size is 0.593km2. We believe the area of 1.03km2 is more appropriate.

2.2 Flow data

The flow data concluded a catchment yield of 55,140m3 over the whole year (based on average of 3 years) Our confidence in the flow data is low. The position of the doppler probe meant that lower flows were not being recorded and there is no way of knowing below what flow this error was occurring. Correspondence with In-Situ's Binod Acharya (their doppler expert) showed that the probe is not designed to work in low flow situations. Binod said:

> *"for the depth measurement, the sensor must be mounted such that the depth sensor is always covered by water to a depth of at least 50mm (2 inches)."*
>
> *"I would recommend a wedged weir for your application. This would ensure there is enough water above the sensor during the trickle flows and wouldn't cause extra maintenance."*

This is acknowledged in the LTC report, however, I am not confident that removing the zeros and averaging the remaining flows is going to provide an adequate fix for this problem. This still creates a zero flow when flows are low for more than a day and we do not know how the probe performs when operating in 0 to 5cm of water. So the range of flows that were affected is unknown.

Figure 1: Catchment area based on FEH and LIDAR boundaries.

When we visited the site we estimated a flow of 2-3l/s coming through the culvert. The sensor was above the water level at this time, suggesting that flows would need to be considerably more for the probe to function accurately. It is therefore highly likely that any baseflow element coming from the unlined lake/moat at the center of the catchment will not have been measured, as well as a considerable amount of the increasing and receding flows.

We understand that the flow data was then modeled to create the water balance output, however, the model will only be as good as the averaged flow data that has been put into it.

To emphasize the disparity between the measured flows and what we would expect the catchment to yield, here are two examples of simple catchment estimation methods that give us a rough idea of yield. In our experience we have found these methods to give us reasonable estimate of flows in catchments of this type. I have carried out these calculations based on both catchment areas of 0.0593km2 and 1.03km2.

2.2.1 Catchment area reduction from a local gauging station

Gaynes Park Gauging Station on the River Ingrebourne is 4km to the west of the abstraction point. It represents a local set of data for us to compare flows. If we do a simple catchment area reduction we get the following results:

Gaynes Park Gauging Station = catchment area 47.9km2

NRFA mean **winter** daily flow = 0.442m3/s (38,188m3)

Note: Gauged flow benefits from Brentwood STW discharge. So flows will be slightly higher than would be naturally.

Manor Farm catchment (higher) = 1.03km2 or 2.1% of Gaynes Park catchment area.

Manor Farm catchment (lower) = 0.593km2 or 1.2% of Gaynes Park catchment area.

Estimated available daily resource = % of catchment/100x0.442m3/s

daily resource x 151 days = winter resource

Yield from local data

1.03km2 catchment = 0.0093m3/s (801m3/day) x 151 = **121,096m3/winter**

0.593km2 catchment = 0.0054m3/s (458m3/day) = **69,198m3/winter**

Note: *It is helpful to see that LTC have included a catchment area reduction in their revised water balance report. However, they derived lower yield figures because they used the annual mean daily flow rather than the winter mean daily flow. We would argue that winter daily flows should have been used.*

2.2.2 Effective rainfall estimation

Alternatively, we can get a rough idea of the yield of a catchment by using the long-term average rainfall and evaporation data. When you run this calculation for Manor Farm you get a yield of 130mm over the year. When applied to the two catchment sizes, this gives:

Yield from long-term effective rainfall	
1.03km2 catchment	= 133,900m3/yr
	= **87,035m3/winter** (assuming 65% of the rain is in the winter)
0.593km2 catchment	= 77,090m3/yr
	= **50,109m3/winter**

Note: that we have revised our rainfall figures based on a conversation with the EA. They suggested that a figure of 130mm is generally what is used for the East of England. This was then checked against more specific Standard Average Annual Rainfall 1961-1990 for the catchment and the Annual Mean Evaporation (for Central and Eastern England). This gave an effective rainfall of 145mm a year. In light of this, it is considered that our original figure of 119mm is too low and we have therefore used the EA suggested figure of 130mm.

2.3 Conclusions regarding the water balance

There is uncertainty regarding the catchment area used by LTC. We would disagree with the area chosen for the first draft of their water balance report and welcome the inclusion of the larger area (0.992km2) in their redrafted report. The area shown in Plate A.1 of LTC's report is not materially different than what we have proposed in figure 1 of this report and therefore we continue to use the catchment area of 1.03km2 as we have calculated it to be.

