From:	Stephen Fox
To:	One Earth Solar
Subject:	Submission of Technical Report and Formal Request for a Mandatory Joint Commission on Cumulative Flood Risk Assessment: One Earth Solar Farm Development Consent Order (DCO) NSIP (EN010159)
Date:	30 September 2025 08:00:35
Attachments:	Tech challange modeling cumulative letter.docx REquest for joint modelingThe Cumulative effects of Flood risk from the One Earth Proposal and Implications of the deficit in Local Authority Resources.docx

The Examining Authority

One Earth Solar Farm

The Planning Inspectorate

Temple Quay House

Temple Quay

Bristol BS1 6PN

By Email

Date: 29 September 2025 **Subject:** Submission of Technical Report and Formal Request for a Mandatory Joint Commission on Cumulative Flood Risk Assessment: One Earth Solar Farm Development Consent Order (DCO) NSIP (EN010159**)**

Dear Sirs,

I enclose the attached technical report, entitled "The Cumulative effects of Flood risk from the One Earth Proposal and Implications of the deficit in Local Authority Resources" (Submission 4) , which provides my critical, independent assessment of the hydrological and governance failures inherent in the One Earth Solar Farm DCO application. I submit this report to assist the Examining Authority (ExA) in testing the compliance of the proposal against the core mandates of the Overarching National Policy Statement for Energy (NPS EN-1), particularly the requirement that the project must be "safe for its lifetime" and must not "increase flood risk elsewhere".

The Unresolved Cumulative Hydrological Deficit

The central finding of my assessment is that the Applicant's approach, reliant on a fragmented, site-specific Flood Risk Assessment (FRA), is fundamentally inadequate for a project situated within a high-risk, multi-source flood catchment undergoing simultaneous, large-scale land-use conversion. Specifically, my review finds:

1. **Scientific Failure:** The Applicant's modelling fails to account for the empirically demonstrated, non-linear acceleration of surface runoff caused by solar photovoltaic arrays, which can increase peak discharge rates by a factor exceeding 11 times.
2. **Cumulative Omission:** The assessment deliberately restricts its scope, preventing the quantitative modelling of the combined, synchronized peak runoff effects from the clustered NSIP solar projects and major residential developments in the region.
3. **Regulatory Gap:** Existing statutory flood maps, including the Environment Agency's Risk of Flooding from Surface Water (RoFSW) map, are based on broad, national-scale models using pre-existing land-use assumptions. I argue these maps inherently omit the future, systemic hydrological alteration posed by this cluster of development. This represents a critical failure by all relevant Risk Management Authorities (RMAs) to robustly quantify future surface water risk.

The necessity of a Regional Hydrological Model (RHM) is not merely a technical request; it is a **necessary precursor** to providing the quantum of safety required for this DCO application.

My Formal Request for Mandatory Joint Technical Commission

Given that the quantification of cumulative flood risk is a shared statutory responsibility of the Applicant, the Lead Local Flood Authorities (LLFAs), and the Environment Agency (EA) , and recognizing the documented admission by Nottinghamshire County Council (NCC) of lacking the internal capacity to fully scrutinise the drainage strategy , I respectfully suggest that the ExA use its procedural powers to enforce the creation of a unified, validated technical assessment.

I formally request that the Examining Authority, via a Rule 8 Letter or subsequent ExA Questions (ExQs), mandates the following four parties to jointly fund, execute, and validate the Regional Hydrological Model (RHM) and Governance Impact Assessment (GIA) as detailed in Section 7 of my attached report:

1. **The Applicant (One Earth Solar Farm Limited)**
2. **Nottinghamshire County Council (LLFA)**
3. **Lincolnshire County Council (LLFA**
4. **The Environment Agency (EA)**

The commissioned RHM should utilise the **SHETRAN Physically-Based Distributed (PBD) Model**. This model is technically superior for this specific DCO as it simulates coupled 3D surface/subsurface flow and explicitly models contaminant transport, a function required to assess the public health risk associated with increased runoff near the Tollerton Airfield contamination site.

