

RDS 2019

Realistic Disaster Scenarios
Scenario Specification
January 2019

Key Contacts

Performance Management Director

Jon Hancock
020 7327 6304
jon.hancock@lloyds.com

Head of Risk Aggregation

Kirsten Mitchell-Wallace
020 7327 5839
kirsten.mitchell-wallace@lloyds.com

Exposure Management

Emma Watkins
020 7327 5719
emma.watkins@lloyds.com

Steven Champion
020 7327 5983
steven.champion@lloyds.com

Charlie Melly
020 7327 6496
charlie.melly@lloyds.com

David Ryan
020 7327 6402
david.ryan@lloyds.com

Robin Knight
020 7327 5399
robin.knight@lloyds.com

Outwards Reinsurance

Chris Wallings
020 7327 5048
chris.wallings@lloyds.com

Kevin Bridge
020 7327 5745
kevin.bridge@lloyds.com

IT Support

ITG Data Management Helpdesk
020 7327 5252
ITGApplicationSupport2@lloyds.com

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The spatial data used to generate the revised maps within this document were as follows: -

- Gulf of Mexico blocks - the Bureau of Ocean Management (<http://www.boem.gov/Oil-and-Gas-Energy/Program/Mapping-and-Data/Maps-And-Spatial-Data.aspx>);
- all other maps - Natural Earth (<http://www.naturalearthdata.com/downloads/>)

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Document history

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1 Introduction

The purpose of this document is to describe the loss assumptions for each of Lloyd's Realistic Disaster Scenarios [RDS].

For information about Lloyd's 2019 reporting requirements, please see the 2019 RDS Guidance & Instructions.

1.1 Specification of the RDS events

For each compulsory scenario (see section 1.2.1) this document contains: -

- a definition of the physical event, with a map showing the footprint or storm track;
- the assumed industry insured loss for property, split by primary class of business;
- additional lines of business that managing agents are recommended to consider;
- where applicable, a catalogue of major infrastructure (i.e. ports) that may be affected by the event;
- where applicable, supplementary information that managing agents are required to provide (i.e. offshore energy).

For each *de minimis* scenario this document contains: -

- a description of the event, or type of event;
- additional information to the loss return which managing agents should provide;
- where applicable, examples of scenarios - or types of scenarios - which managing agents may choose;
- where applicable, assumptions about reinsurance protections.

For details of the Political Risks scenarios, please see the separate 2019 RDS Political Risks Scenario Specification document which is available on request from Lloyd's Risk Aggregation team or the LMA Political Risks panel.

1.2 Scenarios

1.2.1 Compulsory scenarios

There are sixteen compulsory scenarios which managing agents must complete for all syndicates.

Lloyd's does not prescribe how managing agents should calculate losses from these scenarios. The Calculation Principles in the RDS Guidance & Instructions describe some possible methodologies and the reporting conditions applying to each.

Managing agents who use the Lloyd's damage factors and/or Lloyd's suggested property distributions will find them in the RDS Damage Factors spreadsheets. Table 1 shows the scenarios for which this data is available.

RDS		Industry Loss	Lloyd's damage-factors provided?	Lloyd's property distribution tables provided?	Scenario ID
Two events – North-East windstorm		USD 81bn	Yes	No	41
Two events – South Carolina windstorm		USD 39bn	Yes	No	42
Florida Windstorm – Miami-Dade		USD 131bn	Yes	No	2
Florida Windstorm – Pinellas		USD 134bn	Yes	No	3
Gulf of Mexico Windstorm	Onshore	USD 111bn	Yes	No	12
	Offshore	USD 7.1bn	No	n/a	
European Windstorm		€ 24bn	Yes	Yes	8
Japanese Typhoon		¥ 1.7trn	Yes	Yes	13
California Earthquake – Los Angeles		USD 78bn	Yes	Yes	4
California Earthquake – San Francisco		USD 80bn	Yes	Yes	5
New Madrid Earthquake		USD 44bn	Yes	Yes	6
Japanese Earthquake		¥ 8trn	Yes	Yes	9
UK Flood		GBP 6.2bn	No	No	51
Terrorism – Rockefeller Center		n/a	No	No	43
Terrorism – One World Trade Center		n/a	No	No	78

Table 1

Managing agents should report two further realistic events (Alternative A and B) that represent potential material impact to the syndicate but are not listed in either the compulsory or *de minimis* scenarios.

1.2.2 De minimis scenarios

The following scenarios are subject to *de minimis* reporting. Please see RDS Guidance & Instructions 2019 for definition of *de minimis* thresholds.

RDS		Scenario i/d
1	Marine (two scenarios)	79,80
2	Loss of Major Complex	17
3	Aviation Collision	18
4	Satellite risks (four scenarios)	70,71,72,73
5	Liability risks (two scenarios)	53,54
6	Cyber – Major Data Security Breach	76
7	Political risks (<i>see RDS Political Risks Scenario Specification 2019 document</i>)	

Table 2

Compulsory Scenarios

2 Two Windstorm events

A North-East US hurricane, immediately followed by a South Carolina hurricane.

Managing agents should return separate loss estimates for each event.

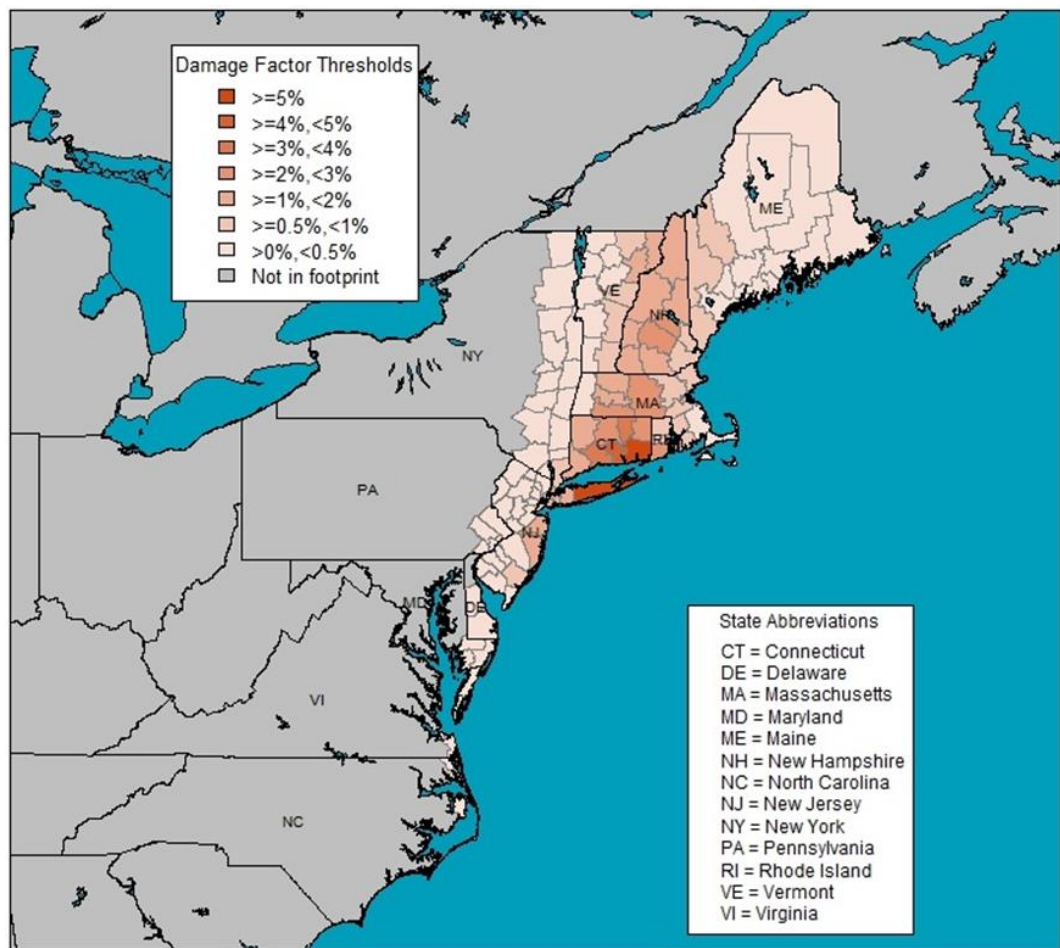
Managing agents should assume that these events fall in the same reinsurance year, and that there has not been sufficient time between events to purchase additional reinsurance protection.

2.1 Event definition 1 - North East hurricane

A North East hurricane making landfall in New York State, including consideration of demand surge and storm surge. The hurricane also generates significant loss in the States of New Jersey, Connecticut, Massachusetts, Rhode Island and Pennsylvania.

2.1.1 Event footprint 1 – North East hurricane

Map 1 illustrates the footprint and combined damage levels for the North East Hurricane Event.



Map 1

2.1.2 Industry Loss Levels – North East hurricane

This event results in an estimated Industry Property Loss of USD81bn with the following components:

Residential Property	\$49.50bn
Commercial Property	\$31.50bn
Auto	\$1.75bn
Marine	\$0.75bn

Table 3

Managing agents should consider all other lines of business that would be affected, including:

- 1) Specie/Fine Art
- 2) Personal Accident
- 3) Aviation
- 4) Liability
- 5) Cancellation

2.1.3 Exclusion of Contingent Business Interruption Losses

Lloyd's recognizes the difficulties involved in modelling losses from Contingent Business Interruption (CBI) covers. Managing agents should therefore exclude CBI losses from this event.

2.2 Exposure information for North East hurricane

2.2.1 Major ports

Table 4 lists the main affected ports that managing agents should consider in assessing their potential exposures. They should also consider smaller ports that fall within the footprint of the event.

Port	County	State
Camden	Camden	New Jersey
New York/New Jersey		
Philadelphia	Delaware	Pennsylvania

Table 4

2.2.2 Major airports

Table 5 lists the main international airports in the affected areas. Managing agents should also have regard to exposures in smaller airports that fall within the footprint of the event.