There is also very low confidence in the catchment yield data as produced by the LTC URMOD model. The free parameters of the model require calibration using gauged flow data (A.3.8 of the LTC water balance report). Since the gauge was falsely recording zero flows and also potentially recording outside of the manufacturers recommended parameters for a range of the lower flows, the recording of flow is likely to be very inaccurate at the lower range. LTC's attempt to fix this issue by using daily averages and removing zeros cannot replace the missing data and hence the monitoring errors have been fed through into the model calculations.

Therefore, we would suggest that simple catchment yield calculations, based on catchment characteristics and other local data sources, would be a more reliable estimate of runoff volumes from the catchment.

We welcome the fact that LTC have incorporated these catchment yield assessments into their revised water balance report.

2.3.1 Summary of results

Assuming that the larger catchment areas of 0.992km2 (LTC) and 1,03km2 (this report) are used, the following yields were reported:

LTC:

A. **Modelled yield:** A range of **31,675m3 to 105,874m3** per year over the three years of observations
B. **Compared to a local gauged record:** **88,352m3** per winter (151 days).
C. **Effective rainfall method:** based on 75% of 119mm per year = **91,928m3** per winter (151 days).

This report:

A. **Modelled yield:** We did not run a model.
B. **Compared to a local gauged record:** **121,096m3** per winter (151 days).
C. **Effective rainfall method:** based on 75% of 119mm per year = **87,035m3** per winter (151 days).

Notes

It should be noted that methods B and C are both based on long-term data. However, method A is based on three years of data collected by LTC and therefore is much more of a snapshot. However, as we have already explained we don't have any confidence that the data collected is an accurate representation of catchment yield.

Also, for method B the LTC team have used the annual flow averages rather than the winter flow averages, which are available and were used in our calculations. This is why our method B shows higher yield.

All the long-term catchment yield calculations (using ~1km2 catchment) presented in this report and in the LTC water balance report suggest that the average catchment yields are likely to be somewhere between 87,000m3 and 120,000m3 annually. However, we are very willing to accept that these estimates are inferred from general data for the area and not specifically derived from this catchment. Therefore, in the absence of reliable local data we would suggest extending the lower range to account for potential overestimation. Our suggestion is a range of **70,000m3 to 120,000m3**. I repeat for emphasis, that this is a range of the likely average not the full range of yields that the catchment might produce. In other words, we think the average sits somewhere in this range. Yields may be higher than this range in very wet years and lower than this range in dry years.

Based on this assumption, we are saying that the catchment, on average, produces between 50% - 80% of the licence quantity. This is consistent with the principle of multi-year reservoirs, which are filled over two years or more. However, the licence quantity is outside this range to allow for the abstraction of higher quantities in very wet years. This provides some insurance for dry years.

3. Proposed Options

3.1 The importance of maintaining the existing supply

The water balance discussion suggests that on average between 50% and 80% of the licence quantity enters the reservoir each year. This is typical of a double-year storage reservoir, where inflow over two years is used to build up full storage.

2022 was one of the driest summers on record. In that year Mr Mee used 70,000m3 of water to irrigate his farm. This is approximately half his licence quantity and fits within the catchment yield range that we have concluded is likely from the long-term data. However, the range we have presented is the range for the average year and there is no doubt that in dry winters less than this range will be produced by the catchment. So having a larger licence, twice Mr Mee's dry year demand (based on 2022), means he can collect additional water in wet winters to cover the lack of yield in dry winters.

Understanding this is critical to finding the best option, because if the catchment yield drops below 50% of the licence quantity, then the reservoir becomes a three-year storage reservoir, which is a fundamentally different from the system that Stuart Mee currently operates.

Needing three years to get the quantities on the licence would put the farm at much higher risk of running out of water in dry periods and would devalue the land due to the reduced reliability of the abstraction. In addition, the impact to climate change is likely to mean more water is going to be needed to produce the same crops in the future. So maintaining his current supply is crucial for the future of this business.

An added factor with this reservoir, is that it is also used as a commercial fishery. Therefore, drawing down levels is not an option, as it might be on a normal agricultural reservoir. This is another reason to maintain the full percentage of inflow that the current runoff provides.