The primary deliverable of this commission should be the quantification of off-site risk, where the RMAs use the RHM output to explicitly overlay the modelled cumulative increase in runoff and peak discharge rates onto existing statutory flood maps. This action alone will provide the objective data required for the ExA to determine if the One Earth proposal, in combination with concurrent NSIPs, poses an unacceptable future flood risk to the Trent Valley catchment.

I trust the Examining Authority will treat the deficiencies outlined in the attached report as material planning considerations demanding immediate resolution before the Examination can proceed to a safe conclusion.

Yours faithfully,

Stephen Fox BA MSc

Interested party reference number FA3 AE8AE5

--
Regards

Stephen

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Yours faithfully,

Stephen Fox BA MSc

Interested party reference number FA3 AE8AE5

The Cumulative Effects of Flood Risk from the One Earth Proposal and Implications of the Deficit in Local Authority Resources

Technical Review and Recommendations

1. Summary: The Necessity of a Regional Hydrological Commission

This submission presents my technical review of the One Earth Solar Farm Development Consent Order (DCO) NSIP (EN010159**)** application. I suggest that the project's Flood Risk Assessment (FRA) is deficient in three critical areas: the scientific characterisation of solar photovoltaic (PV) runoff dynamics, the quantification of cumulative hydrological effects, and the institutional capacity for 60-year mitigation oversight. I conclude that, without mandatory intervention by the Examining Authority (ExA), the proposal poses an unquantified and potentially severe regional flood risk to the Nottinghamshire and Lincolnshire regions.

The current application fundamentally fails to meet the core statutory requirement of the Overarching National Policy Statement for Energy (NPS EN-1), which mandates that a Nationally Significant Infrastructure Project (NSIP) must be demonstrably "safe for its lifetime" and must not "increase flood risk elsewhere". Empirical scientific literature, particularly my review of the work of Baiamonte et al. (2015, 2023)1, establishes that solar PV arrays behave as semi-impervious surfaces, capable of increasing runoff volume by approximately 14.7% and peak discharge by a factor exceeding 11 times. Applying this non-linear hydrological change across the dense cluster of concurrent mega-solar and major residential developments in the region—including the Great North Road Solar Park and the Tollerton Airfield housing scheme—creates an aggregated flood risk that remains entirely unquantified by the Applicant.

Furthermore, the integrity of the proposed 60-year flood mitigation strategy, reliant on Sustainable Drainage Systems (SuDS), is undermined by a documented deficit in institutional capacity. The Nottinghamshire County Council (NCC), acting as the Lead Local Flood Authority (LLFA), has explicitly stated in its Local Impact Report (LIR) that it "does not have the expertise or resource to provide comprehensive comments" on the submitted drainage strategy and FRA2. I view this documented governance failure not merely as an administrative issue, but as a material planning consideration that voids the guarantee of long-term maintenance and enforcement required for the project's safety over its operational lifespan.

To resolve these interconnected scientific, cumulative, and governance conflicts, a mandatory, joint Regional Hydrological Model (RHM) and Governance Impact Assessment (GIA) are required. I formally request the ExA to issue a Technical Commission to the Applicant, the two affected LLFAs (Nottinghamshire and Lincolnshire), and the Environment Agency (EA) to produce this strategic assessment as an immediate requirement of the examination process.

2. The Statutory Framework and Breach of Policy Mandates

2.1 Overarching National Policy Requirements (NPS EN-1)

The DCO framework places specific, non-negotiable requirements on applicants concerning flood risk. NPS EN-1 is explicit that any proposed infrastructure, particularly one with a proposed 60-year operational life, must be demonstrated to be safe for its entire lifetime. Critically, the policy prohibits the development from "increasing flood risk elsewhere" and requires applicants to aim for a "no net loss of floodplain storage"3.

The minimum requirements for a compliant Flood Risk Assessment (FRA) stipulate that the assessment must "consider and quantify the different types of flooding (whether from natural and human sources and including joint and cumulative effects)"4. This quantification must also incorporate the impacts of climate change across a range of scenarios throughout the project's lifespan, extending to 2125 for the 60-year duration proposed for the One Earth Solar Farm5. I contend that the failure to provide a comprehensive model that aggregates the regional impact of concurrent developments represents a fundamental non-compliance with the quantified cumulative risk mandate established in NPS EN-1.

