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Allison Brooks, Executive Director
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Bay Area Metro Center
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VIA: Electronic Mail

RE: Comments on *Raising the Bar*

Allison:

Thanks for giving me the opportunity to review *Raising the Bar*. I really like the fact that you are framing this information as a call to action, and that you have linked resilience to earthquakes and resilience to climate change. While I think this linkage might be obvious to your member agencies as they are leaders in building resilience to earthquakes, I think this is important framing to reinforce for the public. We're already investing for resilience to earthquakes, we know how to do this, and we need to expand on this approach given the projected impacts of climate change.

I like grouping case studies by "regional vulnerability" type (housing, transportation, etc...), and it is very effective to have real examples with photos instead of maps or concept drawings. Is there a list of the roads that already flood? (for example, I noted in the East Palo Alto discussion that Highway 84 in the area that already floods). This would be another example of a real-time impact (and a list that can be expanded over time).

I would like to offer an additional comment that I with support with several findings, and this is followed by some specific recommendations.

I think the report should recognize that transportation planning will play a fundamental role in building regional resilience to sea level rise beyond just providing for functional transportation infrastructure. Since so much of our critical transportation infrastructure is along the shore, enhancing its resilience to sea level rise will influence (and possibly control) the risk of inundation for many nearshore properties and residents. The designs for this

resilient infrastructure also will influence the availability of ecosystem services such as wildlife habitat (especially wetlands), recreation, and clean water.

This means that in the future transportation planning agencies will have an expanded role to play in shoreline planning/development, and I suggest they accept a leadership role in this regard. They are well suited to this effort given (1) their demonstrated commitment to making our infrastructure resilient to other threats such as earthquakes, (2) their unambiguous accomplishments in this regard and the wide support these efforts enjoy throughout our community, and (3) the regional solution area inherent in the mission of these agencies (e.g., Caltrans Region 4, MTC, BATA).

I offer below five findings in support this comment that I briefly summarize, but for which I provide additional information if needed.

1. More flooding is in our future. This earth's climate is changing at an extraordinary rate, and this is already resulting in higher waves, rising sea level, and more intense downpours. These changes are accelerating, and this acceleration will continue in coming decades with profound impacts on the economy and the quality of life in the Bay Area.¹

The California Ocean Protection Council currently estimates a 67% chance that sea level will be 1-3.4 feet higher in 2100 in San Francisco Bay, with a 5% chance of a rise of 4.4 ft. However, it is also plausible that sea levels could rise 10 feet if carbon emissions continue unabated and the destabilization of the West Antarctic Ice Sheet accelerates.²

2. Transportation Infrastructure is Vulnerable. Flooding in the future will damage our regional transportation infrastructure without a major public works effort to defend vulnerable roads, bridges, and other transportation assets. Such damage is already apparent at the highest tides on roadways throughout the region, particularly when the highest tides occur during major rainstorms. The US Geological Survey has documented significant erosion in the last decade of beaches and other coastal landforms in California.³ In a pilot analysis, the Adapting to Rising Tides program, in conjunction with MTC, Caltrans District 4, and the Federal Highway Administration, documented the vulnerability of transportation infrastructure along the Alameda County shoreline.⁴

Caltrans District 4 estimates that just 0.5m sea level rise will expose 33.9 miles of state highways in the region to inundation, while a 1.75m rise in sea level will expose 94.3 miles. These numbers rise to 49.2 and 110.2 miles inundated when a 100-year storm surge is included. About 40% of this

exposure occurs just in the counties of Marin and San Mateo.⁵

3. Transportation asset protection will dominate local sea level rise planning. In many locations around the Bay Area, major transportation assets are located along the shore. Examples include Highway 37, Highway 237, Interstates 880 and 580, Highway 101, and the approaches to many of our major bridges. Given the scale of these assets, it seems likely that projects undertaken to defend them from sea level rise will form the anchor for other nearby efforts to create resilience to sea level rise.

The methods used to defend this infrastructure from sea level rise impacts will influence (and possibly control) the risk of inundation for many nearshore properties and residents. If a levee is constructed to protect a transportation asset, those on the landward side of levee will benefit from the project (this concept has already been recognized by transportation agencies in a pilot project that identified “adjacent assets”).⁶ However, if a road or bridge approach is protected by building a causeway, this will leave landward property owners and residents vulnerable. In some instances, defense of roadways will protect other important assets, such as sewage treatment plants.⁷

4. The Bay Area has already demonstrated its commitment to transportation asset resilience, placing transportation agencies in a leading role. The Metropolitan Transportation Commission’s Toll Bridge Seismic Retrofit Program has financed over \$9billion in bridge improvements using tolls.⁸ Toll payers also paid \$4.5billion of the \$6.4billion cost of the new Bay Bridge.⁹ Caltrans has invested over \$12billion in its seismic retrofit program for the state’s bridges, which involves addressing more than 2,200 structures.¹⁰

5. State, Local and Regional Funding will be Essential for Building Resilience. Given the growing cost to the federal government just for humanitarian relief and reconstruction from climate-related disasters, it seems inevitable that the funding for creating resilient infrastructure will fall increasingly to local, regional, and state agencies. Damages from Hurricanes Harvey, Irma, and Maria are currently projected at over \$300billion,¹¹ with the wine country fires adding \$9.4billion in damages¹², and losses from the fires southern California likely to be over \$2billion.¹³ Caltrans estimates the heavy rainy season of 2016-17 produced over \$1billion of damage to state highways.¹⁴

