

# Overview of User Needs for 2018 NSHM Update and Beyond

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USGS 2018 NSHM Update Workshop

Wednesday, March 7<sup>th</sup>, 2018

RMS Headquarters, Newark, CA

# NSHMs Spectral Periods & Site Classes

- Historically, USGS has made and published in OFRs hazard maps for
  - 3 spectral periods (PGA, 0.2sec, 1.0sec) &
  - 1 reference site class (BC)
- Although not in the OFRs and not used by the building codes, USGS has been making hazard maps for additional periods and site classes for many years. WUS 2008 NSHM:
  - 11 spectral periods (PGA, 0.1, 0.2, 0.3, 0.5, 0.75, 1, 2, 3, 4, 5) &
  - 6 site classes (B, BC, C, CD, D, DE)
- Realizing the shortcomings of the current **simple design spectrum**, building code has decided to take advantage of USGS additional maps and has requested additional periods and site classes to develop **multi-period design spectrum** for the next-generation of seismic design value maps for Project '17.
  - 21 “NGA” spectral periods
  - 8 site classes

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# Project '17

**Project '17:** A joint USGS-BSSC effort to develop consensus among practicing engineers and earth science communities engaged in formulating the rules by which next-generation seismic design value maps will be developed. (2021 NEHRP, ASCE 7-22, 2024 IBC)

Initially identified 13 issues as important for consideration in the next-generation of design value maps (4 were selected as primary issues due to limited budget and resources):

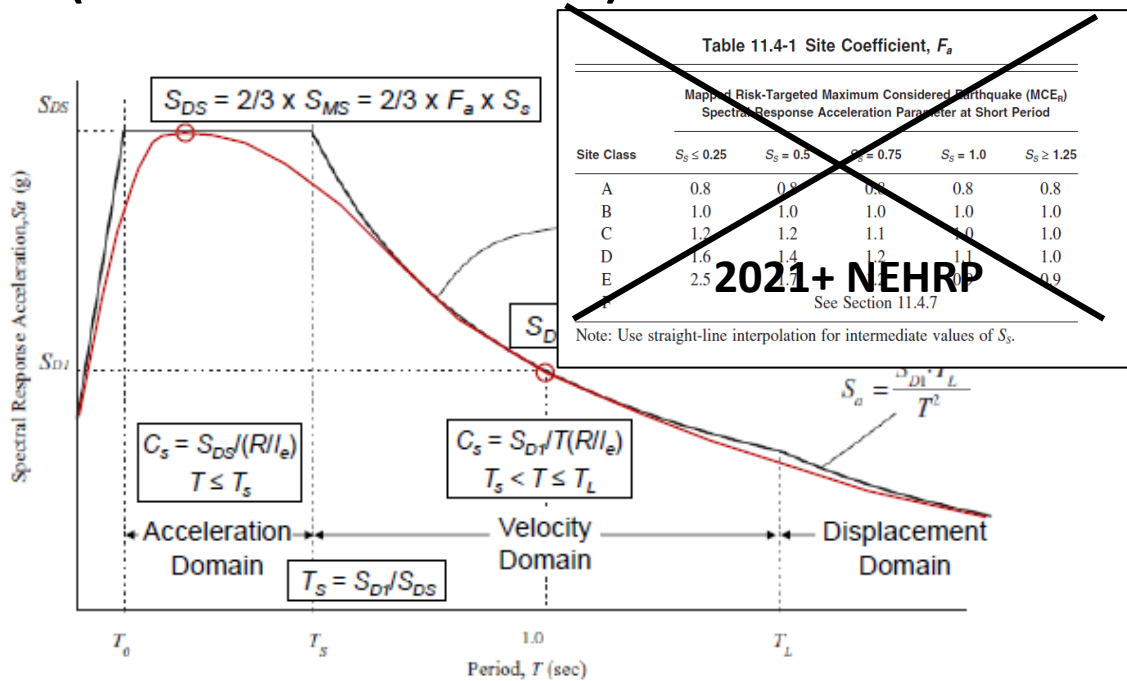
1. Timing for Updated Map Publication
2. Design Value Conveyance
3. **Balancing Precision and Uncertainty**
4. **Acceptable Collapse Risk Definition**
5. Collapse Risk Definition
6. Maximum Direction Ground Motion Components
7. **Multi-Period Spectral Values**
8. Duration as a Mapped Parameter
9. Damping Levels
10. Vertical Motion Parameters
11. **Use and Definition of Deterministic Parameters**
12. **Basin Effects**
13. **Use of 3-D Simulation to Develop Long Period Parameters**