2.2 Legal Status of Cumulative Impact Assessment (CIA)

The assessment of cumulative effects is a mandatory requirement under the Infrastructure Planning (Environmental Impact Assessment) Regulations 20176. The assessment must consider the effects arising from the proposed development in conjunction with those associated with other planned developments.

The concentration of large-scale projects in Nottinghamshire and Lincolnshire constitutes an unprecedented, concentrated land-use transformation within a defined hydrological basin. The collective scale of land conversion across thousands of hectares necessitates a strategic, unified hydrological analysis. Standard FRAs, typically confined to the immediate development footprint, are inadequate to capture this systemic regional alteration. I argue the ExA has the responsibility to ensure this strategic analysis is conducted to enforce the NPS EN-1 mandate to quantify changes in flood extent, frequency, depth, velocity, and duration resulting from combined effects. The lack of a strategic, unified model means the entire DCO cluster is currently operating under unverified hydrological assumptions, which places the onus on the ExA to compel this strategic, catchment-wide analysis7.

2.3 The Inadequacy of Existing Flood Mapping Data

I maintain that the reliance on existing statutory flood maps, such as the Environment Agency's Risk of Flooding from Surface Water (RoFSW) map, is insufficient for assessing the cumulative impact of this cluster of NSIPs. While the EA updated the national RoFSW map in 20258, it is based on national-scale modelling that accounts for local topography and rainfall patterns under existing land-use assumptions.

- Future Land-Use Change: The collective hydrological impact of converting thousands of hectares of permeable agricultural land to the semi-impermeable solar farm surface cluster is not incorporated, leading to a massive omission in the projected regional runoff volume and peak discharge rates.
- Non-Linear Runoff Dynamics: The fine-scale, non-linear acceleration of surface water (the "Baiamonte principle") caused by panel concentration and flow channelisation across multiple adjacent sites is too localised and complex for the broad assumptions of national models to capture9.

I conclude that the ExA must challenge the assumption that flood risk is fully understood and quantified based on current data. The failure to overlay the known impact of increased runoff and peak discharge rates onto the EA's updated flood maps highlights a systemic regulatory gap that both the Applicant and the Risk Management Authorities must be compelled to close through the commissioned Regional Hydrological Model.

2.4 Failure of the Sequential and Exception Tests

The One Earth proposal is partially located within Flood Zone 3, a high-risk area. National policy requires that development in such areas must be "exceptional" and must demonstrate compliance with the Sequential and Exception Tests. The West Lindsey District Council's (WLDC) Local Impact Report (LIR) specifically noted that the applicant's justification for this high-risk site choice was not considered clear, pointing to a direct conflict with national planning policy10.

The integrity of the Exception Test hinges on proving the project will be safe for its lifetime and will not increase flood risk elsewhere. Given the project's 60-year operational lifespan, this safety must be demonstrated under future climate change scenarios, specifically utilising allowances appropriate for the 2125 epoch5. Without a quantified Regional Hydrological Model (RHM) that incorporates both the cumulative land-use effects and stringent climate change projections, I cannot accept that the Applicant can definitively prove the flood mitigation measures will be sufficient, rendering the Sequential and Exception Tests non-compliant.

3. Scientific and Hydrological Critique: The Flaw of the Non-Linear Runoff Change

3.1 Solar PV as a Hydrological Alterant

The natural hydrological cycle is partitioned between infiltration into groundwater and surface runoff. Land-use change, even when vegetative cover is maintained between panel rows, significantly alters this balance. The construction of large-scale solar facilities introduces semi-impervious surfaces—the panels themselves—which intercept precipitation and redistribute the moisture.

The critical issue, which I have highlighted, is the concentration of water at the panel driplines (the lower edge of the arrays). This concentration leads to localised soil saturation, overwhelming the soil's infiltration capacity and reducing the "time to peak flow". This spatial redistribution of rainfall accelerates the generation of surface runoff, a principle consistently observed in developed sites1.

