

Materials Management and Warehousing Engineering Justification Paper





**Material Management and Warehousing
Engineering Justification Paper**

1. Executive Summary

This Engineering Justification Paper sets out the need for improved materials management and warehousing capabilities over the RIIO-T2 period and beyond. We need to address the limitations of the current inventory management system and to drive the changes needed to improve network resilience through the reliability, availability and maintainability of asset and spares inventory. This will improve repair times, reduce network and customer risks, rationalise spares holdings and reduce the consequences of system failures through improved logistics and inventory management.

SHE Transmission has outlined the following deliverables for this approach;

- Develop a two-warehouse solution at two separate locations complete with in-house logistics support.
- Bespoke storage to house oil filled components such as transformers.
- Implementation of an Inventory Management System (IMS) – covered by our Non-Operational Capital Expenditure Paper.

The cost to deliver the above option excluding the IMS stands at £40.26m. This cost has been developed through supply chain engagement and will be delivered during the RIIO-T2 price control.

Upon project delivery there are several benefits relating to the RIIO-T2 business goals which have been listed below:

- Improved inventory management control to ensure all spares are appropriately managed and maintained.
- Better response following faults on the network contributing to improved network resilience
- Reduced need to procure spares through projects leading to lower capital costs of projects
- Spares are stored in a controlled environment ensuring longevity and availability and reducing environmental risk

This scheme is not flagged as eligible for early or late competition due to it being under Ofgem's £50m and £100m thresholds respectively.





**Material Management and Warehousing
Engineering Justification Paper**

Name of Scheme/Programme	Material Management and Warehousing
Primary Investment Driver	Resilience
Scheme reference/ mechanism or category	SHNLT2032
Output references/type	NLRT2SH2032
Cost	£40.26m
Delivery Year	2025
Reporting Table	D4.3a_Non Op_Capex
Outputs included in RIIO T1 Business Plan	None

**Material Management and Warehousing
Engineering Justification Paper****2. Introduction**

This Engineering Justification Paper sets out our plans to introduce enhanced material management and warehousing during the RIIO-T2 period (April 2021 to March 2026).

The Engineering Justification Paper is structured as follows:

Section 3: Need

This section provides an explanation of the need for the planned works. It provides evidence of the primary and, where applicable, secondary drivers for undertaking the planned works. Where appropriate it provides background information and/or process outputs that generate or support the need.

Section 4: Optioneering

This section presents all the options considered to address the need that is described in Section 3. Each option considered here is either discounted at this Optioneering stage with supporting reasoning provided or is taken forward for Detailed Analysis in Section 5.

Section 5: Detailed Analysis

This section considers in more detail each of the options taken forward from the Optioneering section. Where appropriate the results of Cost Benefit Analysis are discussed and together with supporting objective and engineering judgement contribute toward the identification of a selected option. The section continues by setting out the costs for the selected option.

Section 6: Conclusion

This section provides summary detail of the selected option. It sets out the scope and outputs, costs and timing of investment and where applicable other key supporting information.

Section 7: Price Control Deliverables and Ring Fencing

This section provides a view of whether the proposed scheme should be ring-fenced or subject to other funding mechanisms.

Section 8: Outputs included in RIIO-T1 Business Plan

This section identifies if some or all the outputs were included in the RIIO-T1 Business Plan and provides explanation and justification as to why such outputs are planned to be undertaken in the RIIO-T2 period.

Section 9: References

**Material Management and Warehousing
Engineering Justification Paper****3. Need****3.1. Existing Facilities**

Our current warehousing facilities are:

- [REDACTED]. The [REDACTED] facility is a leased site which was formerly utilised as a depot for the Beaulieu – Denny project. It has limited expansion opportunities and no heavy lifting capability. It also has environmental and access/egress issues.
- [REDACTED], where the building was previously part of an old power station. [REDACTED] has similar functional constraints to [REDACTED], although access/egress is suitable
- [REDACTED] near Dundee, used for transformer storage.