One of the primary issues that will effect 2018 and future USGS NSHMs

Long period issues that can be combined into issue 7

# Multi-Period Response Spectrum (MPRS)

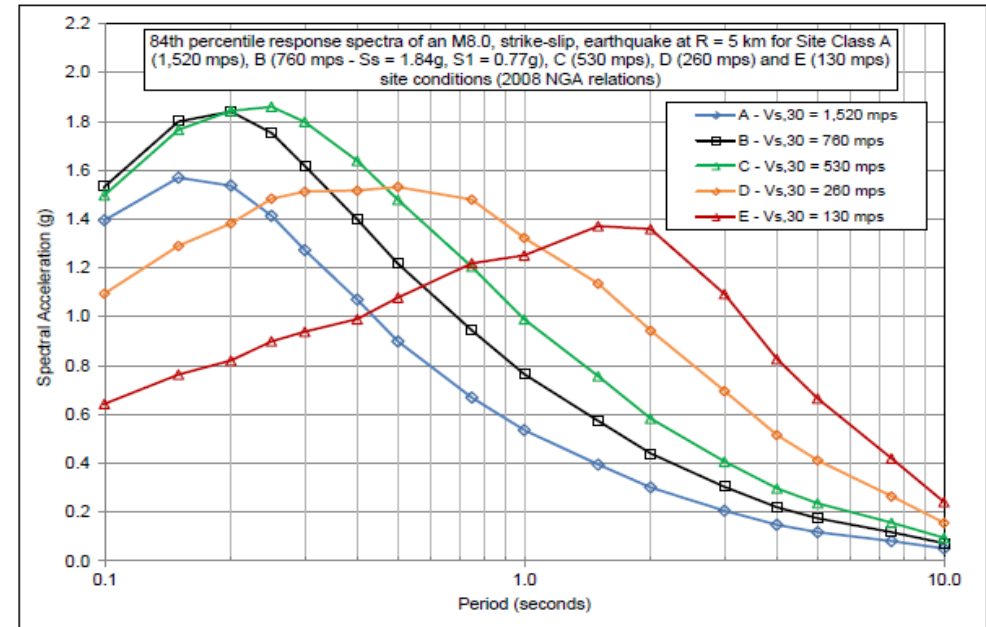
## Current Design Spectrum (based on $S_s$ & $S_1$ for BC):