3.2 Quantification of Non-Linear Runoff Increases (Baiamonte et al. Review)

The scientific literature confirms that the impact of solar panels on runoff is non-linear and underestimated by conventional hydraulic models. My review of the work of Baiamonte et al. (2015, 2023)1 provides empirical quantification of this effect:

- Research utilising rainfall simulators demonstrated that, compared to a bare field, solar panel arrangements resulted in peak discharges that were 11.5 times higher when panels were aligned with the slope and 11.7 times higher cwhen arranged across the slope. Furthermore, independent modelling using the EPA SWMM model observed that solar farm construction led to a14.5% increase in total runoff volume during a -year, -hour design storm.

If the Applicant's Flood Risk Assessment (FRA) relies on simplifying assumptions, I believe the model will inevitably fail to capture the empirically demonstrated non-linear acceleration of runoff. This failure to model the fine-scale flow paths between panel rows results in a massive underestimation of the peak flow velocity and volume, placing downstream receptors at greater risk. This modelling gap directly violates the NPS EN-1 requirement to "quantify the different types of flooding"3.

3.3 The Central Contention: Reliance on Unverified SuDS

The primary mitigation strategy involves Sustainable Drainage Systems (SuDS). While SuDS are designed to manage runoff, their effectiveness is entirely dependent upon a robust design capable of managing the empirically demonstrated non-linear runoff acceleration, and guaranteed long-term maintenance. Given the high concentrations of runoff and accelerated flow paths proven by hydrological science, I maintain that the margin for error in the SuDS design is severely limited11.

4. Assessment of Unquantified Regional Risk: The Compounding Effect

4.1 Scale of Concurrent Major Development

I recognize that the One Earth proposal is not an isolated development but is one element within a rapid and widespread period of concurrent, large-scale land transformation across the Nottinghamshire/Lincolnshire area. The cumulative risk assessment must account for the simultaneous hydrological impact of all major projects currently in planning or development phases.

The following table details the magnitude and specific risks posed by the key concurrent developments that I believe must be included in any joint Regional Hydrological Model (RHM):

Project Name	Type	Location (Counties)	Scale (Hectares) / Homes	Planning Status / Tier	Specific Hydrological Risk	Associated Compounding Risk
One Earth Solar Farm	Solar/BESS	Nottinghamshire/Lincolnshire	1,414	NSIP (Examination)	Altered runoff patterns, increased peak discharge, and runoff volume	LLFA Oversight Deficit (Maintenance failure)
Great North Road Solar Park	Solar/BESS	Nottinghamshire	2,800	NSIP (Pre-Application/Tier 2)	Significant land-use change, potential for localised overwhelming of drainage	Regional infrastructure overwhelm, strain on EA/LLFA resources
Cottam Solar Project	Solar/BESS	Nottinghamshire/Lincolnshire	1,150–1,300	NSIP (Post Decision - Granted)	Contribution to cumulative solar saturation	
West Burton Solar Project	Solar/BESS	Nottinghamshire	769.08	NSIP (Post Decision - Granted)	Segmented land-take requiring cohesive drainage mitigation	
Gate Burton Energy Park	Solar/BESS	Lincolnshire	684	NSIP (Post Decision - Granted)	Cumulative pressure on Trent Valley hydrology	
Heckington Fen	Solar/BESS	Lincolnshire	587	NSIP (Post Decision - Granted)	Contribution to cumulative solar	

Solar Park					saturation	
Tillbridge Solar Project	Solar/BESS	Lincolnshire	~1,400	NSIP (Examination)	Contribution to cumulative solar development; WLDC notes omission from Applicant's CIA	
Tollerton Airfield	Residential/ Mixed-use	Nottinghamshire	Up to 3,850 homes	DCO (Pending/Tier 2)	Increased impervious surface area from housing and roads	Contaminant mobilisation (Radium-226 and hydrocarbons)
Top Wighay	Residential/ Mixed-use	Nottinghamshire	710-1,000 homes	Local Plan (Approved /Tier 1)	Introduction of hardstanding, increased localised runoff	Incremental pressure on local drainage networks
Fair Oaks Renewable Energy Park	Solar/BESS	Nottinghamshire	49.9MW	Approved (Tier 1)	Increased surface runoff, altered flow paths	Localised pressure on adjoining catchments
Steeples	Solar/BESS	Nottinghamshire	888	NSIP (Pre-Application/Tier 2)	Contribution to cumulative solar saturation	Unquantified strain on regional flood management strategy

4.2 The Compounding Effect

I observe that each development listed above will individually increase surface runoff and shorten the time to peak flow. When these massive land conversions are combined, the cumulative effect is not additive but compounded, introducing a systemic hydrological alteration.