In addition to these warehouse facilities, overhead line and small substation plant spares are stored at various substation sites across our network. All facilities were selected to fulfil short-term operational needs and have mid to long term limitations as warehouse facilities. These facilities do not meet our fundamental requirements for a warehousing facility. Without suitable facilities, materials may be stored in exposed locations and therefore not comply with manufacturer's recommendations, with the material vulnerable to the environmental conditions, as well as being more vulnerable to theft.

3.2. New Technology Types

At the commencement of the RIIO-T1 period the network was primarily of a 132/275kV Air Insulated Switchgear (AIS) design which has changed to a significantly more complex design of 132/275/400kV AIS and Gas Insulated Switchgear (GIS). In addition, our network now includes diverse assets such as HVDC, 220kV subsea cables, 275 & 400kV Gas Insulated Switchgear and specialised equipment such as Static VAR Compensators (SVCs) and Statcoms that help manage the network. These significant changes to the network are not solely limited to substations and cable. The addition of 400kV overhead lines to our asset base and the improved technology utilised by the protection and control systems have contributed to an evolving network.

As a result, our requirements for spares holdings has also increased, and will continue to increase, significantly, with a need to store not only more types of spares, but an increased volume to correspond to the increased asset base.



**Material Management and Warehousing
Engineering Justification Paper**

3.3. Inventory Management

A further consequence of the growth of our network is the increased importance of our Inventory Management System (IMS). The existing inventory management system is a manual process which was fit for purpose at the commencement of the RIIO-T1 period but is now unsustainable.

Note that while the IMS is integral to this work and is discussed throughout this paper, related costs for this aspect of the project are contained within our Non-Operational Capex submission and not part of the costs herein.

3.4. Fault Response Capabilities

Most Original Equipment Manufacturers (OEMs) work a just in time system for plant and equipment meaning that plant is only manufactured for customers when required. This results in low levels of spares being available. Therefore, if a failure occurs, lead times can vary from several days or weeks to months, or even years dependent on the spare required and from where it is being supplied. It should be noted that a significant amount of our strategic assets such as transformers, switchgear and cables are manufactured outside of the UK.

Whilst the network is designed to take asset failures into account, if the lead times are significant, this can lead to an increased risk to the remainder of the network. Whilst we currently share some resources with other TOs and DNOs, from a risk avoidance perspective and often due to differences in the type of plant installed, it is not possible to pool all our resources and therefore we must obtain, store and manage a minimum level of spares. Where a construction project upgrades the network, any recovered plant is assessed for use elsewhere or as a potential spare. Where suitable for a spare, it will be refurbished and must be stored and appropriately managed.

Material Management and Warehousing Engineering Justification Paper

4. Optioneering

This section presents all the options considered to address the need that is described in Section 3. Each option considered here is either discounted at this Optioneering stage with supporting reasoning provided or is taken forward for Detailed Analysis in Section 5.

When reviewing our options in this area, we produced a three-tier approach to our development, in addition to a “Do Nothing” option:

- **Minimum Requirements**
 - The bare minimum required to “keep the lights on” & maintain legal/regulatory compliance
- **Responsible Operator**
 - A more resilient network for longer term customer benefit
- **Progressive Network Enabler**
 - An adaptable, sustainable and flexible network providing enhanced value to current and future customers

4.1. Do Nothing

This option consists of maintaining existing business practices. Whilst this option has no additional cost, it does not address any of the issues raised on Section 3.

On this basis, this option is not taken forward to detailed analysis.

NOT PROGRESSED TO DETAILED ANALYSIS

4.2. Minimum Requirements

The minimum requirements in this area would be to develop a single warehouse. Transformer storage would remain at [REDACTED] noting that this site cannot be expanded to allow for increased spares storage. An Inventory system will be developed and implemented to reduce the risk of inaccurate data and improve resilience and emergency response times, alongside Service Level Agreements (SLAs) with haulage contractors to provide transportation capabilities when required.

