

The Bay Area a Hazard-Rich Region

How do we Protect and Provide Resiliency to our Transit Infrastructure?

Brian Cooney – Marsh
James McMillan – Guy Carpenter

June 6, 2019

Marsh & McLennan Companies at a Glance

We are four businesses with one purpose:
Helping our clients meet the challenges of our time



 GUY CARPENTER

 MARSH

 MERCER

 OLIVER WYMAN



Clients in more than
130 countries



Over 75,000
colleagues globally



Combined annual revenue
of **\$17 billion***



One of the **Fortune**
250 companies



148-year history of
leadership and innovation

*Preliminary estimate based on 2018 results

GUY CARPENTER - CONFIDENTIAL

Storm Surge and Earthquake Risks Impact on Transit Infrastructure

- The geography and structure of transit systems—with critical infrastructure located both above and below ground—make them vulnerable to wide range of hazards, including flooding and earthquakes
- Compounded by factors including age of the system, extent of deferred maintenance backlogs, sensitivity of electrical and communications equipment, and stringency of safety standards
- Complex nature of transit system operations mean losses are often magnified by “network effects,” where damages to individual assets can ripple out into crippling system-wide impacts
- Because transit systems are the underpinning of dozens of other economic sectors, major service interruptions can also create cascading disruptions and disproportionate losses throughout a regional economy

Why Governments Look to Insurance

- Frequency and severity of disasters (earthquakes, floods, wildfire) have grown - gap between insured and total economic loss has also grown
- Many governments and public utilities are overexposed and underinsured
 - Often the largest at-risk asset holders in the public sector are not cities, but the **utilities** and **transit authorities** that serve them
- Local leaders are also coping with aging and failing infrastructure systems that increase the potential for cascading failures and devastating losses
(Oroville Dam – Feb. 2017)
- In recent years, governments have begun to use financial instruments such as Cat Bonds, to transfer risks from the public sector to the capital markets
 - low-probability, high-consequence natural disasters, aim is not to limit damages on the ground, but reduce the resulting economic disruption

Hurricane Sandy & The New York City Subway

- New York Metropolitan Transportation Authority (MTA) experienced significant subway flooding during Hurricane Sandy
- Availability of conventional insurance plummeted after Hurricane Sandy
- To address market conditions, MTA issued Cat Bond in 2013 **MetroCat Re** followed by one in 2017, to include earthquake as well as storm surge
- The MTA secured \$200 million Cat Bond at premium costs well below quotes received for traditional property coverage for the same period

Cat Bond Programs Covering Transit Systems

Cat Bond Program (Coverage Area)	Sponsor	Bonds Issued	Annual Coupon Payments
Metro Cat Ltd. (MTA Service Area)	New York MTA	\$125 million	\$4.6 million/yr
PennUnion Re Ltd. (NY, DE, CT, MD, MA, NJ, & RI)	Amtrak	\$275 million	\$12.4 million/yr

Shift from protection centric to strategy emphasizes resilience - critical infrastructure policies need the following

- **All-hazards and threats:** An all-hazards and threats forward-looking approach to critical infrastructure resilience and enables policy makers and operators to better prepare for the unexpected.
- **System-level:** A system approach allows for prioritizing the most critical components, and addresses weak points that create critical vulnerabilities for the entire system.
- **Multi-sectoral coordination:** Operators tend to be well aware of their own dependencies upon critical sectors, they may not be as conscious of the dependencies others have upon their own services.
- **Public-private cooperation:** Resilience depends upon governments partnering with infrastructure operators from the public and private sectors.
- **Entire risk management cycle:** A comprehensive resilience policy should incorporate measures throughout the entire risk management cycle, from risk assessment, to risk prevention, emergency preparedness, response, recovery and reconstruction.
- **Risk-based and layered approach:** A risk-based and layered approach helps account for complex interdependencies, for all-hazards and across the infrastructure life-cycle.

Note: Organization for Economic Cooperation and Development (OECD) “Governance of Critical Infrastructure Resilience”

Seven steps for critical infrastructure resilience policies

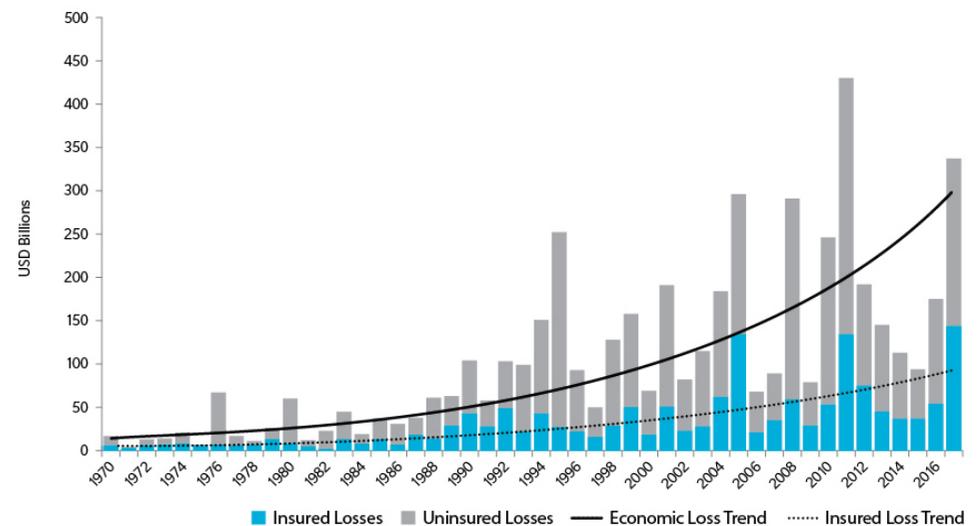
1. Setting up a multi-sector governance structure for critical infrastructure resilience
2. Understanding complex interdependencies and vulnerabilities across infrastructure systems to prioritize resilience efforts
3. Establishing trust between government and operators by securing risk-related information-sharing
4. Building partnerships to agree on a common vision and achievable resilience objectives
5. Defining the policy mix to prioritize cost-effective resilience measures across the life-cycle
6. Ensuring accountability and monitoring implementation of critical infrastructure resilience policies
7. Addressing the transboundary dimension of infrastructure systems