3.2 Previously proposed options

LTC have proposed a number of options to ensure that Mr Mee is able to continue to abstract water. These include:

1. Re-routing the drain.

2. Partially 'tanking' the cutting to prevent dewatering of the shallow groundwater reserves.

3. Constructing new chalk boreholes to provide an alternative source of supply.

Our concerns about these options are set out in our Initial Abstraction Licence Impact Assessment, written by Paul Bradford in May 2022. I will not repeat the concerns here, other than to say that none of these solutions in themselves solve the issue.

3.3 Proposed Options

When considering the options for the protection of Stuart Mee's water source, we would propose two elements:

1. Re-instatement element
2. Make-up element to ensure like-for-like solution is delivered.

3.1.3 Preferred option for the re-instatement element

We feel that the option that has the most chance of maintaining a good proportion of Mr Mee's current abstraction system is to pump the water from one side of the new road to the other. By intercepting the runoff from the catchment before it reaches the new road and piping it to the other side, would mean minimal loss of water.

This will mean re-locating of the abstraction point on licence 8/37/55/0076 to the east of the proposed new road. At the new abstraction point, water would be directed into a pumping sump before being pumped around the new and existing roads/railway, and into the current gravity system that runs west of the road to the reservoir. (see re-instatement elements in green on Figure 2)

The irrigation main that brings water back across the roads in the summer, will also need to be re-instated after the new road has been constructed. It is possible that the same pipe could be used to serve both these purposes. The best way to connect the new and existing systems will be confirmed in the options development.

3.1.4 Uncertainties of delivering the preferred re-instatement option

Having said that this option presents our best chance of creating a like-for-like system, there are a couple of key issues that may mean it doesn't deliver:

- It is possible that some of the drainage from the banks of the current M25 road may no longer be captured at the new abstraction point.

- Water that currently runs along the drains at the southern boundary of the catchment are likely to be disrupted by the construction of the new road, or potentially directed away from the new abstraction point.

In order to minimize this potential reduction in catchment area, we would suggest the following steps are taken:

- Where possible LTC look to direct drainage from the new road into ditches that supply the catchment to the abstraction point.
- That the drains on the southern boundary of the catchment are considered when positioning the new abstraction point in order that this part of the resource is maximized.

Therefore, since it is not possible to be certain how well the re-instatement option will perform, it would be appropriate to add a 'make-up element' to the solution.

3.2 Options for the make-up element

We have already said that any reduction in the current inflow to the reservoir could switch it to a three-year storage facility. Therefore, we suggest that at least 40% of the current licence quantity should be made-up by the provision of an alternative supply. We suggest that, in combination with the re-instatement element suggested above, LTC also support Stuart Mee with an make-up element. The following three options all have some potential in providing this additional supply

3.2.1 Make-up Option 1: Development of licence 8/37/55/20

One option is to develop the licence already existing at Kemps Farm. This licence currently allows the abstraction of 6,819m3/yr. This abstraction point was considered in our previous report 'Report to EA V0.4'. We concluded that the catchment area was approximately 0.8km2. Looking again, this may be on the high side, but even if we assume a catchment area of just 0.4km2, based on the effective rainfall method detailed earlier in this report, the catchment could yield up to 50,000m3 a year. It is quite feasible that 30,000m3 of this could occur in the winter.

So, our conclusion is that this licence could potentially support a larger abstraction. Mr Mee doesn't own the land where the current reservoir is sited. However, he does own the ditch where the abstraction point is located. Therefore, by creating a new abstraction sump adjacent to the ditch, on Mr Mee's land, would allow abstraction into the main reservoir (see Figure 2). There are already some irrigation mains in this area. These would need to be upgraded and connected into the new system. Flow data would need to be collected over a winter season to support an application.

Environment Agency Comments on Option 1

Licence 08/37/55/0020 was issued back in 1966 and solely was a recognition that an abstraction had previously existed at this location. There would not have been any technical assessment to confirm the viability of such an abstraction. Recent return data implies no abstraction has been undertaken. The expectation based on the catchment area is that the available resource is limited and it may require full saturation of the shallow deposits before flows might rise to any meaningful level. We hold no gauged flow data that could imply the quoted volumes might be feasible. The normal expectation is that a period of flow gauging/data collection is undertaken to support any request to increase the proposed abstraction rates. This would need to incorporate those wet periods.