The collective shortening of the "time to peak flow"—the duration it takes for rainfall to generate maximum runoff—from thousands of hectares simultaneously hitting the receiving catchment area will drastically stress existing drainage infrastructure and natural flood defences. The consequence of this accelerated and compounded discharge is that the overall catchment faces a high risk of being overwhelmed. The WLDC LIR explicitly voices "significant concerns regarding the cumulative impact of the scheme with other NSIP solar generating station projects"10. Therefore, the Applicant must demonstrate, through a comprehensive RHM, that the regional effects—specifically changes in flood extent, frequency, depth, velocity, and duration —remain acceptable under the NPS EN-1 mandate3.

4.3 The Intersection of Hydrology and Contamination

A particularly severe compounding factor, which I have identified, is the proximity of new developments to contaminated land. The Tollerton Airfield site has been identified as containing legacy contaminants, including the radioactive isotope Radium-226 and carcinogenic hydrocarbons12.

The cumulative increase in surface runoff velocity and volume resulting from the cluster of solar and residential developments acts as a vector for transporting these carcinogenic and radioactive materials through the local water system. An intense storm event, modelled cumulatively, could significantly increase the depth, velocity, and reach of floodwater that intersects with the contaminated zones, mobilising pollutants and creating a severe public health and environmental risk. This critical factor underscores that the RHM is not merely required for flood management, but is necessary for a mandatory cumulative Water Framework Directive (WFD) compliance assessment, addressing issues like pollutant transfer and adherence to groundwater quality standards13.

5. Local Authority Resourcing, Governance, and Oversight

5.1 The Statutory Role and Documented Capacity Gap

Local Authorities, including the LLFAs (Nottinghamshire and Lincolnshire), play an essential statutory role in the NSIP process. The LLFA's mandate centres on local flood risk from surface water, groundwater, and ordinary watercourses, which is precisely the risk altered by solar farm development14.

The NCC, as the LLFA for the majority of the One Earth proposal area, has provided a stark acknowledgment of its operational limits. The NCC LIR explicitly states that the council "does not have the expertise or resource to provide comprehensive comments" on the project's submitted drainage strategy and flood risk assessment2.

I believe this documented deficit transfers the burden of design validation from the statutory authority to external parties. This capacity gap is not an isolated incident but symptomatic of systemic pressures on local authorities expected to manage complex NSIPs without the commensurate internal funding or capacity, a risk recognised at the government level15.

5.2 Consequences for Long-Term Safety and Enforcement

I argue that the LLFA's admitted inability to perform its core design review function creates severe consequences for the long-term safety of the community, rendering the flood mitigation guarantees questionable.

5.2.1 Compromised Design Approval

If the LLFA cannot perform its own due diligence on the hydraulic models and SuDS design, it must rely entirely on external consultants. My conclusion is that this compromises the initial design approval process and weakens the integrity of the technical challenge required by statutory bodies. This is especially the case since the consultant chosen to review the flood risk by NCC is also working for One Earth on waste management, highlighting both a conflict of interest and a generic lack of resources in the economy to objectively assess NSIPS.

5.2.2 The 60-Year Oversight Deficit

The effectiveness of any flood mitigation measures is entirely dependent on proper maintenance, monitoring, and enforcement over the project's entire operational lifespan of 60 years. A local authority already documenting a chronic resource deficit cannot credibly guarantee the long-term policing and enforcement required for six decades. I contend that this institutional failure creates a material risk that the DCO requirements will fail to be discharged or enforced post-consent, which means the project, if consented, carries a known and critical failure probability related to governance. This makes the LLFA resource deficit a material consideration that the Secretary of State should address if the project is to be genuinely "safe for its lifetime"3.

6. Justification and Mandate for the Examining Authority's Technical Commission

6.1 ExA Procedural Powers and Compulsory Information Gathering

The necessity for a joint RHM and GIA is driven by the failure of the Applicant's submitted documentation to resolve the cumulative hydrological risks and the governance crisis. Crucially, I must stress that the failure to model and quantify this regional surface water risk is a shared deficit that must be resolved by all Risk Management Authorities (RMAs) through a joint mandate.