Note: Organization for Economic Cooperation and Development (OECD) “Governance of Critical Infrastructure Resilience”

Leveraging Cat Bonds to Increase Community Resiliency

- Only 33 percent of economic disasters are alleviated through (re)insurance
 - \$2.7 trillion of natural catastrophe losses between 1970 and 2014 were uninsured
 - 1906 SF earthquake occurred today it would create damage of \$400 billion with over \$200 billion in uninsured property losses
 - How do we lessen the protection gap (gap between insured and uninsured losses)?
- Need strong resilient communities; withstand shocks caused by catastrophic events
- Examples of risk transfer mechanisms:
 - **Cal Phoenix Re** (PG&E): August, 2018 catastrophe bond (wildfire)
 - **FloodSmart Re** (FEMA): August 2018 catastrophe bond for NFIP
 - **MetroCat Re** (MTA): July 2013 Metropolitan Transportation Authority \$200 million catastrophe bond protect against the risk of storm surge

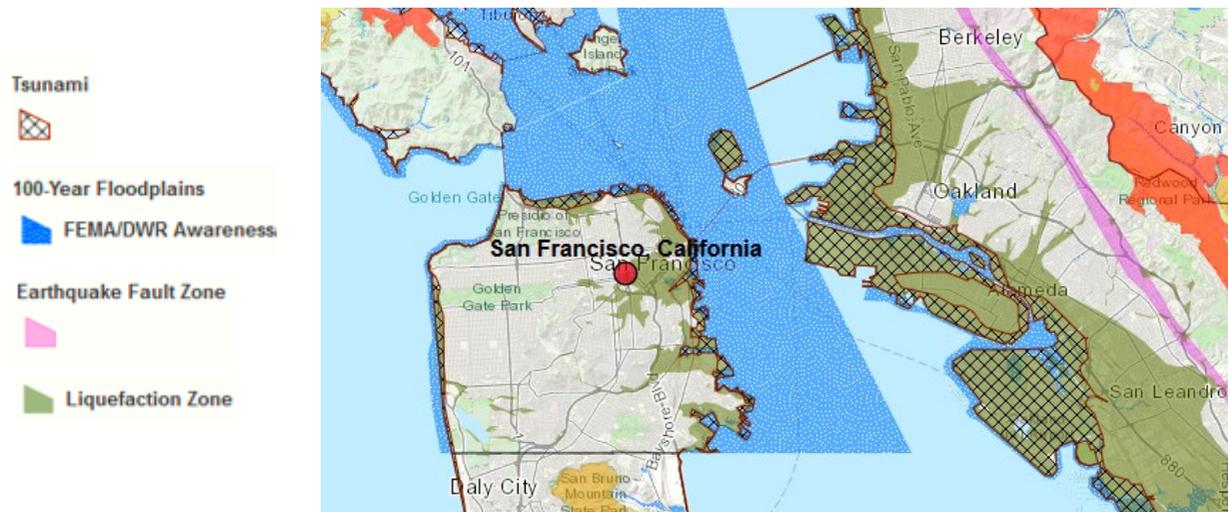
GLOBAL INSURED VERSUS UNINSURED LOSSES, 1970-2017



Source: Swiss Re Institute

Bay Area communities face a range of natural hazards flooding, wildfires, earthquakes, landslides, and drought

- Increase in frequency and intensity of extreme weather events
 - seismic events and higher risk of liquefaction for bay muds and artificial fill
 - longer/drier summer droughts, sea level rise and more frequent and intense wildfires
- Greater than 70% chance at least one major earthquake of magnitude 6.7 or greater will strike somewhere in the Bay Area within the next 25 years



<http://myhazards.caloes.ca.gov/>

- Climate change will exacerbate the effects of natural hazards, amplifying concerns for human health and safety, ecosystem resilience, and economic stability