It is standard to incorporate a HOF (flow constraint) condition. This is to protect flow integrity but may also need to consider other factors (subject to internal consultation comments). The best solution will be to incorporate a constraint value into a local restriction immediately downstream of the abstraction point or combine it into the intake works. This proposal and the subsequent investigation will be heavily reliant on the flow data that needs to be collected. Without such data it is likely to be difficult to take forward such a proposal

3.2.2 Make-up Option 2: Development of shallow groundwater

Another mark-up element that has been considered is to develop a shallow groundwater source. The source would need to have sufficient continuity with surface waters to allow the EA to regulate it based on surface water flows. For the majority of Mr Mee's land the gravels are contributing water to the same catchment as his other abstractions, making it very unlikley that other resources would be avaiable. However, in the north western part of the farm, to the north of the reservoir, is an area of gravels that looks likely to be contributing water to the River Ingrebourne catchment.

In principle this is possible but we would need a local control method to judge when the flow is sufficient, as there really isn't any EA flow gauging in the area. This is challenging as there is no watercourse at this location. Also, it could be a sensitive location based on close proximity to conservation sites to the north. So this probably isn't a strong option compared to the other two options.

Environment Agency Comments on Option 2

The NGR provided places the abstraction point between the Stubber's Outdoor Pursuit Centre (West) and Kemps Farm (East). The location is also surrounded by various conservation designations and a small ditch system. There could be various challenges and monitoring requirements to understand the relationship between all these other factors alongside a proposal to abstract water from the shallow deposits. This would need to be understood and potential safeguards incorporated into any proposal taken forward. There are unknowns on both the potential yield available and its possible implications for any identified nearby water based features. Where the decision is taken to pursue this particular option then my colleagues in the Area Groundwater team will deal with such a request. They will require an enhanced pre-application submission to allow a review of the proposal and any relevant supporting technical data that you can provide.