This option provides the following benefits:

- No reliance on renewal of leases as SHE Transmission will construct its own facility.

Material Management and Warehousing Engineering Justification Paper

- Improved physical protection of spares.
- The controlled of spares by the Inventory Management System. Spares would only be ordered based on a Maximum/Minimum holding system. It is envisaged that this will decrease spares holding.
- Provision of greater data accuracy for spares held in storage.
- Provision of heavy lifting capability at each facility.
- Provision of bespoke storage to reflect the various mix of materials. E.g. meeting temperature & humidity requirements.
- High cost, lead assets stored and maintained internally which maintain their condition in readiness for installation.
- Increased Quality Controls and assurance. E.g. Materials would not be released for service without the material provenance.
- Improved safety - By removing materials from open view in live substations it lessens the attraction of attempted theft and therefore access into a live busbar environment. It also removes the need for staff to access a live compound environment with cranes and lifting equipment.

Whilst this addresses all of the concerns raised, it introduces the following risks:

- Storage of all spares of a given asset type in one location introduces business continuity risk,
- Potentially, insufficient storage capacity requirements based on future network expansion scenarios, or unfeasibly large warehouse facility.
- Storage of plant at a live substation site [REDACTED] is not desirable.

On this basis, this option is not taken forward for detailed analysis.

NOT PROGRESSED TO DETAILED ANALYSIS

4.3. Responsible Operator

This option examines a two-warehouse solution complete with in-house logistics support. This option would include bespoke storage to house oil filled components such as transformers in order to minimise the risk to the environment in line with our Sustainability Strategy. This option offers the following benefits in addition to those listed under Minimum Requirements:

- The reduction of business continuity risk by having two locations.



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- An improved reaction time during fault/storm situations.
- Materials will be stored in line with the requirement of the manufacturer's specification
- The controlled of spares by the Inventory Management System. Spares would only be ordered based on a Maximum/Minimum holding system. It is envisaged that this will decrease spares holding.
- Provision of greater data accuracy for spares held in storage.
- Provision of heavy lifting capability at each facility.
- Provision of bespoke storage to reflect the various mix of materials. E.g. meeting temperature & humidity requirements.
- High cost, lead assets stored and maintained internally which maintain their condition in readiness for installation.

The capacity requirements of these warehouse facilities have been estimated based on the dimensions/weight of spares and the high likelihood that "second hand spares" will become available from load related projects. Again, the impact of the diversity of the installed equipment and the need to meet the OEMs engineering recommendations has a considerable influence on the capacity requirements. The volume of spares to be stored will be based on various factors such as existing stockholding, standardisation of material, engineering design, scheduling/ lead times, procurement strategy, inspection criteria, quality controls, unique packaging and storage requirements. This option addresses all of the concerns raised in this area. On this basis, this option is taken forward for detailed analysis.

PROCESSED TO DETAILED ANALYSIS

4.4. Progressive Network Enabler

The Progressive Network Enabler option is to develop an Operations Centre in both the north and south areas, complementing the Warehousing Facilities. This option would include the establishment of facilities to support the complex range of activities that will enhance Operations capability and improve the network reliability and resilience. These facilities would include a Disaster Recovery Centre, Blackstart support, Protection test facility, offices and a maintenance workshop.

This option addresses all of the concerns raised in this area.

On this basis, this option is taken forward for detailed analysis.

PROCESSED TO DETAILED ANALYSIS



**Material Management and Warehousing
Engineering Justification Paper**

A summary of the above optioneering is shown in Table 1, below.