## Future USGS Deliverables:

1. Provide more periods
2. Directly implement Vs30 into GMMs

## Multi-T Multi-Vs30 Spectrum:

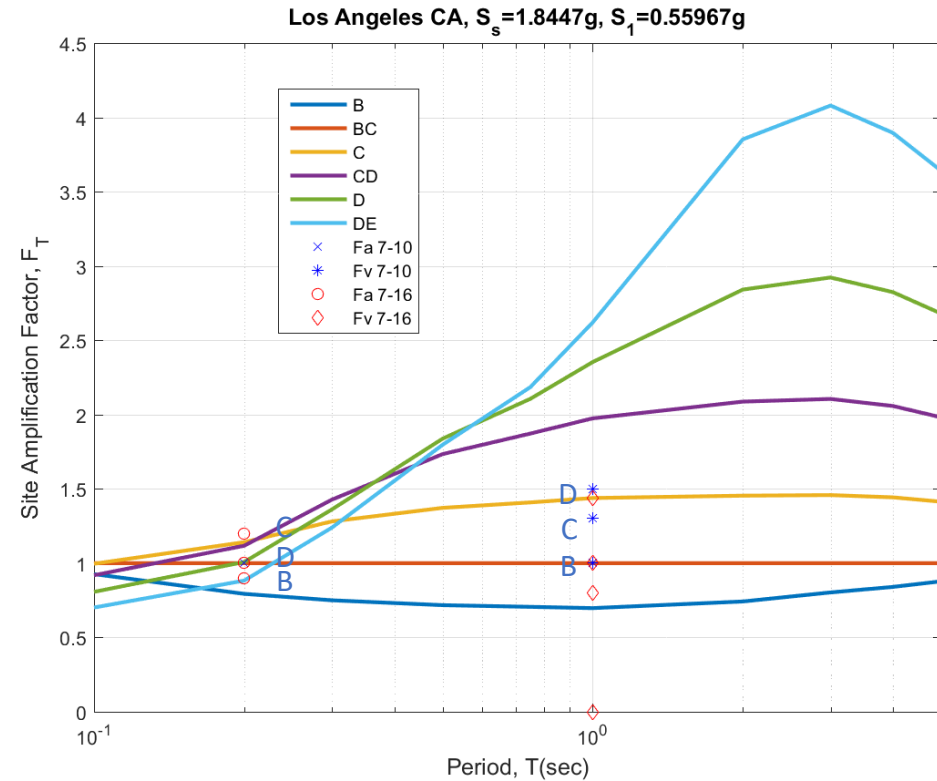
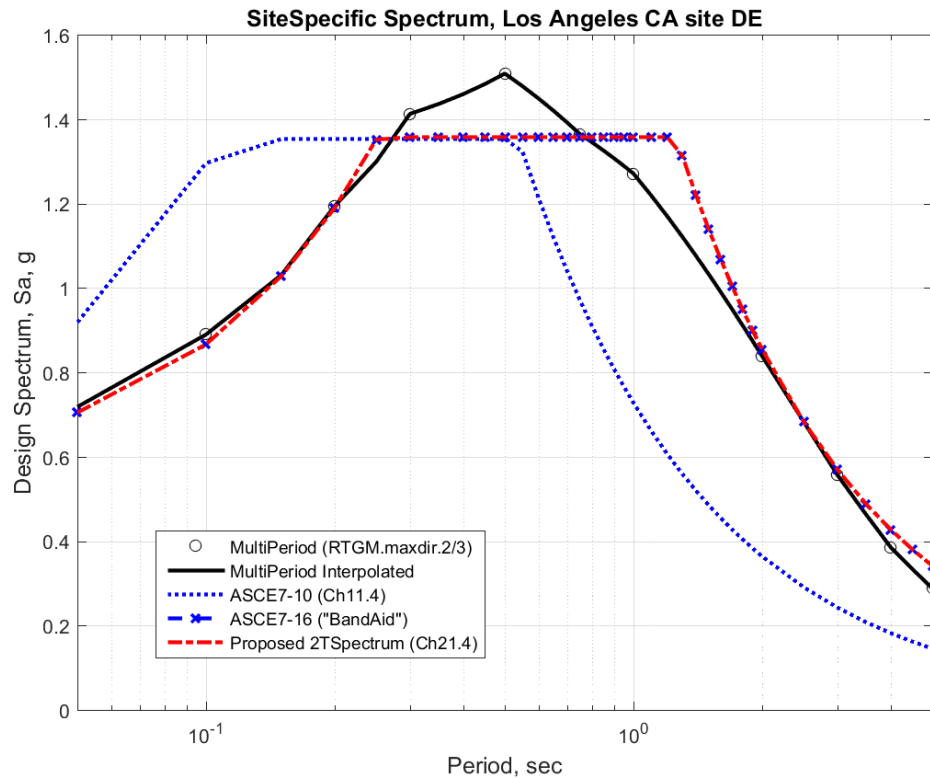


## Challenges (Current GMM Shortcomings):

1. What to do in the CEUS (long T, soft soil)?
2. What to do for basin effects in the WUS (long T, soft soil)?

# Multi-Period Response Spectrum (MPRS)

Example: Los Angeles, CA (-118.25 , 34.05)



Note: the ASCE7-16 and ASCE7-22 are the same because ASCE7-16 calls for a site-specific. (ASCE7-16 "exception" using conservative  $F_a$  for Site Class C incorporated)