Airport	County	State
Atlantic City International Airport (ACY)	Atlantic	New Jersey
Bradley International Airport (BDL)	Hartford	Connecticut
Edward Lawrence Logan International Airport (BOS)	Suffolk	Massachusetts
John F. Kennedy International Airport (JFK)	Queens	New York
La Guardia Airport (LGA)	Queens	New York
Lehigh Valley International Airport (ABE)	Lehigh	Pennsylvania
Newark International Airport (EWR)	Essex	New Jersey
Philadelphia International Airport (PHL)	Delaware	Pennsylvania
Providence - T.F. Green Airport (PVD)	Kent	Rhode Island
Teterboro Airport (TEB)	Bergen	New Jersey
Wilkes-Barre/Scranton International Airport (AVP)	Luzerne	Pennsylvania

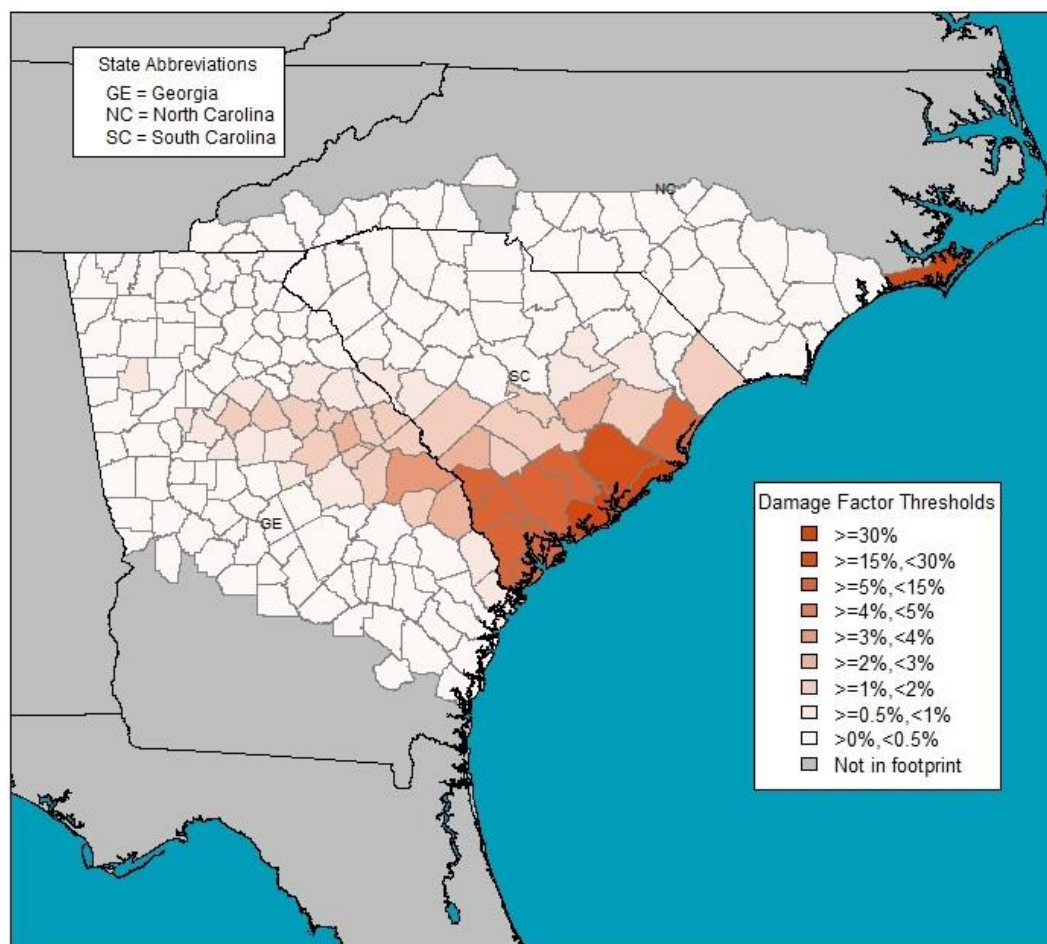
Table 5

2.3 Event definition 2 – South Carolina hurricane

A hurricane making landfall in South Carolina, including consideration of demand surge and storm surge.

2.3.1 Event footprint 2 – South Carolina hurricane

Map 2 illustrates the footprint and combined damage levels for the South Carolina Windstorm Event.



Map 2

2.3.2 Industry Loss Levels – South Carolina hurricane

This event results in an estimated Industry Property Loss of USD 39bn including consideration of storm surge and demand surge. Managing agents should assume the following components of the loss.

Residential Property	\$26.00bn
Commercial Property	\$13.00bn
Auto	\$0.53bn
Marine	\$0.27bn

Table 6

Managing agents should consider all other lines of business that would be affected by the event. Particular consideration should be given to losses arising from:

- 1) Specie/Fine Art
- 2) Personal Accident
- 3) Aviation

- 4) Liability
- 5) Cancellation

2.3.3 Reinsurance

For reinsurance purposes, managing agents should assume that the South Carolina hurricane falls in the same reinsurance year as the North East hurricane, and that there has not been sufficient time between events to purchase additional reinsurance protection.

2.4 Exposure information for South Carolina hurricane

2.4.1 Major Ports

Table 7 lists the main ports in South Carolina that would be affected by the windstorm that managing agents should consider in assessing their potential exposures. They should also have regard to exposures in smaller ports that fall within the footprint of the event.

Port	County
Charleston	Charleston
Georgetown	Georgetown
Port Royal	Beaufort

Table 7

2.4.2 Major Airports

Table 8 lists the main international airports in the affected areas, which managing agents should consider in assessing their potential exposures. They should also have regard to exposures in smaller airports that fall within the footprint of the event.

Airport	County
Charleston International Airport (CHS)	Charleston
Greenville - Spartanburg International Airport (GSP)	Greenville

Table 8

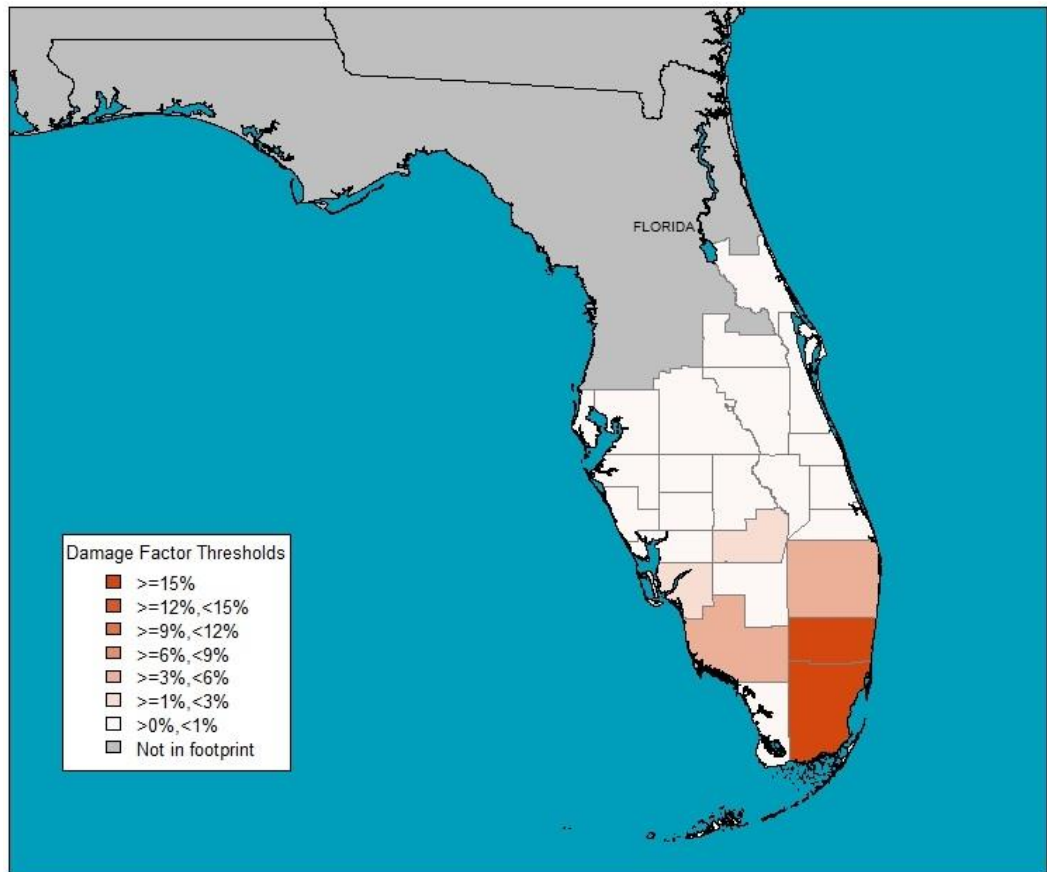
3 Florida windstorm: Miami Dade

3.1 Event definition

A Florida Windstorm landing in Miami-Dade County, including storm surge and demand surge.

3.1.1 Event footprint

Map 3 illustrates the event footprint and combined damage levels for the Miami-Dade Windstorm Event, which are detailed in the 2019 RDS Damage Factors available from Lloyd's.



Map 3

3.1.2 Industry Loss Level

This event results in an estimated Industry Property Loss of USD 131bn including consideration for storm surge and demand surge. Managing agents should assume the following components of the loss: -

Residential Property	\$66.00bn
Commercial Property	\$65.00bn
Auto	\$2.25bn
Marine	\$1.00bn

Table 9

Managing agents should consider all other lines of business that would be affected by the event. Particular consideration should be given to losses arising from:

- 1) Specie/Fine Art
- 2) Personal Accident
- 3) Aviation
- 4) Liability
- 5) Cancellation

3.1.3 Exclusion of Contingent Business Interruption Losses

Lloyd's recognises the difficulties involved in modelling losses from Contingent Business Interruption (CBI) covers. Managing agents should therefore exclude CBI losses from this event.

3.2 Exposure information

3.2.1 Major ports

Table 10 lists the main ports in Florida, which managing agents should consider in assessing their potential exposures.

They should also have regard to exposures in smaller ports that fall within the footprint of the events.

Port	County
Jacksonville	Duval
Miami	Miami-Dade
Palm Beach	Palm Beach
Port Canaveral	Brevard
Port Everglades	Broward
Port Manatee	Manatee
Tampa	Hillsborough

Table 10

3.2.2 Major airports

Table 11 lists the main international airports in Florida, which managing agents should consider in assessing their potential exposures.

They should also have regard to exposures in smaller airports that fall within the footprint of the events.

Airport	County
Fort Lauderdale/Hollywood	Broward
Miami	Miami-Dade
Orlando	Orange
Tampa	Hillsborough

Table 11

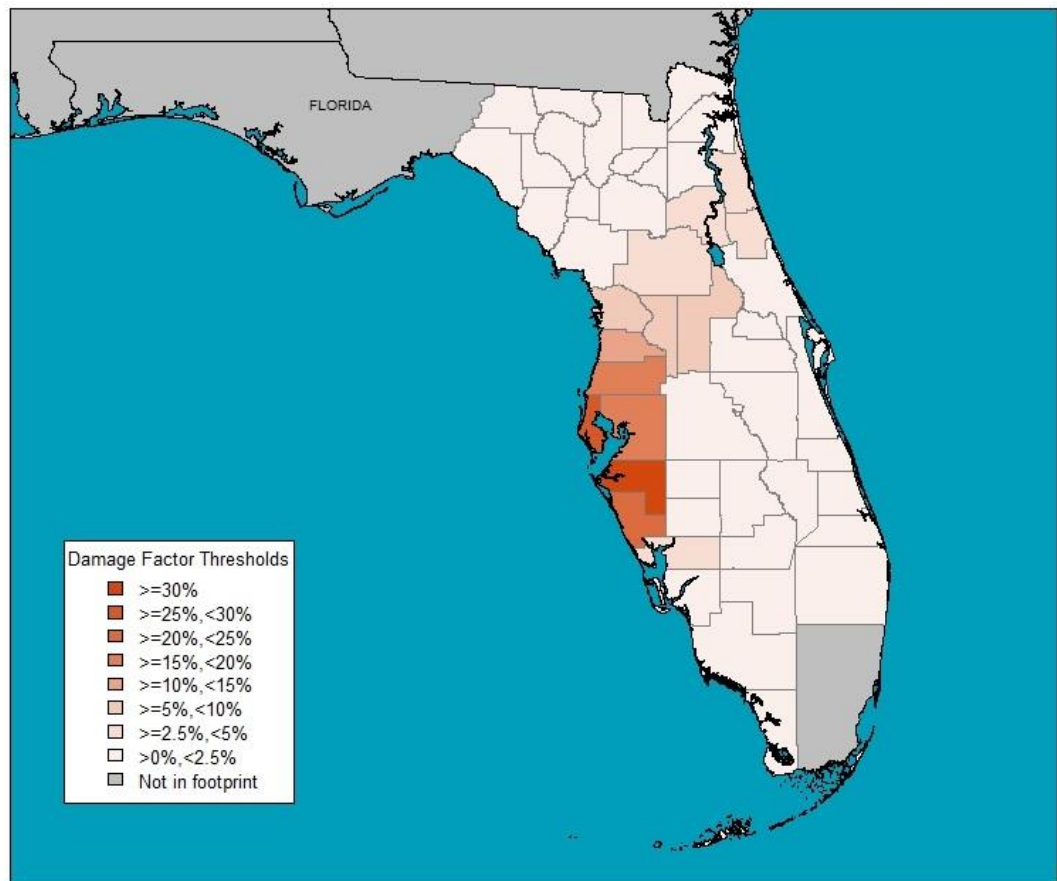
4 Florida windstorm: Pinellas

4.1 Event definition

A Florida Windstorm landing in Pinellas County, including storm surge and demand surge.