The ExA has the procedural authority to compel the submission of this critical, missing information16. Since the issue of cumulative flood risk transcends the boundaries of a single DCO application and addresses the LLFAs' statutory surface water mandate, the solution must be a mandatory, joint study, leveraging the collective resources and data of all affected RMAs. I ask the ExA to formally challenge the current positions of the LLFAs and the EA to ensure they actively participate in the development and validation of the RHM, thereby fulfilling their statutory duties under the Flood and Water Management Act 2010 to manage and assess local flood risk17.

6.2 Technical Standards for Hydrological Modelling

The commissioned RHM must adhere rigorously to established UK modelling standards18. I specify that the model should comply with Environment Agency (EA) standards, specifically utilising a Physically-Based Distributed (PBD) Hydraulic Model. The most appropriate tool for this integrated assessment is the SHETRAN model, due to its capability to simulate coupled 3D subsurface flow and contaminant transport, which is essential for quantifying the complex cumulative solar farm runoff and the compounding risk of contaminant mobilisation near Tollerton Airfield19. This is superior to standard 2D models because it accounts for the crucial intersection of surface flows with groundwater and contamination pathways.

The model's scope must calculate any change in off-site flood risk between a baseline and post-development scenario, covering key metrics such as flood extent, frequency, depth, velocity, hazard, speed-of-onset, and duration across multiple time horizons. Crucially, the model must:

- Be fully calibrated and verified against existing EA flood mapping and historical data.
- Incorporate appropriate climate change allowances, considering the project's 60-year lifespan, specifically using sensitivity test allowances for the 2056 to 2125 epoch5.
- Utilise parameters within the hydrological runoff modelling that accurately reflect the empirically demonstrated non-linear peak discharge acceleration associated with large-scale solar arrays (i.e., incorporating Baiamonte principles1).

6.3 The Unresolved Critical Issue

The central conflict—the Cumulative Deficit—is the combination of unquantified aggregate hydrological impact and demonstrably insufficient institutional capacity to police the mitigation. The Applicant cannot independently resolve this regional cumulative impact, and the LLFA cannot independently resolve its resource gap. I submit that the ExA must intervene to force the cooperative data generation required to bridge this scientific and governance gap before consent is considered.

7. The Proposed Technical Commission: Scope and Deliverables (Mandate to Parties)

I recommend that the Examining Authority issues a compulsory Technical Commission encompassing two core mandates: the Joint Regional Hydrological Model (RHM) and the Governance Impact Assessment (GIA). This commission must be directed at the Applicant, the LLFAs (Nottinghamshire and Lincolnshire), and the EA.

7.1 Mandate for the Joint Regional Hydrological Model (RHM)

I request the Examining Authority to commission a Joint Regional Hydrological Model (RHM) to be executed by the Applicant, in consultation and agreement with the statutory Risk Management Authorities.

Requirement/Deliverable	Mandated Responsible Parties	Technical Scope (Minimum Standard)
RHM Development and Calibration	Applicant (Lead Funding/Execution), Nottinghamshire LLFA, Lincolnshire LLFA, Environment Agency (Technical Review/Data Provision)	Utilise the SHETRAN Physically-Based Distributed Model to simulate coupled surface/subsurface flow and contamination transport. Must be fully calibrated and verified against existing flood mapping and historical data.
Cumulative Land-Use Input	Applicant (in consultation with other DCO applicants)	Input land-use data for all concurrent projects listed in Section 4.1. Model the impact of aggregated land-use change, specifically using parameters that reflect PV runoff acceleration (Baiamonte principles).
Climate Change and Storm Scenarios	Applicant, EA	Model 1-in-100-year and 1-in-1,000-year design storms, incorporating current climate change allowances up to the 2125 epoch (60-year lifespan) for the project.
Flood Map Validation and Overlay	EA and LLFAs	The EA and both LLFAs should use the RHM output to overlay the modelled cumulative increase in surface water runoff and peak discharge rates onto existing statutory flood maps (e.g., RoFSW) to quantify changes in flood extent, frequency, and depth off-site, thereby validating the RHM and fulfilling the LLFAs' statutory duty for surface water risk management.
Contaminant Mobilisation Pathway Analysis	Applicant, EA (with advice from relevant health bodies)	Model runoff velocity, depth, and flow direction within the RHM, focusing on potential mobilisation pathways connecting the One Earth/Concurrent solar sites to the contaminated Tollerton Airfield site. Assess the risk