Earthquake Risk - Liquefaction and urban fire hazard

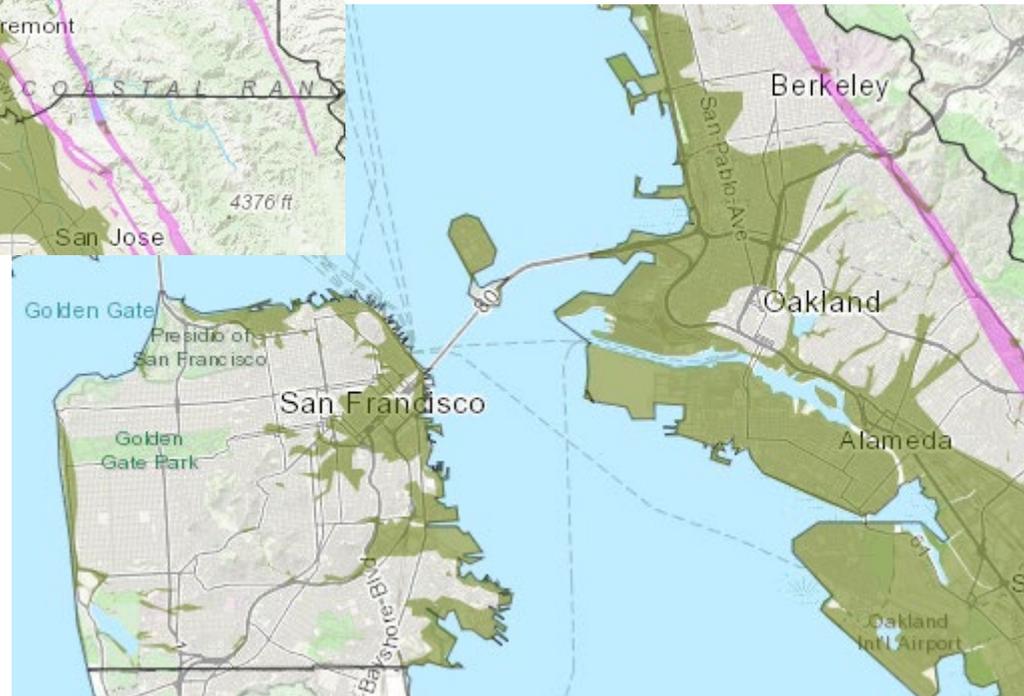


In addition to shaking caused by earthquakes, **landslides**, surface fault ruptures and **liquefaction** – may all cause injury or property damage

1906 - City lost 90% of water supply; fires raged out of control



Loma Prieta, 1989



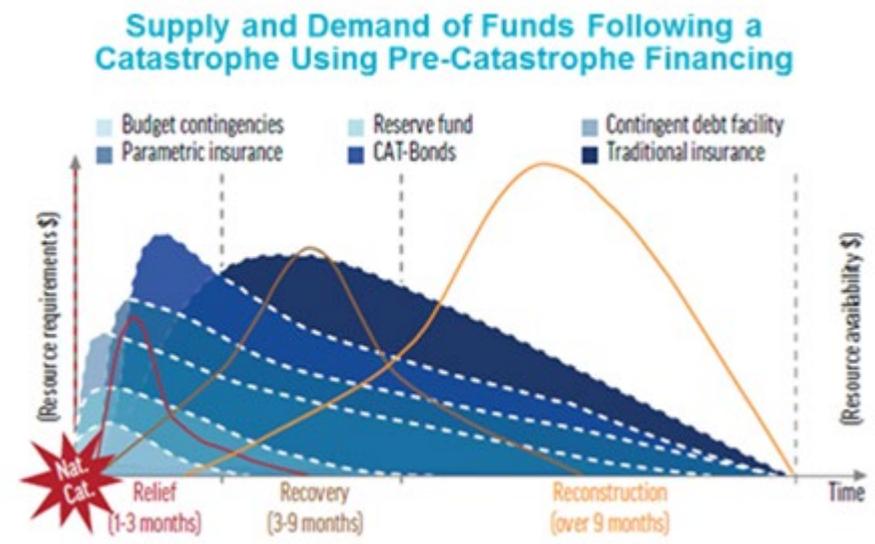
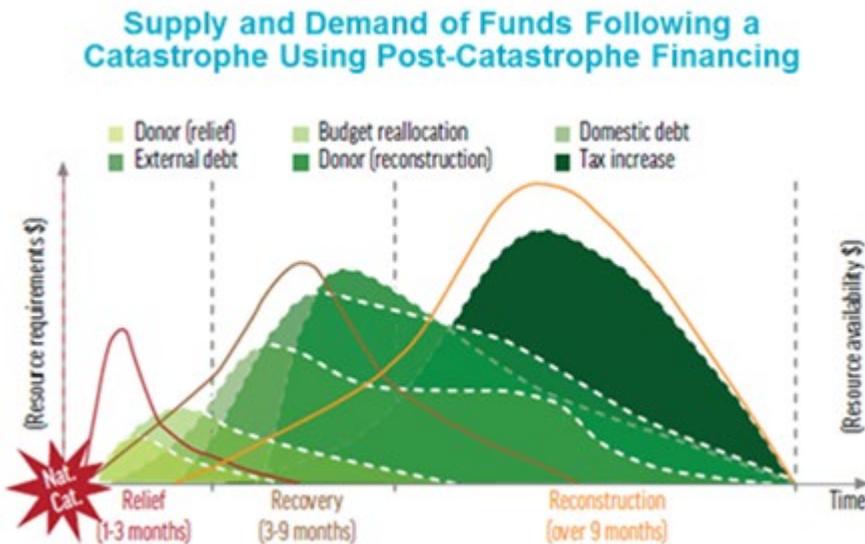
What can be done to ensure a quick response as well as a fast recovery?