4.1.1 Event footprint

Map 4 illustrates the footprint and combined damage levels for the Pinellas Windstorm Event, which are detailed in the 2019 RDS Damage Factors that are available from Lloyd's.



Map 4

4.1.2 Industry Loss Levels

This event results in an estimated Industry Property Loss of USD 134bn, including consideration for storm surge and demand surge. Managing agents should assume the following components of the loss: -

Residential Property	\$94.5bn
Commercial Property	\$39.5bn
Auto	\$2.00bn
Marine	\$1.00bn

Table 12

Managing agents should consider all other lines of business that would be affected by the event. Particular consideration should be given to losses arising from:

- 1) Specie/Fine Art
- 2) Personal Accident
- 3) Aviation
- 4) Liability
- 5) Cancellation

4.1.3 Exclusion of Contingent Business Interruption Losses

Lloyd's recognises the difficulties involved in modelling losses from Contingent Business Interruption (CBI) covers. Managing agents should therefore exclude CBI losses from this event.

4.2 Exposure information

Please see section 3.2 above.

5 Gulf of Mexico windstorm

5.1 Event definition

A Gulf of Mexico hurricane resulting in: -

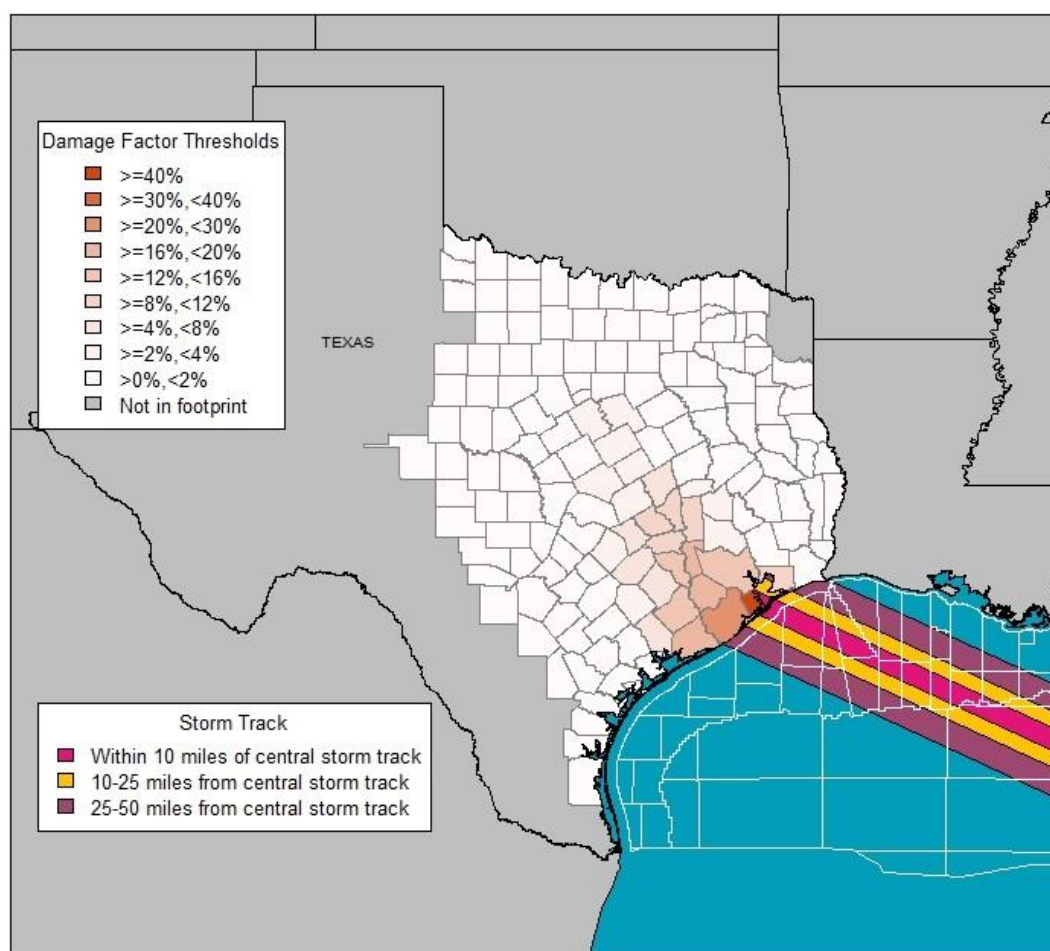
- mainland property losses including the consideration of demand surge and storm surge; and
- offshore energy insured losses.

Managing agents should return a single combined loss (onshore and offshore) for this scenario.

5.2 Offshore component

5.2.1 Storm track

Map 5 below illustrates the damage track of the windstorm in the Gulf of Mexico.



Map 5

Position of centre of damage track: -

Start	Latitude 25° 50' 30.8401" North	Longitude 86° 00' 50.0400" West
End	Latitude 30° 52' 53.7600" North	Longitude 98° 43' 16.3200" West

Table 13

5.2.2 Industry Loss Levels - offshore

This event results in offshore energy insured loss of USD7.1bn (estimated USD17bn insurable loss).

5.3 Onshore component

5.3.1 Storm track - onshore

The map in section 5.2 highlights the footprint and combined damage levels for the onshore component of the affected counties. These damage levels are detailed in the Event Damage Factor Tables that are available from Lloyd's.

5.3.2 Industry Loss Levels - onshore

This event results in onshore insured loss of USD111bn including consideration of storm surge and demand surge. Managing agents should assume the following components of the loss: -

Residential Property	\$67.5bn
Commercial Property	\$43.5bn
Auto	\$1.00bn
Marine	\$1.00bn

Table 14

Managing agents should consider all other lines of business that would be affected by the event. Particular consideration should be given to losses arising from:

- 1) Specie/Fine Art
- 2) Personal Accident
- 3) Aviation
- 4) Liability
- 5) Cancellation

5.3.3 Exclusion of Contingent Business Interruption Losses

Lloyd's recognises the difficulties involved in modelling losses from Contingent Business Interruption (CBI) covers. Managing agents should therefore exclude CBI losses from this event.

5.4 Exposure information

5.4.1 Major Ports

Table 15 lists the main ports in Texas that would be affected by the windstorm, which managing agents should consider in assessing syndicate potential exposures. They should also have regard to exposures in smaller ports that fall within the footprint of the event.

Port	County
Beaumont	Jefferson
Freeport	Brazoria
Galveston	Galveston
Houston	Harris
Matagorda Ship Channel	Calhoun
Orange	Orange
Port Arthur	Jefferson
Texas City	Galveston
Victoria	Victoria

Table15

5.4.2 Major Airports

Table 16 lists the main airports in Texas that would be affected by the windstorm, which managing agents should consider in assessing their potential exposures. They should also have regard to exposures in smaller airports that fall within the footprint of the event.

Airport	County
Brazoria County	Brazoria
Clover Field	Brazoria
David Wayne Hooks Memorial	Harris
Easterwood Field	Brazos
Ellington Field	Harris
George Bush Intercontinental	Harris
Killeen Municipal	Bell
Robert Gray Army Air Field	Bell
Salaika Aviation	Brazoria
Scholes International	Galveston
Southeast Texas Regional	Jefferson
Sugar Land Municipal	Fort Bend
Victoria Regional	Victoria
Waco Regional	Mclennan
William P. Hobby	Harris

Table 16

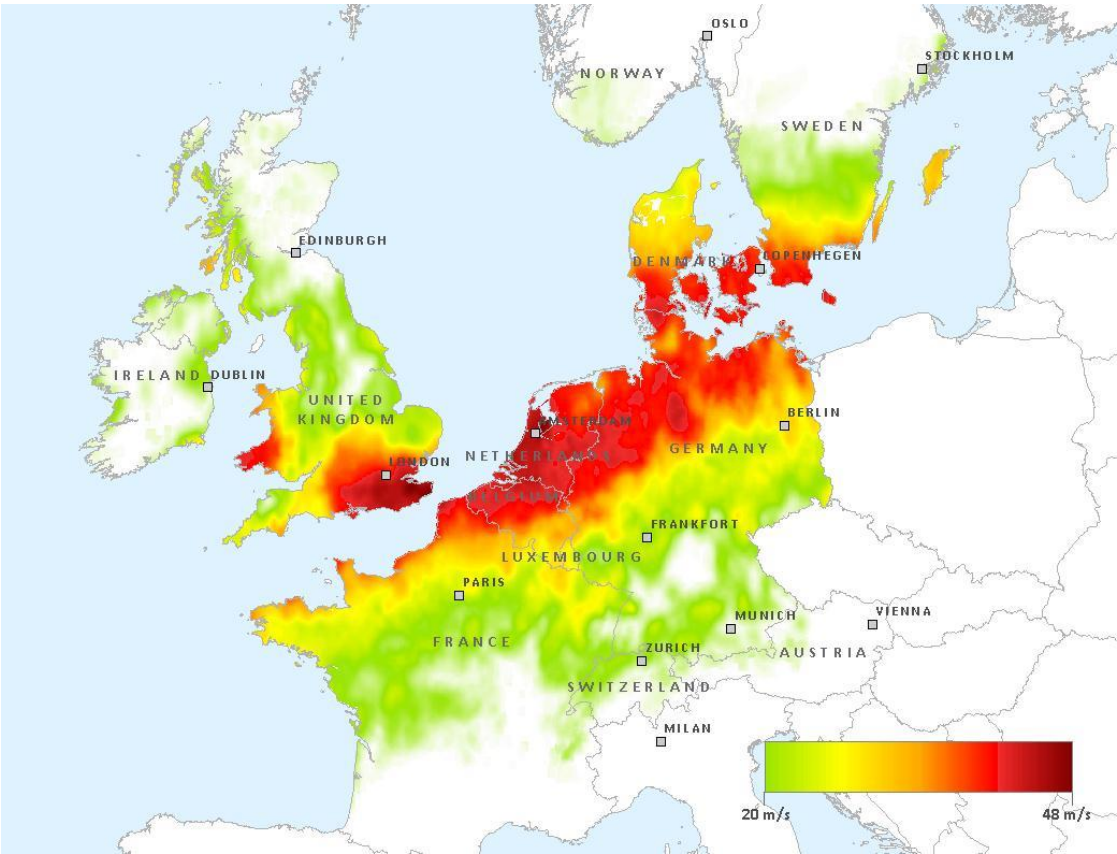
6 European Windstorm

6.1 Event definition

This event is based upon a low-pressure track originating in the North Atlantic basin resulting in an intense windstorm with maximum/peak gust wind speeds in excess of 20 metres per second (45 mph or 39 knots). The strongest winds occur to the south of the storm track, resulting in a broad swath of damage across southern England, northern France, Belgium, Netherlands, Germany and Denmark.

6.1.1 Storm track

Map 6 illustrates the windstorm track and affected regions (image courtesy of AIR Worldwide).