	Do Nothing	Minimum Requirements	Responsible Operator	Progressive Network Enabler
Controlled facility with lifting capability	✗	✓	✓	✓
All SSE Owned facilities	✗	✓	✓	✓
Improved Fault Response	✗	✗	✓	✓
Non-live substation environment	✗	✓	✓	✓
Diversity of location	✓	✗	✓	✓
Quality control	✗	✓	✓	✓
Inventory management	✗	✓	✓	✓

Table 1 - Optioneering Summary



Material Management and Warehousing Engineering Justification Paper

5. Detailed Analysis

This section considers in more detail each of the options taken forward from the Optioneering section. It examines three comparative factors in order to determine the preferred option:

- Risk,
- Stakeholder Requirements, and
- Cost.

5.1. Risk and Benefit Analysis

Due to the nature of this project, risks and benefits involved are not easily quantifiable and, as agreed with Ofgem, are not suitable for traditional Cost Benefit Analysis.

In order to demonstrate the benefits of delivering this project, we have carried out a Risk and Benefit Analysis. For each option taken forward to Detailed Analysis, it looks at the existing risks, the likelihood of these risks being realised, and the severity should that happen. The likelihood and severity combine to give an overall Unmitigated Risk Rating.

Mitigation actions delivered by the delivery of each option are then identified for each risk, and the likelihood and severity are reappraised, resulting in a Mitigated Risk Rating.

This exercise was carried out for the Materials Management proposals. As can be seen in

For both options the Unmitigated Overall Risk Rating is "High". Once all the mitigations are considered, the Mitigated Risk Rating falls to "Low" for both options. Both potential options derive similar amounts of improvement to the risk rating. The full Risk & Benefit Analysis is contained within Appendix A.



**Material Management and Warehousing
Engineering Justification Paper**

Risk ID	Risk Title	Risk	Unmitigated Overall Risk Rating	Responsible Operator	Progressive Network Enabler
				Mitigated Overall Risk Rating	Mitigated Overall Risk Rating
1	Heavy Lifting Capability	Materials cannot be moved in and out of facilities easily which impacts fault recovery times.	High	Low	Low
2	Access/Egress	Materials cannot be moved in and out of facilities easily which impacts fault recovery times.	High	Low	Low
3	External Storage	Without suitable facilities, materials may be stored in exposed locations and therefore not comply with manufacturer's recommendations, with the material vulnerable to the environmental conditions.	High	Low	Low
4	Substation Storage	Storing plant in a live environment introduces unnecessary risk and increases the risk of theft.	Severe	High	High
5	New technologies	Without improved warehousing, we cannot store all the different types of spares required.	High	Low	Low
6	Fault Response	A lack of spares may result in a long-term outage should a fault occur, putting the remainder of the network under increased risk.	Severe	Medium	Medium
OVERALL			High	Low	Low