- Public Sector Risk Financing Solutions Increase Community Resiliency
 - minimize damage & keep weather hazards from becoming a disaster
 - Public entities can mitigate both financial impact and funding lag associated with major catastrophes by engaging in risk transfer
 - The diverse needs of public entities call for creative solutions which traditional insurance solutions may not always address



What can be done to ensure a quick response as well as a fast recovery?

- A pre-event funded parametric hedge not tied to any particular physical loss makes funds available for reconstruction.
- The charts below show the supply and demand of funds following a catastrophic event using post and pre-catastrophe financing.



Introduction to Insurance Linked Securities (ILS)

Available Triggers; Indemnity is Most Common in Cat Bonds

Trigger Options

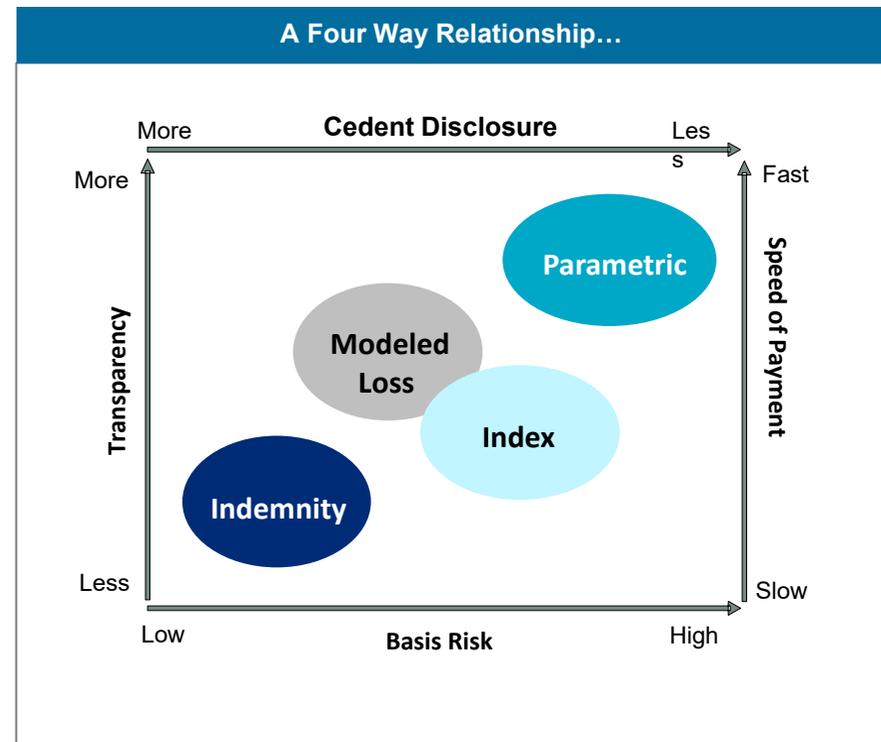
Indemnity Triggered by actual loss of sponsor	Modeled Loss Triggered by modeled results to sponsor portfolio	Index Triggered by industry insured losses	Parametric Triggered by event parameters
---	--	--	--

Basis Risk

- The risk that the reinsurance contract (traditional, cat bond, ILW, etc.) does not perform as desired / anticipated:
 - Negative Basis Risk: sponsor does *not* receive a payment from the reinsurer/investor when claims are large
 - Positive Basis Risk: sponsor receives a payment when losses are below the amount where they need reinsurance coverage capacity