Map 6

6.1.2 Industry Loss Levels

This event results in an estimated Industry Property Loss of €24bn. Managing agents should assume the following components of the loss: -

Residential Property	€16.00bn
Commercial Property	€6.5bn
Agricultural	€1.50bn
Auto	€0.75bn
Marine	€0.40bn

Table 17

Managing agents should consider all other lines of business that would be affected by the event, including: -

- 1) Specie/Fine Art
- 2) Personal Accident
- 3) Aviation
- 4) Liability

6.2 Exposure information

6.2.1 Property value distribution

Tables outlining Lloyd's assumptions for the distribution of property values for this event are listed in the 2019 RDS Damage Factors that are available from Lloyd's.

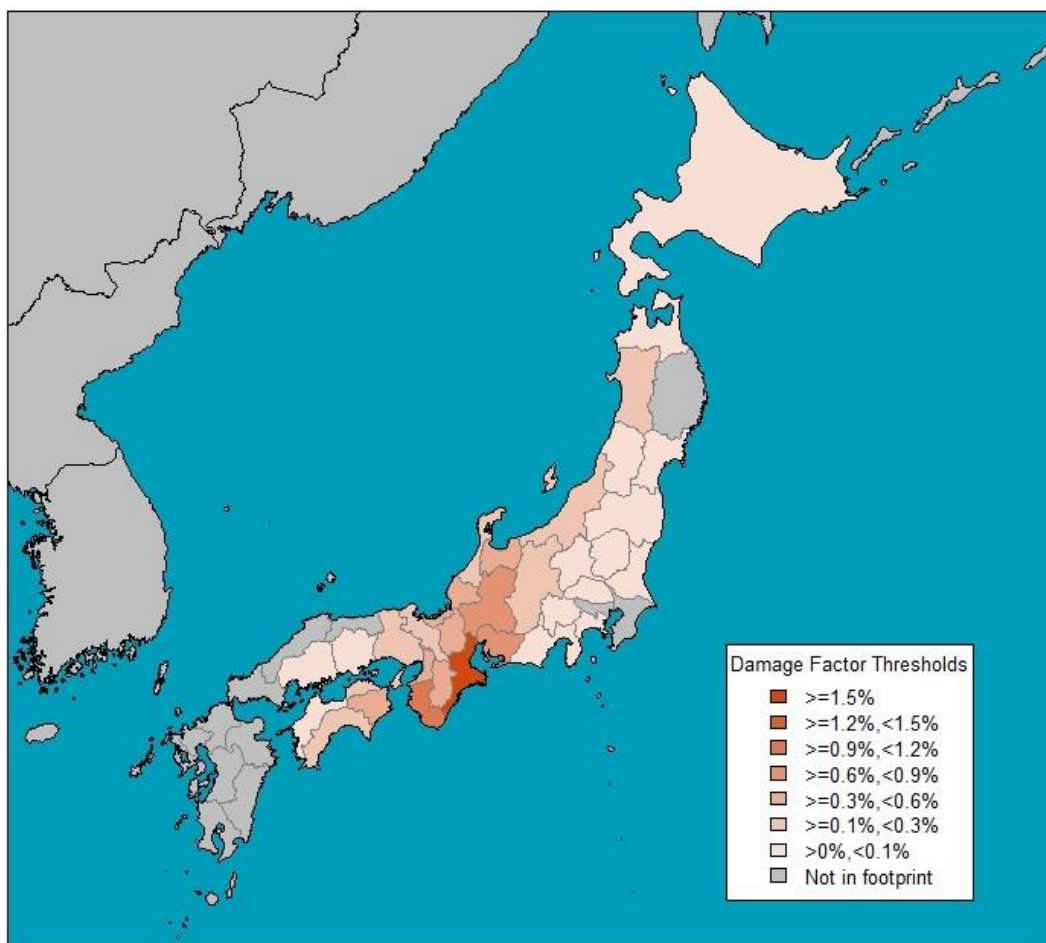
7 Japanese typhoon

7.1 Event definition

This event is based on the Isewan ('Vera') typhoon event of 1959.

7.1.1 Storm track

Map 7 highlights the footprint and residential ground-up damage levels for the Japanese typhoon event. These damage levels are detailed in the Event Damage Factor Tables that are available from Lloyd's.



Map 7

7.1.2 Industry Loss Levels

This event results in a present-day Industry Property Loss estimate of ¥1.7trn. Managing agents should assume the following components of the loss: -

Residential Property	¥750bn
Commercial Property	¥950bn
Marine	¥50bn

Table 18

Managing agents should consider all other lines of business that would be affected by the event, including particularly: -

- 1) Specie/Fine Art
- 2) Personal Accident
- 3) Aviation
- 4) Liability
- 5) Marine

7.2 Exposure information

7.2.1 Property value distribution

Lloyd's assumptions for the distribution of property values at prefecture level are detailed in the 2019 RDS Damage Factors that are available from Lloyd's.

7.2.2 Major Ports

Table 19 below lists the main Japanese ports in the Typhoon Isewan (Vera) footprint, which managing agents should consider in assessing syndicate potential exposures. They should also have regard to exposures in smaller ports that fall within the footprint of the event.

Port
Chiba Port
Nagoya Port
Yokohama Port
Kawasaki Port
Mitushima Port
Kitakyushu Port
Tokyo Port
Osaka Port
Tomakomai Port
Kobe Port

Table 19

7.2.3 Major Airports

Table 20 lists the main international and domestic airports potentially impacted by the Typhoon, which managing agents should consider in assessing syndicate potential exposures.

Airport
Narita International Airport
Central Japan International Airport
Kansai International Airport
Tokyo International Airport
Osaka International Airport

Table 20

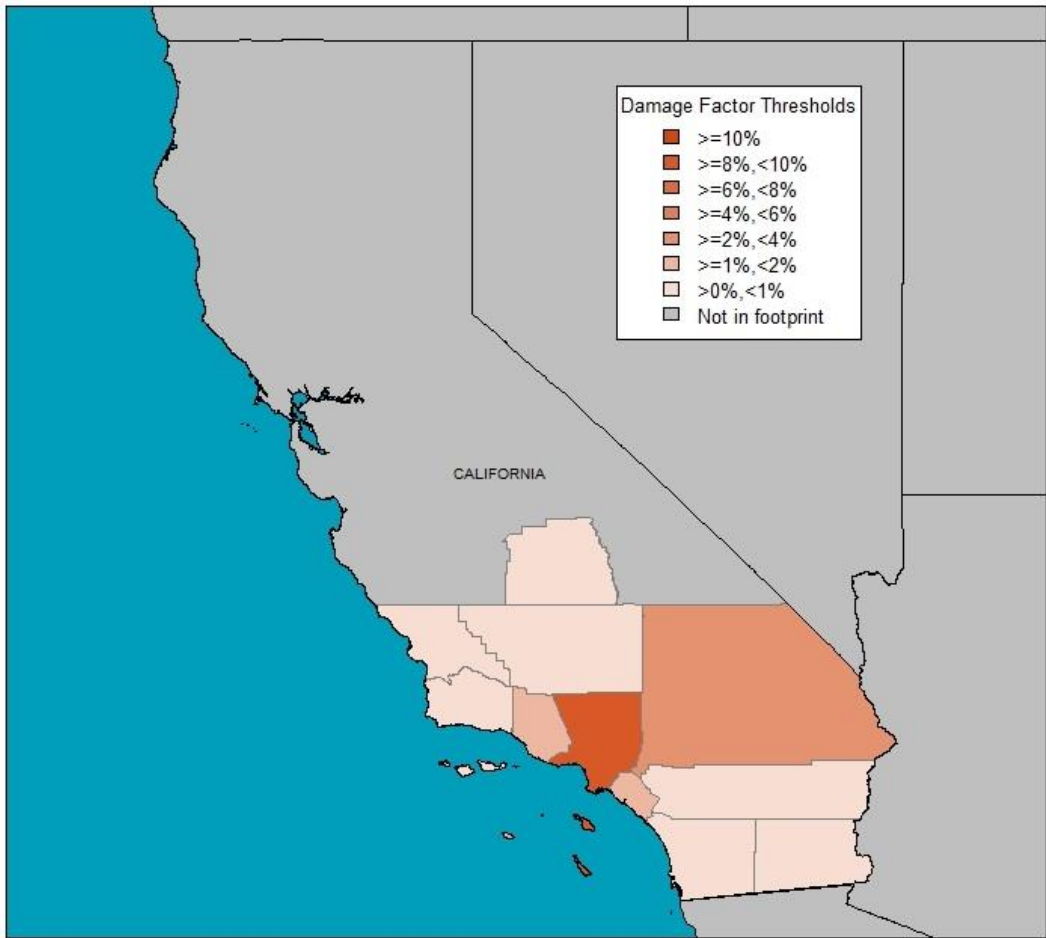
8 California Earthquake: Los Angeles

8.1 Event definition

An earthquake causing major damage to Los Angeles from shake and fire-following, gross of take-up rates and including consideration of demand surge.

8.1.1 Event footprint

Map 8 illustrates the footprint and residential, ground-up shake damage levels for the Los Angeles earthquake event.



Map 8

8.1.2 Industry Loss Levels

This event results in an estimated USD78bn Industry Property Loss (shake and fire following), *after* taking into account take-up rates but *before* applying policy terms. Demand surge is included. Managing agents should assume the following components of the loss:

Residential Property	\$36.00bn
Commercial Property	\$42.00bn
Workers Compensation	\$5.50bn
Marine	\$2.25bn
Personal Accident	\$1.00bn
Auto	\$1.00bn

Table 21

Managing agents should consider all other lines of business that would be affected by the event. Particular consideration should be given to losses arising from:

- 1) Specie/Fine Art
- 2) Liability
- 3) Cancellation
- 4) PA and WCA losses – it should be assumed that there will be 2,000 deaths and 20,000 injuries as a result of the earthquake. Managing agents should assume that 50% of those injured will have PA cover.
- 5) Estimation of Aviation Hull losses – Lloyd's has commissioned research that indicates that minimal Aviation Hull losses would be expected to arise from an earthquake. Managing agents should take account of these findings in calculating syndicate loss estimates.

8.1.3 Exclusion of Contingent Business Interruption Losses

Lloyd's recognises the difficulties involved in modelling losses from Contingent Business Interruption (CBI) covers. Managing agents should therefore exclude CBI losses from this event.

8.2 Exposure information

8.2.1 Property value distribution

Lloyd's assumptions for the distribution of property values are detailed in the 2019 RDS Damage Factors spreadsheet available from Lloyd's.

8.2.2 Major Ports

Table 22 lists the main ports in California, which managing agents should consider in assessing their potential exposures. They should also give regard to exposures in smaller ports that fall within the footprint of the events.

Port	County
Long Beach	Orange
Los Angeles	Los Angeles
Oakland	Alameda
Port Hueneme	Ventura
Richmond	Contra Costa
San Diego	San Diego
San Francisco	San Francisco
Stockton	San Joaquin

Table 22

8.2.3 Major Airports

Table 23 lists the main international airports in California, which managing agents should consider in assessing their potential exposures. They should also have regards to exposures in smaller airports that fall within the footprint of the events.