		of contaminant (Radium-226, hydrocarbon) transport during peak flood events.
Cumulative WFD Compliance Assessment	Applicant, EA	Based on RHM outputs, conduct a comprehensive assessment of cumulative impact on Water Framework Directive (WFD) objectives, focusing on the chemical status of water bodies due to potential pollutant transfer.

7.2 Governance Impact Assessment (GIA) Mandate

I suggest a mandatory Governance Impact Assessment (GIA) to provide objective evidence that the statutory obligation for long-term safety and mitigation enforcement can be met.

- LLFA Capacity Audit: Nottinghamshire County Council (NCC) and Lincolnshire County Council (LCC) should submit a joint report, detailing:
- The required staffing and budget (including external consultant costs) necessary to provide adequate technical review and auditing of the design prior to DCO approval, explicitly demonstrating how the documented deficit in "expertise or resource" has been resolved.
- The resources secured (preferably by way of bond) (e.g., via Section 106 or equivalent DCO requirements) to guarantee the 60-year design,maintenance, monitoring, and enforcement of all SuDS and flood mitigation works for the One Earth NSIP and concurrent Tier 1 projects.
- A confirmation of whether the persistent capacity failure has been eliminated, and if not, a clear statement of the material risk this poses to the DCO's ability to guarantee long-term safety and compliance with the requirement to maintain works.

Statement of Common Ground (SoCG) on Flood Risk and Governance: The Applicant, all LLFAs, and the EA should submit a binding SoCG establishing technical agreement on the RHM results, all necessary design amendments to address cumulative impacts, and the explicit financial and resource commitments necessary to ensure long-term maintenance and enforcement for the project's duration.

8. Conclusions and Recommendations

My evidence demonstrates that the One Earth Solar Farm application currently presents an unquantifiable cumulative flood risk due to a fundamental scientific modelling gap and a material governance deficit.

- Scientific Non-Compliance: The failure to adopt modelling parameters that account for the empirically proven, non-linear acceleration and concentration of surface runoff from solar PV arrays (Baiamonte principles) means the proposed Flood Risk Assessment systematically underestimates peak flood risk1.
- Cumulative Risk: The simultaneous conversion of thousands of hectares to solar arrays and hardstanding, without a joint Regional Hydrological Model, guarantees a systemic alteration of the regional catchment's time to peak flow, potentially overwhelming

existing infrastructure and defences. This unquantified risk violates NPS EN-1 requirements for assessing and quantifying cumulative effects3.

- Governance Failure: The explicit admission by the Lead Local Flood Authority (NCC) of lacking the necessary resources for technical review undermines the integrity of the design approval process and voids the long-term guarantee of mitigation effectiveness required for the 60-year operational life. This deficit is a material consideration impacting public safety2.
- RMA Accountability: The statutory bodies (LLFAs and EA) share the responsibility to validate the assessment of surface water risk and I formally request the ExA to compel them to use the commissioned RHM to overlay the cumulative impacts onto statutory flood maps to confirm the project does not increase flood risk elsewhere.

My Recommendation: The Examining Authority should immediately issue a mandatory technical commission, utilising a Rule 8 letter and ExA Questions (ExQs), compelling the Applicant, the affected Lead Local Flood Authorities (LLFAs) for Nottinghamshire and Lincolnshire, and the Environment Agency (EA) to execute the Regional Hydrological Model (RHM) and Governance Impact Assessment (GIA) detailed in Section 7. Failure by the Applicant to fund and submit this essential data, or the inability of the LLFAs/EA to credibly resolve the required data deficits and maintenance resources, must lead to a recommendation that the Development Consent Order for the One Earth Solar Farm be refused on the grounds of unquantifiable cumulative flood risk and inability to guarantee long-term mitigation integrity, thus violating the core safety mandate of NPS EN-13.