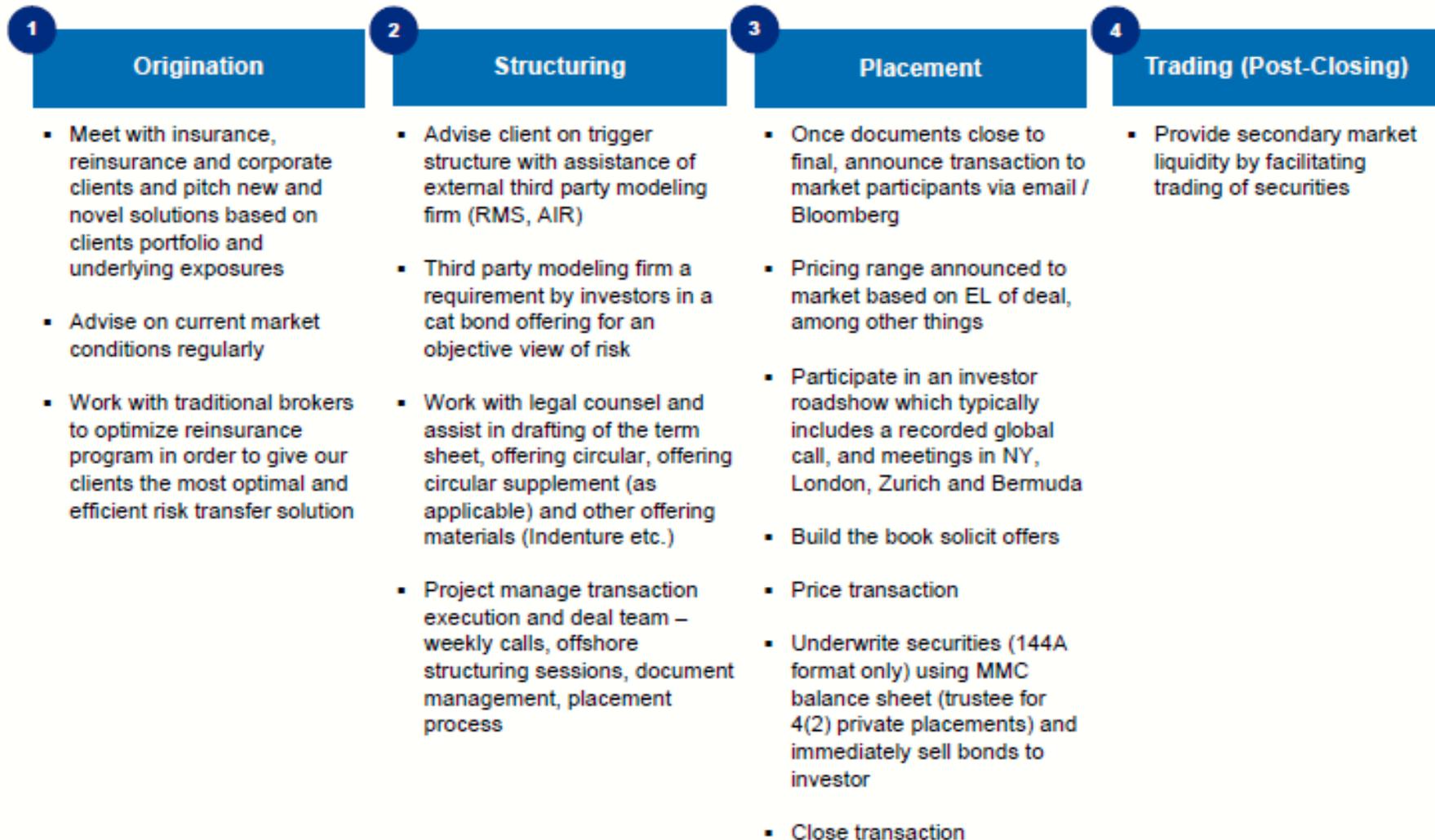
Disclosure / Transparency / Speed of Payment

- Investors need to understand how the protection contract will be triggered:
 - Parametric Trigger: Based on hazard parameters so no other exposure information is disclosed
 - Indemnity Trigger: based on sponsor disclosed losses with more subject business disclosure required
- Investors and sponsors will assess the speed in which a transaction will provide coverage:
 - Parametric Trigger: settles fast as it is only based on triggered of the applicable hazard thresholds
 - Indemnity Trigger: is slower due to claims review and loss assessment