Airport	County
Los Angeles (LAX)	Los Angeles
San Diego-Lindbergh (SAN)	San Diego
San Francisco (SFO)	San Francisco
San Jose (SJC)	San Jose

Table 23

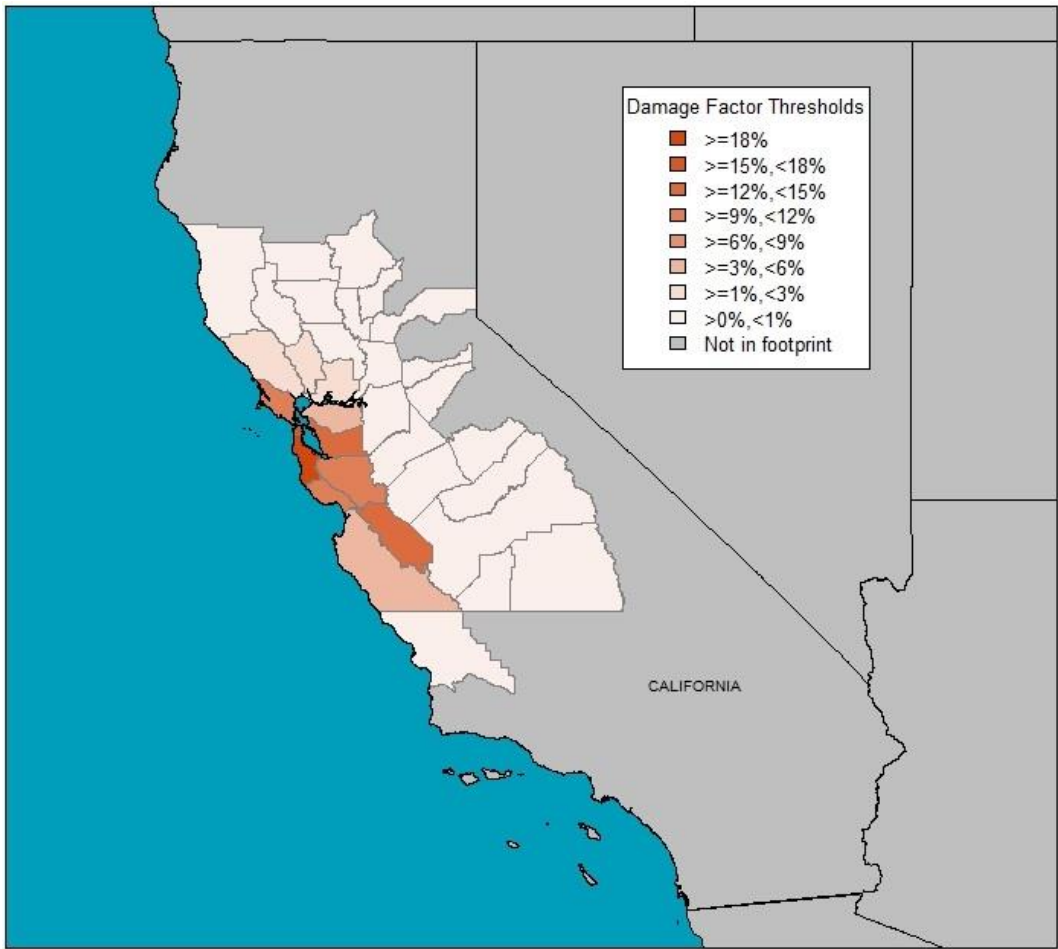
9 California Earthquake: San Francisco

9.1 Event definition

An earthquake causing major damage to San Francisco, from shake and fire-following, gross of take-up rates and including consideration of demand surge.

9.1.1 Event footprint

Map 9 illustrates the footprint and residential, ground-up shake damage levels for the San Francisco earthquake event.



Map 9

9.1.2 Industry Loss Levels

This event results in an estimated USD80bn Industry Property Loss (shake and fire following), *after* taking into account take-up rates but *before* applying policy terms. Demand surge is included. Managing agents should assume the following components of the loss:

Residential Property	\$40.00bn
Commercial Property	\$40.00bn
Workers Compensation	\$5.50bn
Marine	\$2.25bn
Personal Accident	\$1.00bn
Auto	\$1.00bn

Table 24

Managing agents should consider all other lines of business that would be affected by the event. Particular consideration should be given to losses arising from:

- 1) Specie/Fine Art
- 2) Liability
- 3) Cancellation
- 4) PA and WCA losses – it should be assumed that there will be 2,000 deaths and 20,000 injuries as a result of the earthquake. Managing agents should assume that 50% of those injured will have PA cover.
- 5) Estimation of Aviation Hull losses – Lloyd's has commissioned research that indicates that minimal Aviation Hull losses would be expected to arise from an earthquake. Managing agents should take account of these findings in calculating syndicate loss estimates.

9.1.3 Exclusion of Contingent Business Interruption Losses

Lloyd's recognises the difficulties involved in modelling losses from Contingent Business Interruption (CBI) covers. Managing agents should therefore exclude CBI losses from this event.

9.2 Exposure information

See section 8.2.

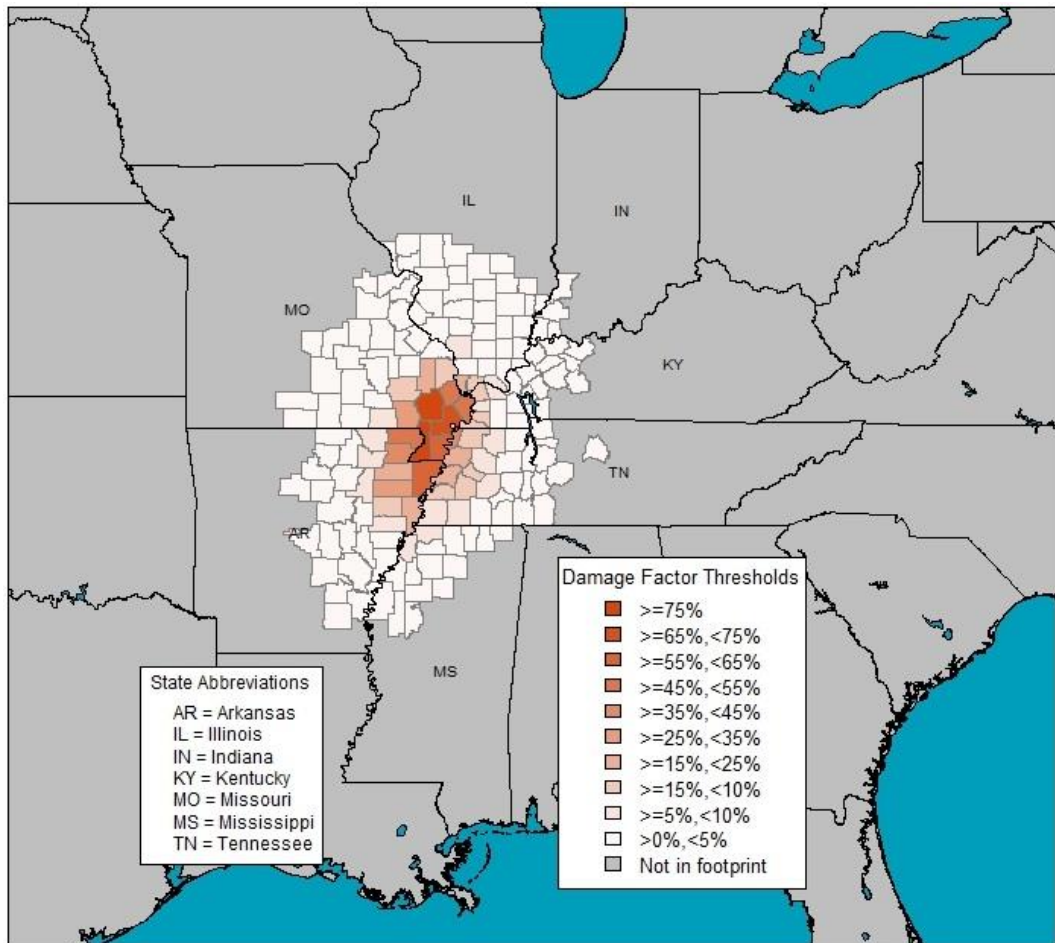
10 New Madrid earthquake

10.1 Event definition

An earthquake causing major damage within the New Madrid Seismic Zone ('NMSZ'), from shake and fire-following, gross of take-up rates and including consideration of demand surge.

10.1.1 Event footprint

Map 10 illustrates the footprint and residential, ground-up shake damage levels for the New Madrid earthquake event.



Map 10

10.1.2 Industry Loss Levels

This event results in an estimated USD44bn Industry Property Loss (shake and fire following), *after* taking into account take-up rates but *before* applying policy terms. Demand surge is included. Managing agents should assume the following components of the loss:

Residential Property	\$30.50bn
Commercial Property	\$13.50bn
Workers Compensation	\$2.50bn
Marine	\$1.50bn
Personal Accident	\$0.50bn
Auto	\$0.50bn

Table 25

Managing agents should consider all other lines of business that would be affected by the event. Particular consideration should be given to losses arising from:

- 1) Specie/Fine Art
- 2) Liability
- 3) Cancellation
- 4) PA and WCA – it should be assumed that there will be 1,000 deaths and 10,000 injuries as a result of this earthquake. Managing agents should assume that 50% of those injured will have PA cover.
- 5) Aviation – Lloyd's has commissioned research that indicates that minimal Aviation Hull losses would be expected to arise from an earthquake. Managing agents should take account of these findings in calculating syndicate loss estimates.
- 6) Business Interruption – overland transport systems are severely damaged and business impacted, leading to significant business interruption exposure for a period of 30 days. This is restricted to the inner zone of maximum earthquake intensities (highlighted on the event footprint).

10.2 Exposure information

10.2.1 Property value distribution

Lloyd's assumptions for the distribution of property values are detailed in the 2019 RDS Damage Factors spreadsheet available from Lloyd's.

10.2.2 Major Ports

Table 26 lists the main ports in the NMSZ, which managing agents should consider in assessing syndicate potential exposures. They should also have regard to exposures in smaller ports that fall within the footprint of the events.

Port	County	State
Pascagoula	Jackson	Mississippi
Gulfport	Harrison	Mississippi
South Louisiana	St John the Baptist	Mississippi
Baton Rouge	West Baton Rouge	Louisiana
Mobile	Mobile	Alabama
Memphis	Shelby	Tennessee
St. Louis	St Louis	Missouri

Table 26

10.2.3 Major Airports

Table 27 lists the main domestic and international airports in the NMSZ, which managing agents should consider in assessing syndicate potential exposures. They should also have regard to exposures in smaller ports that fall within the footprint of the events.