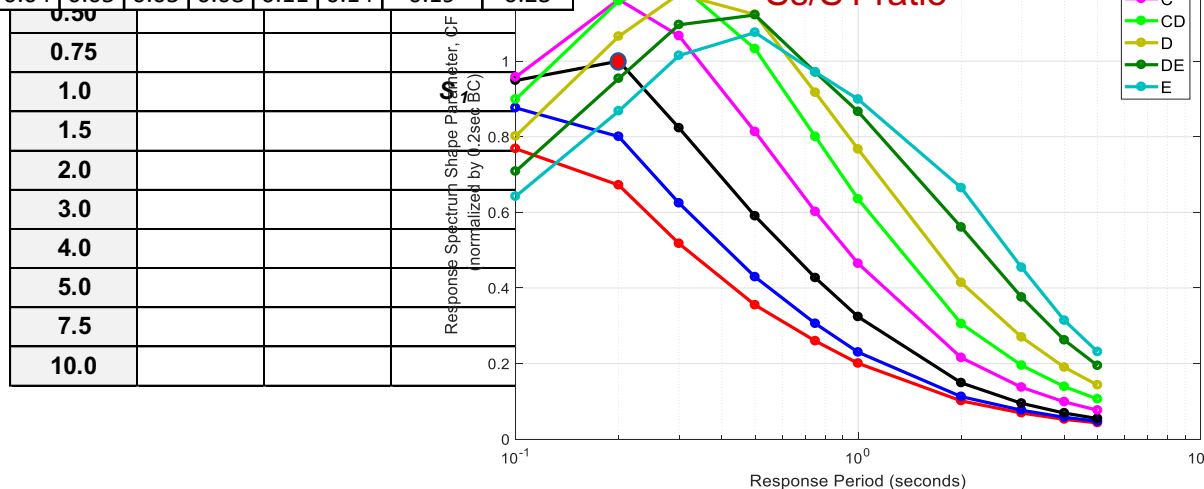
$F_v=0$  refers to site-specific analysis requirement for site D

# User Needs for 2018 NSHM & Beyond

Provide hazard maps for 21 periods and 8 site classes:

Period		Site Class											
Response Spectrum Shape Parameter CF:									C	CD	D	DE	E
T (s)	AB	B	BC	C	CD	D	DE	E					
0.00	0.31	0.36	0.42	0.47	0.49	0.47	0.43	0.40					
0.10	0.77	0.88	0.95	0.96	0.90	0.80	0.71	0.64					
0.20	0.67	0.80	1.00	1.16	1.16	1.07	0.95	0.87					
0.30	0.52	0.62	0.82	1.07	1.20	1.18	1.10	1.01					
0.50	0.35	0.43	0.59	0.81	1.03	1.12	1.12	1.08					
0.75	0.26	0.31	0.43	0.60	0.80	0.92	0.97	0.97					
1.00	0.20	0.23	0.32	0.46	0.64	0.77	0.87	0.90					
2.00	0.10	0.11	0.15	0.22	0.31	0.41	0.56	0.66					
3.00	0.07	0.08	0.09	0.14	0.20	0.27	0.38	0.45					
4.00	0.05	0.06	0.07	0.10	0.14	0.19	0.26	0.31					
5.00	0.04	0.05	0.05	0.08	0.11	0.14	0.19	0.23					

- **CEUS:** 2014 GMMs only applicable up to 2sec, and site class A (Need updated GMMs, e.g., NGA-East)
- **WUS & Subduction:**
  - Remove GMMs not applicable for soft sites (Idriss14) & long periods (Atkinson&Boore03) and re-weight GMMs
  - Basin effects for long T and soft sites
- **Other Regions:** AK, HI, GU&AS, PRVI  
Response Spectrum Shape Factors, developed based on WUS GMMs, until USGS updates are available for each region





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Provide hazard maps for 21 periods and 8 site classes:

Period T (s)	Site Class							
	A	B	BC	C	CD	D	DE	E
PGA								
0.010								
0.020								
0.030								
0.050								
0.075								
0.10								
0.15								
0.20			$S_s$					
0.25								
0.30								
0.40								
0.50								
0.75								
1.0			$S_1$					
1.5								
2.0								
3.0								
4.0								
5.0								
7.5								
10.0								

- **CEUS:** 2014 GMMs only applicable up to 2sec, and site class A (Need updated GMMs, e.g., NGA-East) **Today**
- **WUS & Subduction:**
  - Remove GMMs not applicable for soft sites (Idriss14) & long periods (Atkinson&Boore03) and re-weight GMMs
  - Basin effects for long T and soft sites **Tomorrow**
- **Other Regions:** AK, HI, GU&AS, PRVI  
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