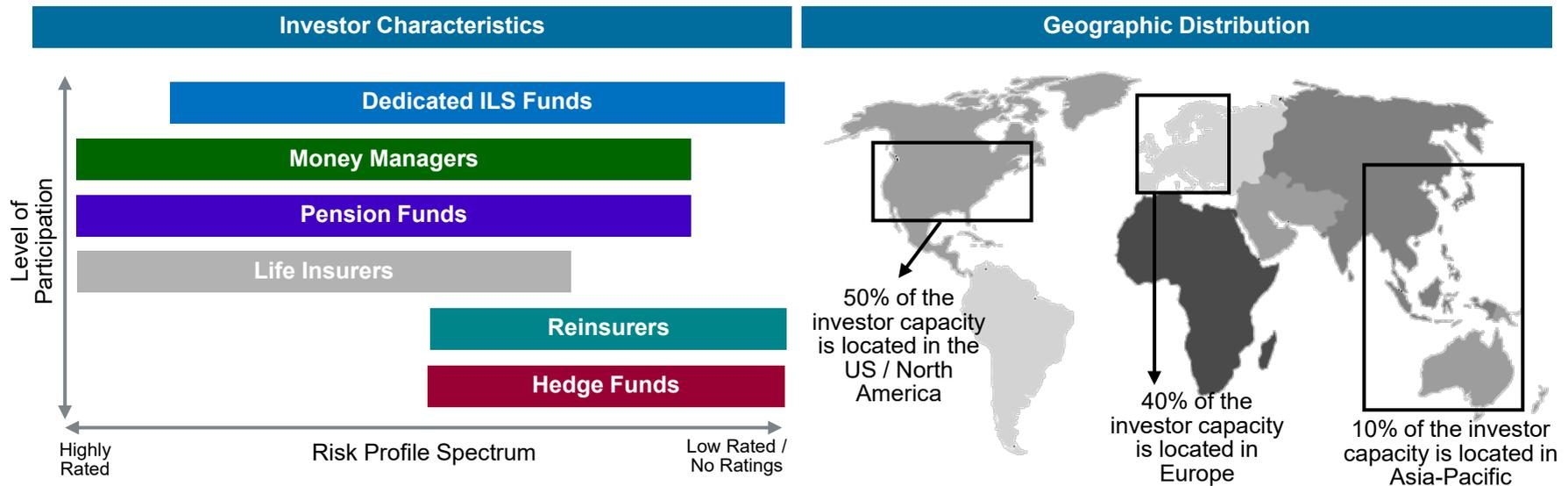
Cat Bond Placement Process

Typical Transaction Workflow



ILS Market Update

Global Investor Base



Dedicated ILS Funds	Money Managers	Pension Funds	Life Insurers	Reinsurers	Hedge Funds
<ul style="list-style-type: none"> Remain the most significant source of capital aggregation for the ILS market Must invest in ILS asset class, which makes their funding levels “sticky” and more stable Increasingly able to independently evaluate new types of insurance risk 	<ul style="list-style-type: none"> Motivation is relative value / uncorrelated diversification Increasingly taking a ‘market beta’ approach to the market, rather than looking to select within the insurance risk sector 	<ul style="list-style-type: none"> Direct and indirect capital deployment from fixed income portfolios or alternative asset bucket (“Dedicated ILS funds”) Increasingly interested in direct participation, focused on the efficiency of the exchange of risk for premium; very expense load focused 	<ul style="list-style-type: none"> Spread buyers Motivation is uncorrelated diversification / attractive risk profile versus return profile Prefer tranches that carry ratings Tend to be more oriented toward liquid / tradable investments 	<ul style="list-style-type: none"> Certain large global reinsurers will maintain a presence as investors in the market, however this is more for market information than significant risk acquisition Less stable capacity source, opportunistic funds 	<ul style="list-style-type: none"> Current participation remains low, market returns are insufficient for their risk appetite Least stable capacity source, opportunistic funds Prefer higher Expected Loss structures

ILS Market Commentary

Innovation: Firsts for Wildfire Only Structures

In 2018, we saw the first wildfire only ILS structures which were utilized by CA utilities to cover third-party property damage (including fire suppression costs):

August 2018

\$200,000,000

Cal Phoenix Re Ltd.

Series 2018-1 Principal At-risk
Variable Rate Notes
due August 13, 2021



*Sole Structuring Agent
and Sole Bookrunner*

GC SECURITIES

October 2018

\$125,000,000

SD Re Ltd.

Series 2018-1 Principal At-Risk
Variable Rate Notes
due October 19, 2021



*Sole Structuring Agent
and Sole Bookrunner*

GC SECURITIES

Recent GC Securities Transactions

FONDEN 2017-1

August 2017

\$360,000,000

FONDEN 2017

Class A, Class B, Class C
Floating Rate Catastrophe-Linked
Capital at Risk Notes

SHCP

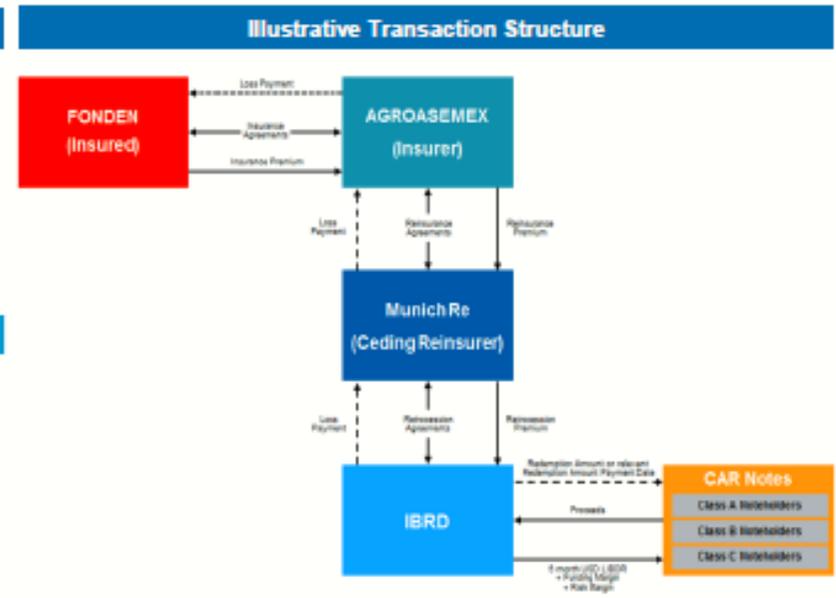
SECRETARÍA DE HACIENDA
Y CRÉDITO PÚBLICO

Joint Structuring Agent,
Joint Manager and Sole Bookrunner

GC SECURITIES

- Fund of Natural Disasters ("FONDEN") of Mexico returned to the capital markets by sponsoring the issuance of Capital at Risk Notes through the Global Debt Issuance Facility of the International Bank for Reconstruction and Development ("IBRD"), as part of a strategic partnership with the World Bank Group
 - The transaction marks the fourth issuance for FONDEN to obtain collateralized reinsurance protection, and the third for IBRD to issue Notes through its Capital at Risk Notes program
- The transaction features a parametric trigger with a step-payout mechanism
 - Payout amounts are determined through the application of event parameters of applicable events onto peril-specific regions that are placed in covered areas with predefined payout rates
 - FONDEN is eligible to recover 25%, 50% or 100% (additionally, 75% payout applicable to earthquake events affecting the Class A Notes) of the aggregate nominal amount
- Munich Re is acting as the fronting transformer ("Ceding Reinsurer"), who will enter into applicable Retrocession Agreements with IBRD ("Issuer") on behalf of the wholly-owned Mexican Federal Government insurer AGROASEMEX ("Insurer") who insured FONDEN ("Insured"), the ultimate beneficiary