9. Technical Report: Justification for SHETRAN as the Mandated Hydrological Model

This supplementary technical note provides the rationale for replacing standard semi-distributed or 2D hydraulic models (such as those using ReFH2 input) with the SHETRAN Physically-Based Distributed (PBD) Model for the mandated Regional Hydrological Model (RHM) defined in Section 7.1 of the main submission.

9.1 The Need for a Physically-Based Distributed Approach

Standard hydrological models typically fall into one of three categories: lumped, semi-distributed (like HEC-HMS), or conceptual (like ReFH2). While these models are suitable for estimating flood peaks in typical catchments or designing greenfield runoff rates, they rely on simplified assumptions that fail to capture the complex, non-linear dynamics of large-scale solar farm clusters, especially when integrated with subsurface hazards.

The SHETRAN model is a physically-based distributed (PBD) model, which means it explicitly simulates the actual physical processes of water flow and transport across a catchment using complex governing equations, rather than relying on empirical formulas or average parameters19.

9.2 Superiority of SHETRAN for Solar Farm Cumulative Risk

SHETRAN's structure addresses three critical technical deficiencies identified in the One Earth proposal's current modelling assumptions:

9.2.1 Integrated 3D Surface and Subsurface Flow

A major failure of standard 2D hydraulic models in the context of solar arrays is the inability to accurately model the interaction between concentrated surface runoff and infiltration into the soil. The solar panels interrupt the natural hydrological cycle, concentrating rainfall at the driplines and altering soil moisture beneath the panels, which critically affects infiltration capacity.

SHETRAN is a 3D integrated surface and subsurface finite-difference modelling system19. This functionality is crucial because it allows the RHM to simulate:

- Vertical Flow (Infiltration): How the increased volume and velocity of surface water runoff from the panels reduces infiltration rates and contributes to soil saturation.
- Groundwater Interaction: The movement of water through the soil and into the groundwater system, coupling the surface water flood risk directly to the shallow water table.

This integrated 3D capacity provides a far more realistic simulation of the actual hydrological alteration caused by the 1,414 hectares of the One Earth site and adjacent developments compared to a decoupled 2D surface model, which treats the vertical interaction simplified or ignores it entirely19.

9.2.2 Quantifying Contaminant Mobilisation (Pollutant Transport)

The most severe compounding risk identified in the main report is the potential for cumulative surface runoff to act as a vector for transporting persistent contaminants, specifically Radium-226 and carcinogenic hydrocarbons, from the Tollerton Airfield site into the wider water system.

Unlike standard hydraulic models, SHETRAN has an inherent capability to model multifraction sediment transport and multiple, reactive solute transport (contaminant transport), fully coupled to the water flow simulation19. This capability means the commissioned RHM can:

- Simulate Pollutant Transfer: Predict how increased flood depth and velocity resulting from the combined NSIPs would mobilise, transport, and disperse the radioactive and hydrocarbon contaminants.
- Inform WFD Compliance: Directly quantify the environmental risk to water bodies, providing the robust data necessary for the mandated cumulative Water Framework Directive (WFD) compliance assessment13.

This integrated contaminant modelling capability makes SHETRAN uniquely suited to assess this specific public health and environmental hazard, which is of material concern to the Secretary of State's decision.

9.2.3 Superior Catchment Resolution and Climate Projection

As a PBD model, SHETRAN is spatially distributed and can be automatically calibrated for large UK catchments, having been successfully driven by UKCP18 climate projections across hundreds of UK river systems19. This provides a robust, pre-calibrated framework for simulating the regional, catchment-wide effects of concurrent land-use changes across Nottinghamshire and Lincolnshire, allowing for a highly detailed resolution of effects across the entire basin.

9.3 Conclusion on Model Mandate

While the widely used ReFH2 model is recommended for simple site-scale applications like estimating post-development runoff rates for individual SuDS features, it is insufficient for this complex regional, cumulative, and multi-hazard DCO assessment. The SHETRAN PBD model is technically superior because it allows for the necessary integration of surface water runoff, deep infiltration, and contaminant transport within a single, physically realistic simulation, fulfilling the full scope of the technical and statutory requirements imposed by the cumulative nature of the flood risk19.

Footnotes and References

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