Airport	County	State
Jonesboro Municipal	Craighead	Arkansas
Cape Girardeau Regional	Scott	Missouri
Barkley Regional	McCracken	Kentucky
McKellar-Sipes Regional	Madison	Tennessee
Memphis International	Shelby	Tennessee
Lambert-St Louis International	Saint Louis	Missouri

Table 27

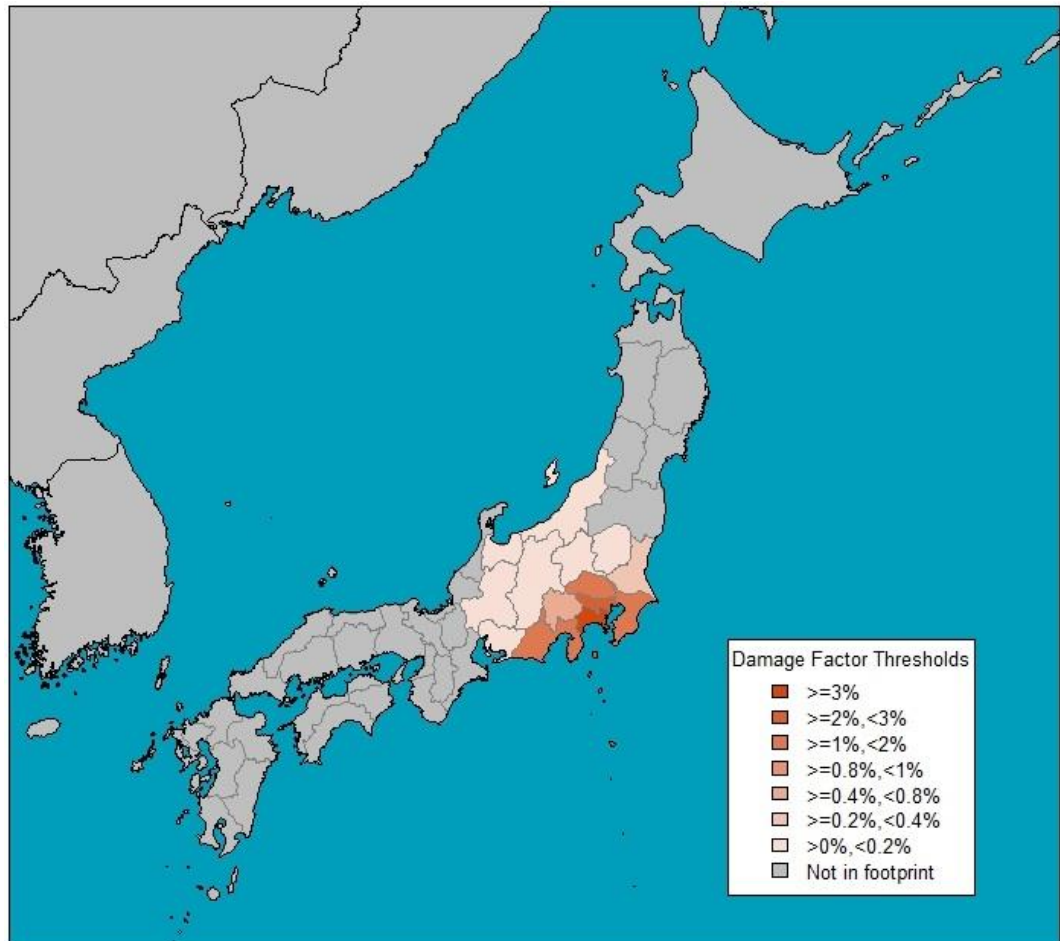
11 Japanese earthquake

11.1 Event definition

This event is based on the Great Kanto earthquake of 1923.

11.1.1 Event footprint

Map 11 illustrates the footprint and residential, shake only damage levels for Japan, which are detailed in the Event Damage Factor Tables that are available from Lloyd's.



Map 11

11.1.2 Industry Loss Levels

This event results in a present-day Industry Property Loss estimate of ¥8trn. Managing agents should assume the following components of the loss:-

Residential Property	¥2.5trn
Commercial Property	¥5.5trn
Marine	¥150bn
Personal Accident	¥50bn

Table 28

Managing agents should consider all other lines of business that would be affected by the event. Particular consideration should be given to losses arising from:

- 1) Personal Accident - it should be assumed that 2,000 deaths and 20,000 injuries will arise as a result of this major earthquake. Assume that 50% of those injured will have PA cover.
- 2) Liability Business
- 3) Aviation - following research undertaken by Lloyd's, managing agents should assume that minimal Aviation Hull losses will arise from an earthquake of this magnitude.
- 4) Business Interruption - overland transport systems are severely damaged and businesses impacted, leading to significant business interruption exposure for a period of 60 days. This is restricted to the inner zone of maximum earthquake intensities (highlighted on Event footprint).

11.2 Exposure information

11.2.1 Property value distribution

Lloyd's assumptions for the distribution of property values at prefecture level are detailed in the 2019 RDS Damage Factors that are available from Lloyd's.

11.2.2 Major Ports

Table 29 lists the main ports in the Great Kanto footprint, which managing agents should consider in assessing syndicate potential exposures. They should also have regard to exposures in smaller ports that fall within the footprint of the event.

Port
Chiba Port
Nagoya Port
Yokohama Port
Kawasaki Port
Mizushima Port
Kitakyushu Port
Tokyo Port
Osaka Port
Tomakomai Port
Kobe Port

Table 29

11.2.3 Major Airports

Table 30 below lists the main international and domestic airports potentially impacted by the Great Kanto earthquake event, which managing agents should consider in assessing syndicate potential exposures. They should also have regard to exposures in smaller airports that fall within the footprint of the event.

Airport
Narita International Airport
Central Japan International Airport
Kansai International Airport
Tokyo International Airport
Osaka International Airport

Table 30

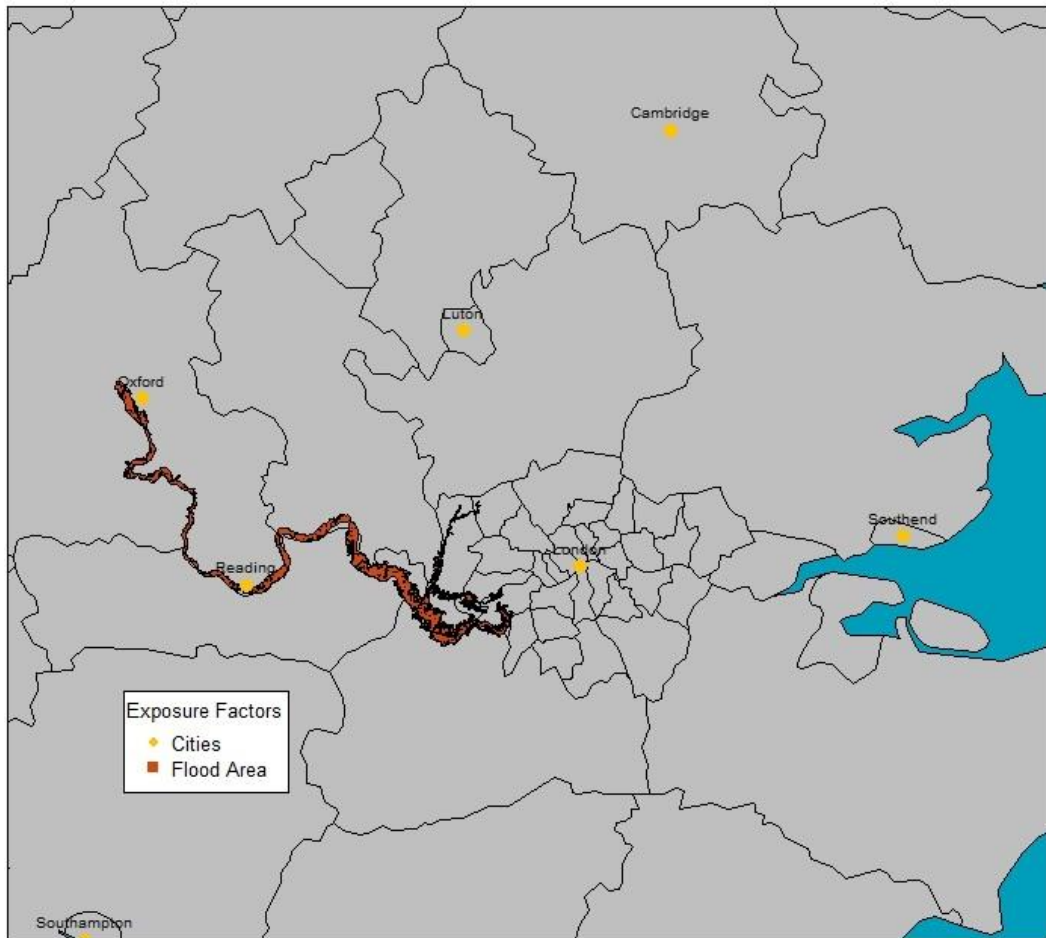
12 UK Flood

12.1 Event definition

This scenario is based on a heavy rainfall event moving from west to east across south east England resulting in extensive flooding of the River Thames from Oxford to Teddington with secondary flooding on the River Colne from Ruislip south and surface flooding on the western and southern edges of Heathrow. The total flood extent covers 194 km² and would cause significant impact on the major populated areas of Oxford, Reading, Slough, and the Henley areas of western London.

12.1.1 Event footprint

Map 12 illustrates the flood footprint for the UK flood event.



Map 12

12.1.2 Industry loss levels

This event results in an Industry Property Loss of £6.2bn. Managing agents should assume the following components of the loss:

Residential	£4.50bn
Commercial/Industrial	£1.60bn
Agriculture	£0.05bn
Motor	£0.05bn

Table 31

Managing agents should also consider other lines of business that may be affected by the event. Particular consideration should be given to the potential for losses arising from:

- 1) Cargo
- 2) Specie/Fine Art
- 3) Cancellation (Event \ Travel)

12.1.3 Event duration

Managing agents should assume that the flood event will not exceed 168 hours.

12.2 Other loss characteristics

12.2.1 Major roads

Table 32 lists the major roads within the flood footprint which managing agents should consider in assessing business interruption:

Major Roads
M25
M3
M4
A40
A34
A404
A437
A4180

Table 32

12.2.2 Major rail

Rail disruption will occur between London (Waterloo) and western services towards Oxford, Bristol, and Cardiff. There will be little disruption to the London Underground system except for flooding of Pinner station on the Metropolitan line.

12.2.3 Heathrow airport

Surface flooding will cause disruption to Heathrow Airport with flooding from the west encroaching into Terminal 5 and the end of both runways. Further flooding from the south will affect cargo transit and handling facilities.

12.2.4 Treatment of pollution

Managing agents are advised that pollution may follow the flood event. Although no specific details are provided here, managing agents should consider the impact and operation of Seepage and Pollution exclusions, and consider the impact of pollution as an aggravating factor in residential losses. Managing agents may wish to refer to historical analogues, including the Carlisle floods of 2005. The impact of pollutants should also be considered for indirect losses at London Heathrow airport. Liability associated with potential pollution episodes will be difficult to calculate and as such should not be included in managing agents' assumptions.

12.2.5 Contingent Business Interruption Losses

Wherever possible, managing agents should consider the potential for additional losses from Named Customer/Supplier extensions in respect of policies identified as sustaining direct losses. For the purpose of the RDS, the potential for CBI losses from policies not directly affected by the flood event can be discounted.

13 Terrorism: Rockefeller Center

13.1 Event definition

The Midtown Manhattan area, New York, at 11:00am on 1 January 2019 suffers a 2 tonne bomb blast attack causing:

Zone	Impact Description	Damage Zones	Property Damage	Fire Loss
1	Collapse and fire following	Inner zone, radius 200m	100%	10%
2	Massive debris damage to surrounding properties	400m radius	25%	2.5%
3	Light debris damage to surrounding properties	500m radius	10%	1%

Table 33

Radii measurements are taken from the Rockefeller Center as a reference point.