Table 2 - Risk and Benefit Analysis Results

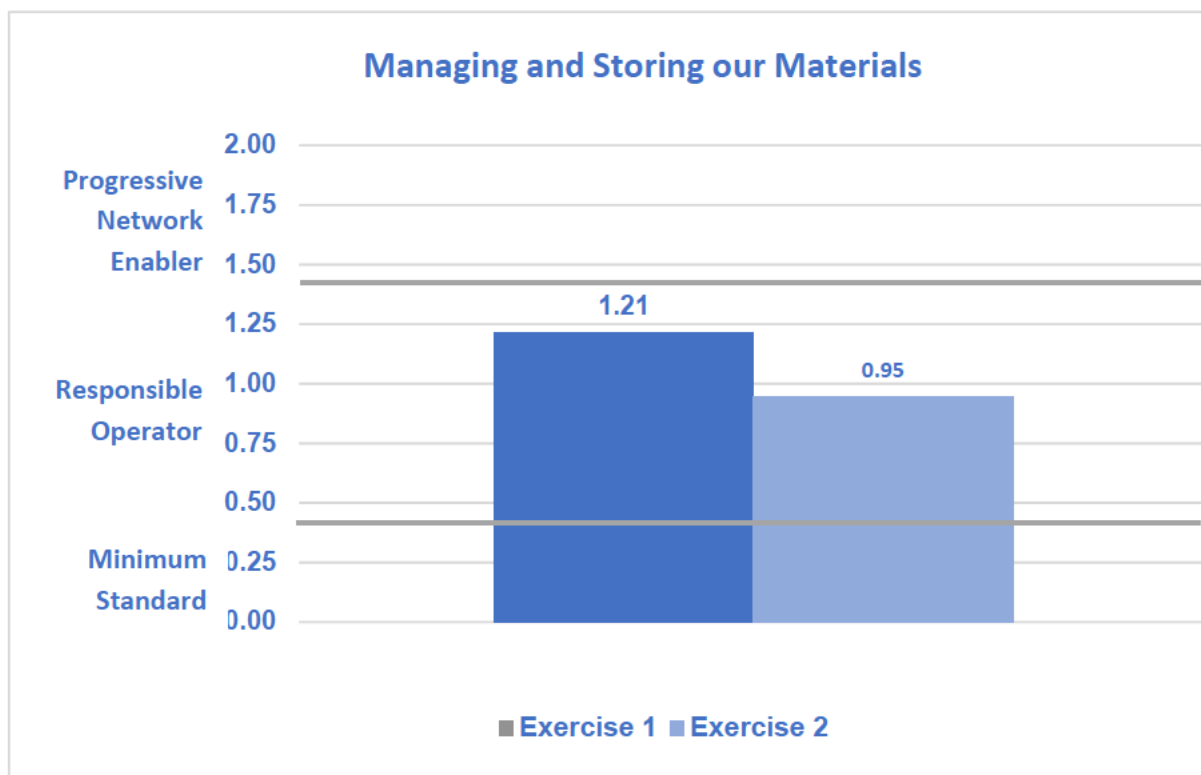
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Engineering Justification Paper**

5.2. Stakeholder Engagement

On 5 March 2019, SHE Transmission hosted a stakeholder workshop, aimed at gathering feedback from its stakeholders on its approach to network resilience and reliability for the RIIO-T2 plan. A total of 46 stakeholders attended the workshop, representing 31 organisations. Stakeholders opted for the “Responsible Operator” option, as can be seen in Figure 1. This was reflected in the table discussions, where stakeholders generally supported going further than the ‘minimum standard’. There was recognition that having spares close by was important in emergencies as it reduced outages. Stakeholders were therefore generally supportive of having two warehouses – one in the north and one in the south. In terms of locations, one stakeholder did urge SHE Transmission to consider the weather as storms could make a warehouse inaccessible.

Whilst the consensus therefore appeared to be ‘responsible operator’ for warehousing, several stakeholders did comment that rather than just building new warehouses, there also needed to be a focus on having good records and properly documenting the spares that were being held.

Figure 1 - Stakeholder Feedback



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Engineering Justification Paper**

5.3. Costs - Responsible Operator

As described above, this option will see the construction of two warehousing facilities with in-house logistics support. This option would include bespoke storage to house oil filled components such as transformers and the deployment of a robust Inventory Management System and an enhanced transportation and distribution capability along with the new warehousing facilities.

The class 2 estimate costs for the total works as listed is £40.26 million for all works. The estimate is based on engagement with experienced framework contractors and in-house specialist support.

5.4. Costs - Progressive Network Enabler

As described above, the Progressive Network Enabler option would expand upon the Responsible Operator option to develop two warehousing facilities which would also include a Disaster Recovery Centre, Blackstart support, Protection test facility, offices and a maintenance workshop. This would be delivered in conjunction with the Warehouse facilities.

The class 2 estimate costs for the total works as listed is £42.06 million for all works. The estimate is based on engagement with experienced framework contractors and in-house specialist support.