Capital at Risk Notes			
Issuer	International Bank for Reconstruction and Development ("IBRD")		
The Insured	Banco Nacional de Obras y Servicios Públicos ("Banobras") in its capacity as trustee of the Trust 2003 – FONDEN		
The Insurer	AGROASEMEX S.A. ("AGROASEMEX")		
The Ceding Reinsurer	Munich Re		
Trigger	Parametric; Per Occurrence		
Modeling Firm	AIR Worldwide Corporation		
	Class A	Class B	Class C
Applicable Event	Earthquake	Atlantic Named Storm	Pacific Named Storm
Nominal Amount	\$150M	\$100M	\$110M
Risk Period	3 years Aug '17 - Aug '20	3 hurricane seasons Aug '17 - Dec '19	
Expected Loss	3.43% (Base)	5.56% (Base) 5.77% (Sensitivity)	3.96% (Base)
Risk Margins	4.50%	7.50% ⁽¹⁾ / 9.30% ⁽²⁾	4.75% ⁽¹⁾ / 5.90% ⁽²⁾

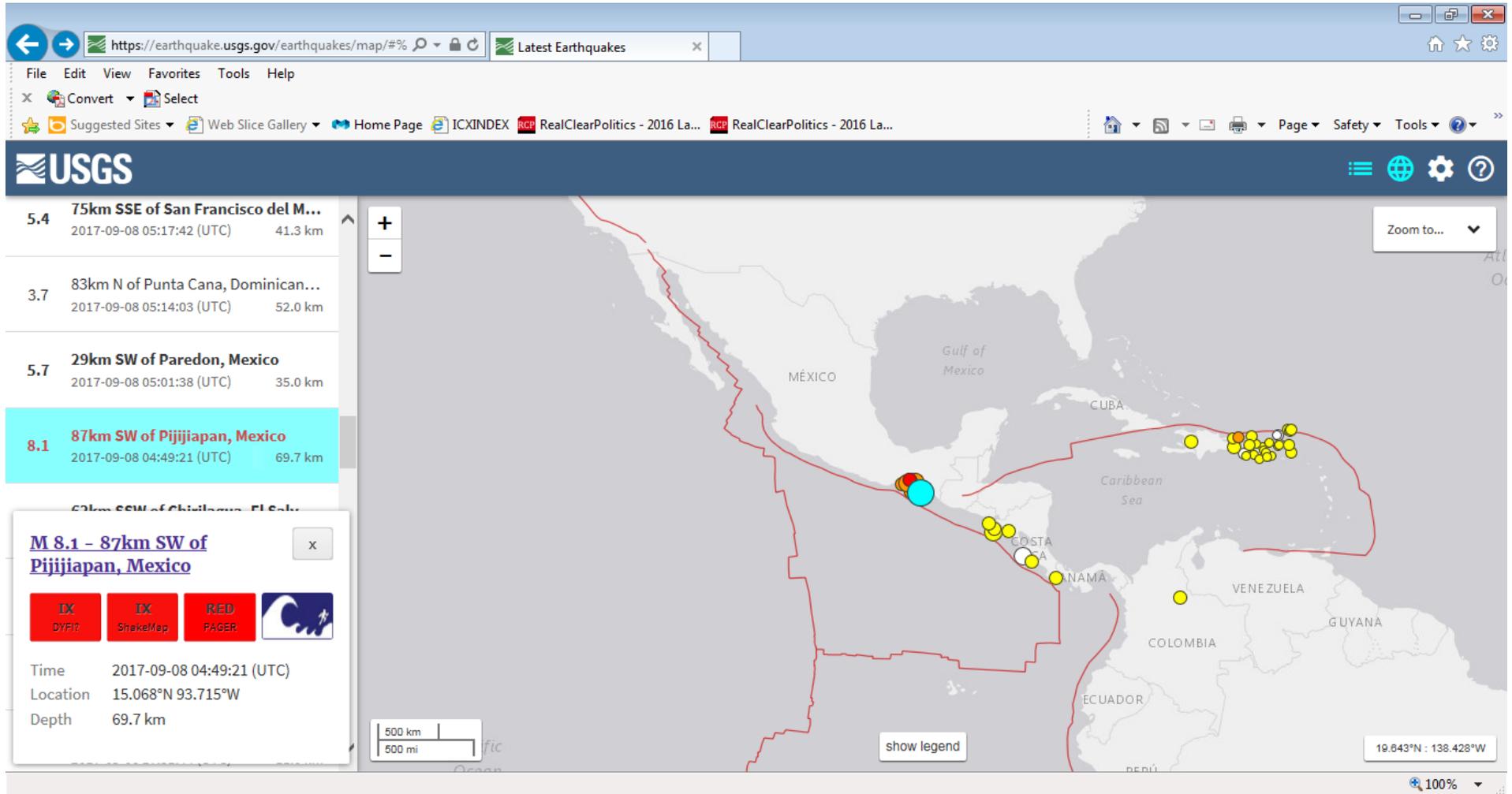


GC SECURITIES

(1) Per annum coupon.
(2) Per annum spreads, derived from adjusting coupon rate with difference between actual bond term and covered hurricane seasons.