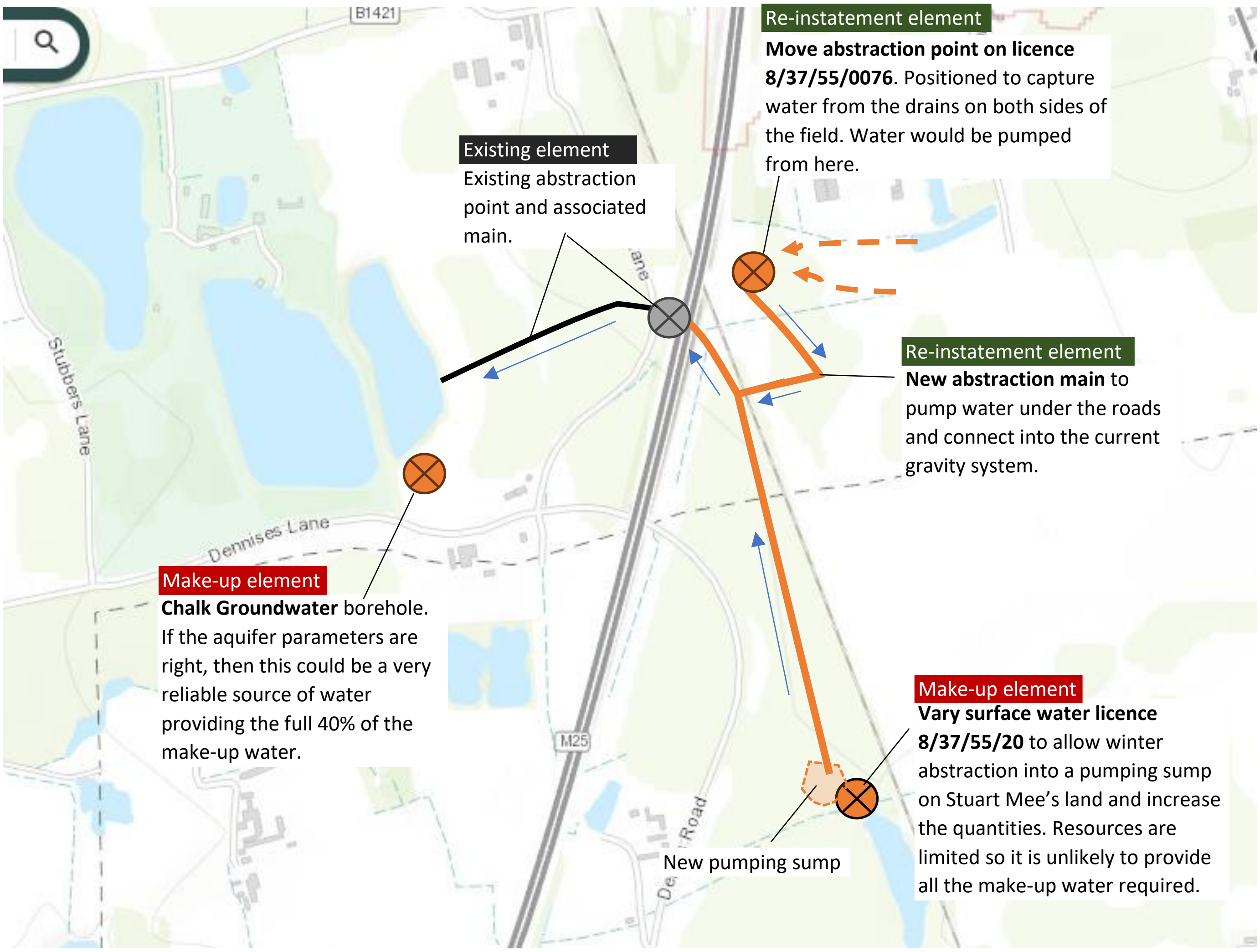

Figure 2: Map of the proposed Re-instatement and make-up options. New elements are in orange, existing elements are in gray/black.

3.2.3 Make-up Option 3: Development of chalk groundwater

This has been looked at in part reports. There is likely to be a some available resource based on our discussion with the groundwater team in relation to other chalk boreholes in the area. However, the quality and yield is unknown. Therefore, there is some risks as to whether chalk boreholes would be able to supply enough water of sufficient quality to meet Mr Mees irrigation requirements. However, this risk is very much reduced because we have data from an LTC observation borehole (located at TQ 58362 84266) that was drilled as part of the LTC project. This will give us both rest water level and quality data.

The chalk in this area comes under the London Groundwater Policy and water is available if certain criteria are met, namely that the chalk is fully saturated and the rest water level is into the Thanet sands. Also, if the groundwater flow is N-S then this would have no implications for the Mardyke, but if the flow is W-E then we would need to chat to the Anglian Groundwater team about implications for their patch. The LTC borehole and groundwater modelling should give us everything we need to do a desk based hydrogeological study that would give us a very good idea of the likely success of a operational bore that meets the London Groundwater Policy criteria.

Environment Agency Comments on Option 3

We can never guarantee the success of any groundwater based proposal will achieve the yield and/or be of a suitable quality for the proposed use. Those risks might not materialise but can be higher in those areas where such resources have not been previously extensively investigated. This is an area where we hold little data to guide any decision on the viability of such a proposal. The review of the data held by Highways Agency will certainly be beneficial to our understanding of the local geological situation. Where the decision is taken to pursue this particular option then my colleagues in the Area Groundwater team will deal with such a request. They will require an enhanced pre-application submission to allow a review of the proposal and any relevant supporting technical data that you can provide.

The principles of the confined Chalk Licensing Policy can be found in the London ALS document Abstraction licensing strategies (CAMS process) - GOV.UK (www.gov.uk)

4. Conclusions and recommendations

We recommend that a pumped system is the best way to re-instate the current system. However, there is some uncertainty around how this will change the water balance and the post-construction drainage. This means that a make-up element needs to be included as part of any final solution. The make-up elements should provide approximately 40% of the current licence quantity to ensure that the reservoir does not switch to a three-year storage facility.

As part of options development we recommend the follow actions:

1. The pumped system described in 3.1.3 is taken to the design stage. This will provide outline design of abstraction and pumping infrastructure and indicative costs.

2. Based on the EA's comments on the options, we would recommend:
    a. Flow data is record over winter 2024/25 to support an increase to licence 8/37/55/20 (Kemp Farm)
    b. A desk based hydrogeological study is carried out to assess the risks involved in developing a chalk groundwater source.

Important Note: All the solutions proposed in this report are dependent on gaining permission from the Environment Agency. Therefore, we will not know if either the re-instatment or the make-up options are fully feasible until we have completed the options development work.

Report prepared by:
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