	Responsible Operator (£m)	Progressive Network Enabler (£m)
Build Costs		
Electrical Fit Out		
Civil Works		
Contractor Prelims		
Design		
Site Investigations		
Land Acquisition		
Site Security		
On-Costs		
Risk		
Total	40.26	42.06

Table 2 - Options cost

5.5. Proposed Solution

We have examined each of the options in terms of three comparative factors:

- Cost
- Risk Reduction
- Stakeholder Requirements



**Material Management and Warehousing
Engineering Justification Paper**

From our analysis the “Responsible Operator” option is proposed as it addresses the identified need and is also the least cost option. It provides significant benefits in terms of resilience and operational risk reduction and it aligns with stakeholder feedback.

**Material Management and Warehousing
Engineering Justification Paper****6. Conclusion**

This Engineering Justification paper sets out the need for Warehousing and Spares due to SHE Transmission's strategy to improve network resilience over the RIIO-T2 period and beyond.

The paper investigated SHE Transmission's current spares options and determined that there was a need to improve the way spares are handled and stored. A new warehousing system separate from current facilities would remove rental costs and ensure more security of supply of spares for the Transmission network.

An optioneering assessment took place which investigated 4 options, two of which were taken forward for detailed analysis.

Taking account of that detailed analysis, the preferred option is the Responsible Operator option, the construction of two warehouses and the implementation of an Inventory Management System.

The cost analysis for this project stands at £40.26m. This cost has been developed in conjunction with reputable contractors.

The project will be delivered over the RIIO-T2 period and will have the following associated benefits relating to the RIIO-T2 business goals:

- Materials stored out of sight will increase operational safety as this lessens the attraction of attempted theft and therefore access into a live busbar environment. Increasing Safety in line with SHE-Transmissions key operational foundations.
- Both warehouses will be able to facilitate outages in short order creating a redundancy measure and increasing system security. This addresses the goal set out in the "Network for Net Zero" Business plan relating to our goal to aim for 100% transmission network reliability for homes and businesses.

This scheme is not flagged as eligible for early or late competition due to it being under Ofgem's £50m and £100m thresholds respectively.



**Material Management and Warehousing
Engineering Justification Paper**

7. Price Control Deliverables and Ring Fencing

As set out in our Regulatory Framework paper (section 1.12 and Appendix 3) we support a key principle from Citizens Advice – one that guarantees delivery of outcomes equivalent to the funding received - to ensure that RII0-T2 really deliver for consumers. At the project level this means that if we don't deliver the output, or a materially equivalent outputs, we commit to returning the ex-ante allowance for the output not delivered.

This means that if the funding for Materials Management and Warehousing should be ring-fenced and if it does not go ahead, we will return the allowances of £40.26m in full (minus any justified preconstruction expenditure).

It also means that we commit to delivering the output specified above for the costs of £40.26m. If we do not deliver the output, or a materially equivalent output, we commit to returning a proportion of the ex-ante allowance. The detailed methodology should be decided at when developing the Close Out methodologies but should apply the same principles of uncertainty mechanisms - that any under delivery should be material.



**Material Management and Warehousing
Engineering Justification Paper**

8. Outputs included in RIIO-T1 Plans

There are no outputs associated with this scheme included in our RIIO-T1 plans.



**Material Management and Warehousing
Engineering Justification Paper**

9. References

- Non-Operational Capex Paper
- Sustainability Strategy

**Material Management and Warehousing
Engineering Justification Paper**

Appendix A

Project Risk and Benefit Matrix - Responsible Operator

Risk ID	Risk Title	Risk	Unmitigated Risk Likelihood	Unmitigated Risk Severity	Unmitigated Overall Risk Rating	Mitigation Action	Mitigated Risk Likelihood	Mitigated Risk Severity	Mitigated Overall Risk Rating	Benefits
1	Insufficient Facilities	Without suitable facilities, materials may be stored in exposed locations and therefore not comply with manufacturer's recommendations, with the material vulnerable to the environmental conditions.	Likely	Serious	High	Develop suitable storage facilities	Almost Never	Serious	Low	Spares will function when required
2	New technologies	Without improved warehousing, we cannot store all the different types of spares	Almost Certain	Major	Severe	Develop suitable storage facilities	Almost Never	Major	Medium	Larger width of spares readily accessible
3	Fault Response	A lack of spares may result in a long-term outage should a fault occur, putting the remainder of the network under increased risk.	Almost Certain	Major	Severe	Develop suitable storage facilities	Almost Never	Major	Medium	Reduced fault durations