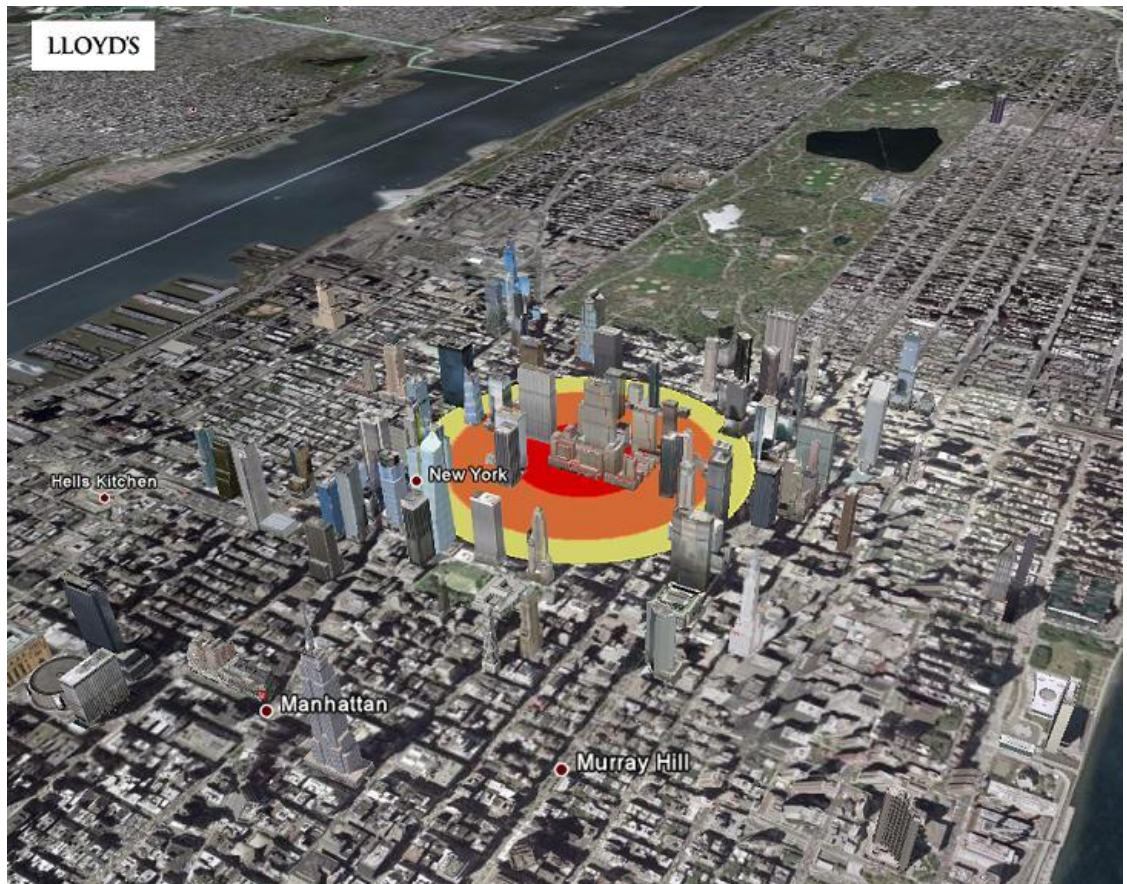


Figure 1

13.2 Loss characteristics

13.2.1 Number of Deaths and Injuries

1,000 blue/white collar worker deaths in total and 2,500 injuries in total. Managing agents to determine a worst case split across lines of business (WCA, PA, Group PA, etc.) and document assumptions using the commentary facility in CMR form 990. The following percentage split should be used for non-fatal injuries:

- 14% life threatening
- 35% moderate
- 51% minor

13.2.2 Business Interruption

Overland/underground transport systems are partially damaged, leading to significant business interruption exposure for a period of three months.

13.2.3 Affected Classes of Business

All possible affected business classes should be included in the calculations, such as Contingent Business Interruption and Specie/Fine Art.

13.2.4 Fire Following

Taking 'Fire Following' into consideration, managing agents should assume the same damage zones with the appropriate Fire Loss percentage applied. Managing agents should assume that all property policies are impacted, given the New York state ruling that property policies cannot exclude fire. Any assumptions concerning Fire-Following Terrorism are to be documented using CMR form 990.

13.2.5 'CBRN' Status

It should be assumed that there are no Chemical, Biological, Radiological or Nuclear hazard exposures arising from these events.

13.2.6 Granularity of Treaty Exposures

Syndicates with low resolution treaty exposure data should use a damage factor based upon claims experience from the World Trade Center attacks of 2001.

14 Terrorism: One World Trade Center

14.1 Event definition

The lower Manhattan area, New York, at 11:00am on 1 January 2019 suffers a 2 tonne bomb blast attack causing:

Zone	Impact Description	Damage Zones	Property Damage	Fire Loss
1	Collapse and fire following	Inner zone, radius 200m	100%	10%
2	Massive debris damage to surrounding properties	400m radius	25%	2.50%
3	Light debris damage to surrounding properties	500m radius	10%	1%

Table 34

Radii measurements are taken from One World Trade Center as a reference point.

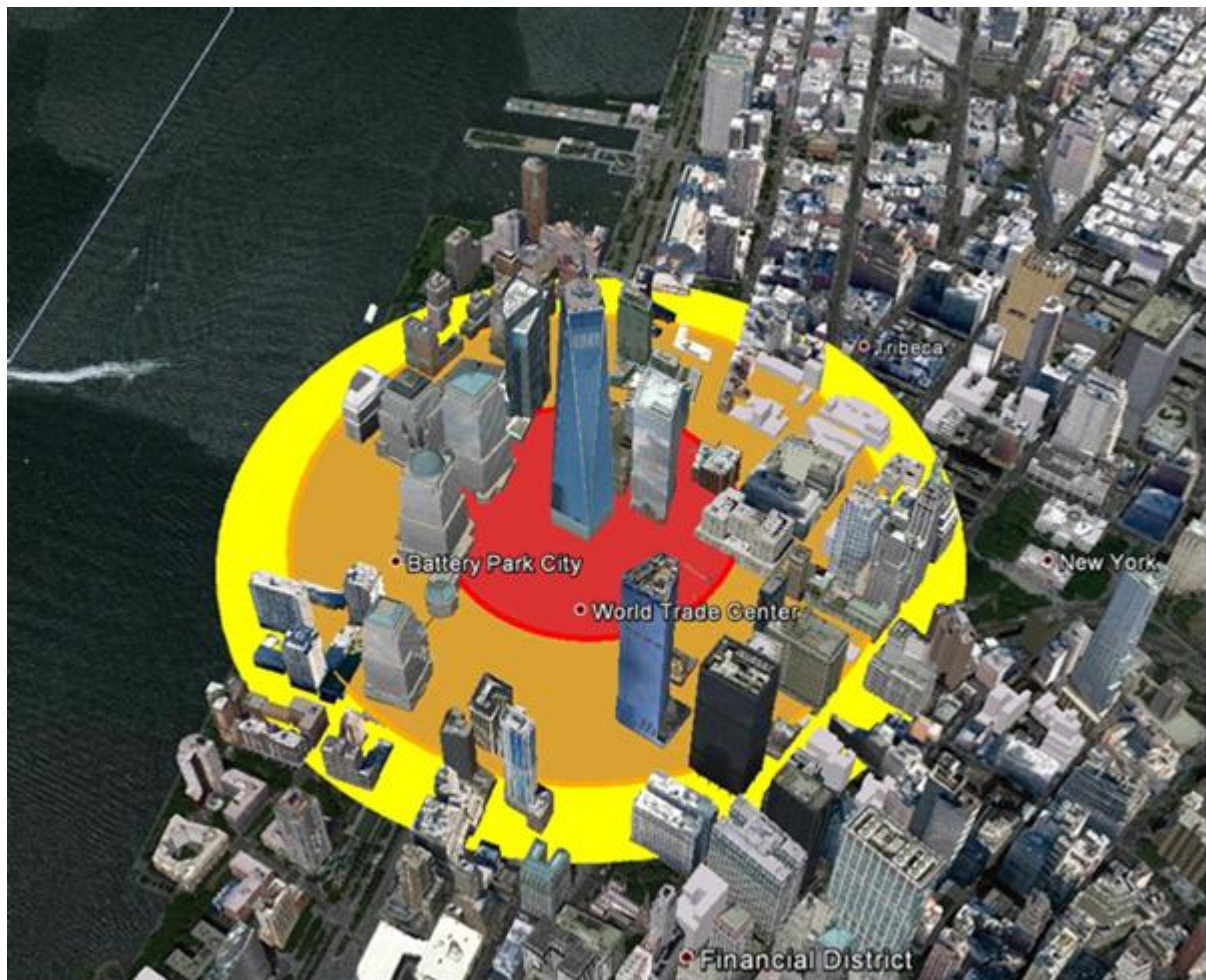


Figure 2

14.2 Loss characteristics

The loss characteristics for this event are the same as for Terrorism: Rockefeller Plaza. Please see section 13.2 above for details.

15 Alternative scenarios A & B

Managing agents should report two further realistic events that represent the most material accumulation risks that are not already covered by compulsory or *de minimis* scenarios.

Examples include:

- 1) Earthquakes other than those occurring in the US (California, New Madrid) and Japan – for example in China, Australia, South America, New Zealand;
- 2) A 'Selby-type' liability loss;
- 3) A major flood incident;
- 4) Accumulation of casualties to members of sports team
- 5) Caribbean/USA hurricane windstorm clash;
- 6) Pandemic risk;
- 7) Terrorism accumulations other than Manhattan;

Scenarios subject to de minimis reporting

16 Marine scenarios

Managing agents should return a marine loss scenario for both of the following incidents. In both scenarios, excess layers of liability, hull and cargo should be included, based on maximum Aggregate exposures.

Please note that for both scenarios, liability costs exceed the coverage afforded by the International Group Programme. Please consider any other covers in force at 1st January 2019 that may be impacted, both Marine and Non-Marine, e.g. Personal Accident and D&O.

16.1 Scenario 1 - Marine Collision in us waters

A cruise vessel carrying 2,000 passengers and 800 staff and crew is involved in a high energy collision with a fully laden tanker of greater than 50,000 DWT with 20 crew.

The incident involves the tanker sinking and spilling its cargo; there are injuries and loss of lives aboard both vessels.

Assume 30% tanker owner/70% cruise vessel apportionment of negligence, and that the collision occurs in US waters.

Assume that the cost of pollution clean-up and compensation fund amounts to USD2bn. This would result in claims against the International Group of P&I Associations' General Excess of Loss Reinsurance Programme, and any other covers that might be in force.

Assume an additional compensation to all passengers and crew for death, injury or other costs of USD1.15bn and removal of wreck for the Tanker of USD100m. The Cruise ship is severely damaged but is towed back to a safe harbour (repair estimate USD50m and USD10m for salvage operations).

16.2 Scenario 2 - Major Cruise Vessel Incident

A US owned cruise vessel carrying 4,000 passengers and 1,500 staff and crew is sunk with attendant loss of life, bodily injury, trauma and loss of possessions.

Assume a final settlement of USD3.2bn for all deaths, injuries and other associated costs. In addition, assume an additional Protection and Indemnity loss of USD1.15bn to cover removal of wreck and USD75m for Pollution.

17 Loss of major complex

Assume a total loss to all platforms and bridge links of a major complex.

Include property damage, removal of wreckage, liabilities, loss of production income and capping of well.

Managing agents should use the commentary facility in form 990 (supplementary scenario information) to name the complex and to provide details of modelling assumptions. Should a mobile drilling rig present potential material exposure to a syndicate, managing agents may wish to report this under the Alternative A or B scenario.

18 Aviation collision

Assume a collision between two aircraft over a major city, anywhere in the world, using the syndicate's two highest airline exposures. Assume a total liability loss of up to USD4bn: comprising up to USD2bn per airline and any balance up to USD1bn from a major product manufacturer's product liability policy(ies) and/or an air traffic control liability policy(ies), where applicable.

Consideration should be given to other exposures on the ground.

Assumptions should be stated clearly using the event commentary facility in form 990.

Managing agents should include the following information in their return;

- 1) the city over which the collision occurs;
- 2) the airlines involved in the collision;
- 3) the airlines policy limits and syndicate's line and exposure per policy;
- 4) maximum hull value per aircraft involved
- 5) maximum liability per aircraft involved
- 6) name of each product manufacturer and the applicable policy limits;
- 7) name of the air traffic control authority and the applicable policy limit.

19 Satellite risks

Managing agents should return satellite loss information relating to the single largest loss from the following events, if this figure produces a loss in excess of the *de-minimis* reporting level.

Managing agents should also consider any other lines of business that would be affected by the following events and in particular exposure under any live satellite third party liability policies that may accumulate.