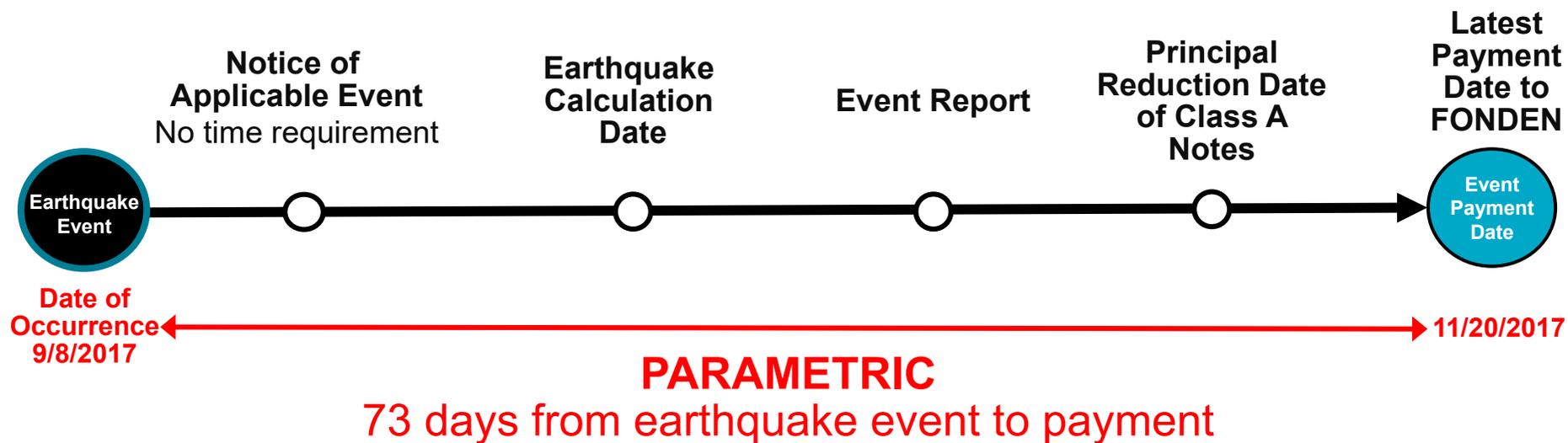
Case Study: FONDEN 2017-1 – \$150M Class A Notes

Event: M8.1-2,100km SW of Pijijiapan, Mexico



Case Study: FONDEN 2017-1 – \$150M Class A Notes

Post-Event Process



Developing an Understanding of Catastrophe Risk



License all major commercial models



Model Suitability AnalysisSM (MSA)

Catastrophe Model Evaluation – Provides a rigorous, systematic assessment of the many available cat models, helping clients formulate their view of catastrophe risk, complete with documentation for communication to stakeholders.



Model Development

Dedicated model development team creates point of sale models and other underwriting solutions as well as catastrophe models for geographies/perils not well represented by commercial models.



Leveraging Big Data

The same data that allows us to evaluate the models and to build underwriting solutions can also be beneficial to clients on its own (such as flood maps, annual wildfire burn probabilities, soil data, etc.)

We offer peril-specific insights to arm clients with the information needed to grow and improve financial outcomes

Next Steps

- Develop an initial Steering Committee (BCDC, BPC and Bay Area Council)
- Identify Key Stakeholders (Public and Private)
- Identify Risks (Insurable and Uninsurable)
- Quantify the Risks - Catastrophic Modeling
- Evaluate Risk Financing Options & Risk Transfer Structure
- Develop a Funding Plan
- Determine Indemnity Allocations
- Socialize the Concept with Local and State Government Agencies
- Develop a Time Line
- Potentially Structure a New Joint Powers Authority
Ex. Bay Area Economic Resiliency Coalition

Important Disclosure

Guy Carpenter & Company, LLC provides this report for general information only. The information and data contained herein is based on sources we believe reliable, but we do not guarantee its accuracy, and it should be understood to be general insurance/reinsurance information only. Guy Carpenter & Company, LLC makes no representations or warranties, express or implied. The information is not intended to be taken as advice with respect to any individual situation and cannot be relied upon as such. Please consult your insurance/reinsurance advisors with respect to individual coverage issues.

Readers are cautioned not to place undue reliance on any calculation or forward-looking statements. Guy Carpenter & Company, LLC undertakes no obligation to update or revise publicly any data, or current or forward-looking statements, whether as a result of new information, research, future events or otherwise.



Statements concerning tax, accounting, regulatory or legal matters should be understood to be general observations based solely on our experience as reinsurance brokers and risk consultants and may not be relied upon as tax, accounting, regulatory or legal advice, which we are not authorized to provide.

All such matters should be reviewed with your own qualified advisors in these areas.

This document or any portion of the information it contains may not be copied or reproduced in any form without the permission of Guy Carpenter & Company, LLC, except that clients of Guy Carpenter & Company, LLC need not obtain such permission when using this report for their internal purposes.

The trademarks and service marks contained herein are the property of their respective owners.

© 2019 Guy Carpenter & Company, LLC

All Rights Reserved