Figure 2 - Risk & Benefit Matrix – Responsible Operator

Project Risk and Benefit Matrix - Progressive Network Enabler

Risk ID	Risk Title	Risk	Unmitigated Risk Likelihood	Unmitigated Risk Severity	Unmitigated Overall Risk Rating	Mitigation Action	Mitigated Risk Likelihood	Mitigated Risk Severity	Mitigated Overall Risk Rating	Benefits
1	Insufficient Facilities	Without suitable facilities, materials may be stored in exposed locations and therefore not comply with manufacturer's recommendations, with the material vulnerable to the environmental conditions.	Likely	Serious	High	Develop suitable storage facilities	Almost Never	Serious	Low	Spares will function when required
2	New technologies	Without improved warehousing, we cannot store all the different types of spares	Almost Certain	Major	Severe	Develop suitable storage facilities	Almost Never	Major	Medium	Larger width of spares readily accessible
3	Fault Response	A lack of spares may result in a long-term outage should a fault occur, putting the remainder of the network under increased risk.	Almost Certain	Major	Severe	Develop suitable storage facilities	Almost Never	Major	Medium	Reduced fault durations

Figure 3 - Risk & Benefit Matrix – Progressive Network Enabler

**Material Management and Warehousing
Engineering Justification Paper**

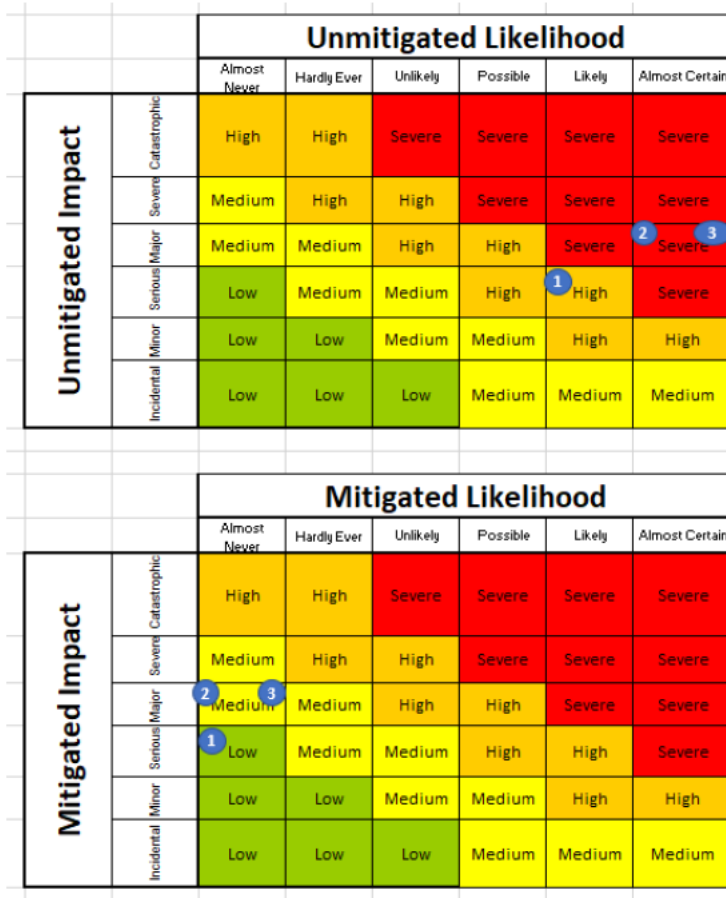


Figure 4 - Risk Heat Maps for Preferred Option