19.1 Space weather – Solar energetic particle event

19.1.1 Event description

A solar energetic particle event such as a solar flare or coronal mass ejection produces a vast outpouring of protons, electrons and other charged particles which will cause permanent damage to semiconductor devices. This scenario specifically considers the effect of such events on the solar cells of a satellite. A certain number of solar energetic particle events are allowed for in the design of every satellite, but an anomalously large event, such as the Carrington event of 1859, could result in a significant number of satellites simultaneously incurring a reduction in operational capability due to the degradation of the satellite power source.

Satellite age and construction will also determine how an event will affect a particular satellite. However, a single large event (or a number of smaller events in close succession) has the potential to affect all geosynchronous satellites and could result in a loss of power on a majority of satellites.

19.1.2 Loss estimation

For the purposes of this RDS, it should be assumed that either a single anomalously event or a number of events in quick succession results in a loss of power to all satellites in geosynchronous orbit. All live exposures in this orbit will be affected by the proton flare. Managing agents should assume a 5% insurance loss to all affected policies.

The loss under this RDS will therefore be the sum of the following calculation for all live policies covering geosynchronous satellites:

(Insured Satellite Value) x (Loss to Policy)

Therefore, if a syndicate's share of two geosynchronous satellites is USD 10m on the first and USD 8m on a second, the loss to the syndicate would be calculated as:

$(\text{USD } 10,000,000 + \text{USD } 8,000,000) \times 5\% = \text{USD } 900,000$

Managing agents should note that under this RDS, "Total Loss Only" policies, component specific policies and policies not covering power losses will not be triggered.

Frequency: the frequency of this type of scenario is considered to be 1-in-100 years.

19.2 Space weather – Design deficiency

In 1994 two satellites of the same type were severely affected by a large space weather event, subsequently attributed to a design deficiency which made the satellites abnormally sensitive to this particular phenomenon. One of the satellites was ultimately a total loss. In 2010 a similar space weather event led to control of a satellite being lost for a period of eight months before the satellite was recovered.

19.2.1 Event description

For the purposes of this scenario, it should be assumed that a design deficiency leaves a particular geosynchronous satellite type vulnerable to space weather events. Such a deficiency should be assumed to leave the satellite, or component part thereof, prone to the effects of deep di-electric charging, surface charging, electrostatic discharge, total radiation dose or other similar effect which could be triggered by a large solar energetic particle event or related disturbances in the Earth's geomagnetic field. In a disaster scenario it is assumed that an anomalously large space weather event results in four satellites of the same type being declared total losses.

19.2.2 Loss estimation

To calculate the loss under this RDS, managing agents should consider all live policies covering geosynchronous satellites. The four largest lines for each satellite type (from the types listed below) should be summed and the largest of these figures reported as the Space Weather Design Deficiency RDS figure.

The following specific satellite types should be considered individually:

- Astrium Eurostar 3000 (all variants)
- Boeing Space Systems 702 and GEM (all variants)
- Lockheed Martin A2100 (all variants)
- Mitsubishi Electric DS2000 (all variants)
- Orbital Sciences Corporation Star 2 (all variants)
- Space Systems Loral LS1300 (all variants)
- Thales Alenia Space Spacebus 4000 (all variants)

Frequency: the frequency of this type of scenario is considered to be 1-in-50 years.

19.3 Generic defect

Supply chain consolidation means that many Western satellite prime manufacturers purchase subsystem units and component parts from small numbers of suppliers. Traveling wave tube amplifiers, reaction wheels, command receivers, solar cells and batteries are typically available from only two suppliers.

19.3.1 Event description

A generic defect that develops in one of these supplied parts has the potential to affect a number of different satellites. For any satellite commencing coverage in good health with all redundant units and margin intact it is considered that a total loss would be unlikely and a worst case loss of 50% is assumed. The likelihood of such a loss is considered to be directly related to the remaining coverage period of the insurance policy. From past experience with generic defects, it is considered safe to assume that after satellites have been in orbit for five years they have passed the point at which a generic defect is likely to occur. Based on the current build rates of the major manufacturers it is reasonable to assume that a generic defect could affect a maximum of ten satellites.

19.3.2 Loss estimation

For all live policies covering each of the satellite types listed under section 19.2.2 and which have not surpassed the fifth anniversary of their launch date, managing agents should calculate a generic defect loss as follows and sum the ten largest resultant figures:

(Insured Satellite Value) x (Risk Period Factor) x (50% Loss)

The Risk Period Factor should be calculated from the following table:

Period Remaining on Policy	Risk Period Factor
Greater than 24 Months	100%
18 Months – 24 Months	80%
12 Months – 18 Months	60%
6 Months – 12 Months	40%
Less than 6 Months	20%

Table 35

Frequency: the frequency of this type of scenario is considered to be 1-in-20 years.

19.4 Space debris

Space debris poses an increasing threat to satellite assets in all orbits. To date, the only collisions to date have occurred in low Earth orbit [LEO].

A satellite break up or collision in LEO results in the generation of a cloud of debris that progresses, over time, both around the orbit and above and below the orbit. The debris cloud then poses an increased threat for other satellites in LEO. Experience from the Iridium 33 / Cosmos 2252 collision of 2009 illustrated that debris from such a collision could reach up to +/- 200 km from the altitude at which the collision took place. Following a collision, the growth of the debris cloud and the likelihood of further collisions is considered to be directly related to remaining policy period of the insurance coverage provided.

19.4.1 Event description

Considering insured assets in LEO, two groups can be considered. It is considered unlikely that a single event within one of these groups would result in a debris cloud expanding sufficiently to affect the other group. The two groups are as follows:

Group 1: Satellites with orbits in the range of altitudes between 400km and 800km (i.e. +/- 200km of 600km). This group encompasses all of the insured imaging satellites and the Iridium and Orbcomm constellations of communication satellites. All other insured satellites known to orbit within this altitude range should also be included in the RDS calculation.

Group 2: The Globalstar constellation of communication satellites with an altitude of 1400km. All other insured satellites known to orbit within +/-200 km of this altitude should also be included in the RDS calculation.

19.4.2 Loss estimation

For each of these two groups managing agents should sum the result of the following calculation for all satellites on live policies and report the larger of the two figures as the Space Debris RDS:

$(\text{Insured Satellite Value}) \times (\text{Risk Period Factor}) \times (100\% \text{ Loss})$

Risk Period Factor is the same as shown in the table in section 19.3.2 above.

Frequency: the frequency of this type of scenario is considered to be 1-in-15 years.

20 Liability risks

Managing agents should report two internally modelled liability loss scenarios for each syndicate, subject to the *de minimis* criteria. Where exposed to both professional and non-professional lines liability scenarios, one of each type should be reported.

20.1 Professional lines

The following example scenarios are provided to help guide managing agents in considering the type, scale and impact of their internally modelled scenarios.

20.1.1 Mis-selling of a financial product

Any systemic loss arising from the mis-selling of a financial product including the distribution of said financial product through the appropriate channels. This could comprise two distinct sources of liability attributable to: 1) product and 2) distribution channel. Regulatory investigation might be a trigger to this type of systemic loss but would not of itself be the systemic loss.

20.1.2 Failure/Collapse of a Major Corporation

The failure or collapse of a major corporation listed on one or more Global Stock Exchanges.

20.1.3 Failure of a Merger

The failure or collapse of a merger involving one or major corporations listed on any Global Stock Exchange.

20.1.4 Failure of a Construction Project

The failure of a construction project involving all of the syndicate's casualty risk codes (for example, non-marine liability, architects, surveyors and engineers, etc.).

As an example, from the past, the London 2012 Olympics represented a major exposure in terms of potential failure of a large construction project. Problems had affected construction for the Greek Olympics; during 2008 – 2011 it would have been reasonable to assume that a similar scenario could arise for the London Games.

20.1.5 Recession-Related Losses

A managing agent may identify that its syndicate is exposed to a dramatic fall in the housing market, associated with high negative equity, mortgage shortfalls and defaults. It could model syndicate exposures by utilising casualty risk codes, including: Independent Financial Advisors (IFAs), Solicitors, Surveyors, Lenders, Accountants.

Modelled exposures should also consider a rising unemployment rate thus potentially increasing the exposures to Employment Practices Liability underwritten as a standalone product or as part of Directors & Officers Liability policies.

20.2 Non-Professional lines

The following example scenarios are provided to help guide managing agents in considering the type, scale and impact of their internally modelled scenarios:

20.2.1 Industrial/Transport Incident

A managing agent may identify that it has a high potential syndicate exposure to an extreme loss arising from a release of chlorine at an industrial site or from a train travelling through a major city.

The managing agent would develop a physical model of the incident, with assumptions for the area and populations affected, and the effects of the chlorine gas itself. The model should identify the various organisations that would be held liable, including joint ventures and professional advisors that the syndicate covers.

20.2.2 Multiple Public/Products Losses

An agent managing a syndicate with multiple peak exposures may determine that it would be severely impacted by catastrophe losses affecting a multiple number of contracts. Such a scenario would capture the cumulative effect of a number of vertical spikes and the impact on the syndicate's reinsurance programme.

An example of a loss scenario involving multiple products losses arising out of a common cause would be defective hip replacements which could generate a high frequency of relatively large individual payments via a series of class actions.

20.3 Back year deterioration

These scenarios focus on losses arising from events occurring in 2019, and therefore do not attempt to quantify potential exposures from back year deterioration. The issue of reserving adequacy is subject to monitoring and review by colleagues within the Lloyd's Corporation.

21 Cyber - Major data security breach

21.1 Event definition

A series of simultaneous cyber-attacks are launched on large multinational organisations across one industrial sector¹ with the intention of causing major disruption and financial loss to organisations. During the attacks, customer data (e.g. IP, credit card details and other information) is lost.

The attacks target vulnerabilities in the operating systems, web applications and/or software used by these organisations. For the purposes of this exercise it is assumed that multiple systems and/or multiple organisations using the same systems/software are affected.

The hacking attacks may take the form of a virus, or an alternative vector of attack.

For the purposes of this exercise it is assumed that multiple organisations across the world in one sector come under attack at the same time.

As a result of the breach, customer management and trading systems, networks and supply chains are disrupted at these organisations for a duration of 24 hours.

The organisations affected have adopted reasonable network security processes, including anti-virus software and patching.

21.2 Assumptions

Please assume that your ten largest clients (based on exposure to policies including cyber liability) worldwide are targeted, in the one sector where you expect to have the greatest exposure.

Please assume that all client data at these organisations is lost (i.e. assume total losses for your top ten companies). Please assume that class actions are pursued and you will face third party liability claims.

For reinsurance purposes please calculate separately on the basis that these attacks are deemed both as one event and as ten separate events, returning whichever causes the largest net loss.

21.3 Losses

What are your estimated losses (split out) taking into account the following lines of business: -

21.3.1 Cyber losses

- First party loss notification, associated costs and breach management costs, including crisis management
- Business Interruption (excl physical damage)
- Contingent business interruption
- Third party liability losses
- Regulatory defence, legal fees and fines covered amounts
- Other losses

21.3.2 Other losses

- Crime
- E&O policies with cyber endorsements
- Technology E&O
- D&O
- GL / failure to supply
- Other policies that may respond

¹ i.e. relating to any sector you deem relevant, including financial, retail and healthcare

22 Political risks

Managing agents should return Political Risks scenarios that generate losses above the *de minimis* reporting level for the events in the 2019 RDS Political Risk Scenario Specification document.

Lloyd's in conjunction with the LMA Political Risks Panel have agreed that Political Violence (PV) damage factors should only be considered when written in conjunction with exposures under risk codes PR, CF or CR.