Given that such costs are projected to escalate in the future as climate change increases the frequency of extreme weather events, it seems prudent to assume that a very large portion of the cost of resilient

infrastructure will be borne by the state and the region. This assumption is further supported by the fact that the Atlantic and Gulf coasts of the country have greater vulnerability to sea level rise than the pacific coast, and will therefore be attracting more federal money for relief in the future.¹⁵

6. Our regional transportation agencies are well suited to lead regional planning. The Metropolitan Transportation Commission (MTC) is a regional agency that has the experience of prioritizing the expenditure of funds across the region. This places MTC in a position of leadership with regarding to planning the financing and implementation of such a major public works project. MTC has demonstrated its commitment and capability to generate resilience to natural threats (e.g., Toll Bridge Seismic Retrofit Program), has broad representation on its Board, and strong support for its mission among the many sectors of the regional economy. MTC is already engaged in regional planning around greenhouse gas reduction (*Plan Bay Area*), and is engaged in regional resilience planning through the Bay Area Regional Collaborative and ART Bay Area. Multiple agencies (MTC, Caltrans, BCDC, BART, FHA) collaborated on a pilot project to assess vulnerability and propose adaptation strategies for key locations in Alameda County.

Caltrans Region 4, which comprises the 9-county Bay Area, is also planning for the impacts of climate change. This agency just produced a vulnerability assessment for state highways in the region, that includes impacts from sea level rise and other effects of climate change (e.g., the need to alter pavement composition to adapt to higher average temperatures).

Recommendations for Action. Based upon these findings, I would recommend that (1) MTC/ABAG integrate resiliency into the Sustainable Communities Strategy, (2) agencies recognize that defending vulnerable bridges, mass transit nodes, and roads will inevitably influence the resilience of neighboring communities, (3) regional agencies (through BARC or another mechanism) explicitly recognize the role that transportation projects will play in generating public benefits beyond transportation (wildlife habitat, recreational opportunities, water quality improvement), (4) transportation agencies produce a map that indicates their best judgement regarding which assets need to be defended by mid-century, as this will create a context for additional planning for sea level rise in these areas¹⁶, and (5) select a pilot study area for a multi-agency effort to design resilient transportation infrastructure that optimizes public benefits across multiple endpoints beyond transportation (this should be based upon lessons learned from the 2014 pilot project).¹⁷

I hope that these comments are helpful to you as you approve the final

version of *Raising the Bar*. I want to explicitly acknowledge that as an environmental scientist I recognize my comments may overlook or oversimplify some key aspects of transportation planning. I also am aware that technical studies have been undertaken already that reflect some of my recommendations (e.g., *Climate Change and Extreme Weather Adaptation Options for Transportation Assets in the Bay Area Pilot Project Technical Report*). However, given the outsized role that transportation projects will play in creating shoreline resilience, a position agreed to by all of my professional colleagues with whom I have discussed this concept, I wanted to make this comment as a call for leadership.

The rate of sea level rise will be increasing in the future, and the decisions and actions we take today while rates of sea level rise are modest will have a great influence on the level of disruption we experience by mid-century. As a region we are going to have to try some new methods and approaches to maintain our economy and quality of life in the face of climate change. This will require leadership from those in regional governance, and I hope these comments can support such efforts.

Please don't hesitate to contact me if you have any questions or need any additional information.

Sincerely,



Andrew J. Gunther, Ph.D.

¹ Since 1993 sea level has risen at 3.4 mm/yr, twice the average rate of the 20th century (Ocean Protection Council, 2017. *Rising Seas in California: An Update on Sea Level Rise Science*).

² Ocean Protection Council, 2017. *Rising Seas in California: An Update on Sea Level Rise Science*. Estimates compared to a baseline of average sea level from 1991-2009.

³ Barnard, P. L., et al., 2017. *Extreme oceanographic forcing and coastal response due to the 2015–2016 El Niño*. *Nature Communications* 8: 14365.

⁴ Adapting to Rising Tides. 2011. Transportation Vulnerability and risk Assessment Pilot Project. http://www.adaptingtorisingtides.org/wp-content/uploads/2015/04/RisingTides_BriefingBook_sm.pdf.

⁵ Caltrans Climate Change Vulnerability Assessment Summary Report, District 4, 2018 (Table 3).

⁶ Climate Change and Extreme Weather Adaptation Options for Transportation Assets in the Bay Area Pilot Project Technical Report. December 2014 (http://files.mtc.ca.gov/pdf/MTC_ClimateChng_ExtmWthr_Adtpn_Report_Final.pdf)

⁷ For example, Highway 580 defense will protect the Sewage Agency of Southern Marin, and defense of the Bay Bridge Toll Plaza will help protect the East Bay Municipal Utility District's major treatment facility.

⁸ <https://mtc.ca.gov/our-work/invest-protect/toll-funded-investments/toll-bridge-seismic-retrofit-program> accessed 1/21/18.

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- ⁹ <https://www.wnyc.org/story/316201-brief-history-64-billion-bay-bridge/> accessed 1/22/18.
- ¹⁰ <http://www.dot.ca.gov/hq/paffairs/about/retrofit.htm>. Accessed January 2018.
- ¹¹ <https://www.usatoday.com/story/news/2017/10/27/harvey-irma-maria-different-disasters-different-recovery/807485001/>
- ¹² <http://www.sacbee.com/news/state/california/fires/article188377854.html> accessed 1/23/18
- ¹³ <https://www.insurancejournal.com/news/west/2018/01/23/478205.htm> accessed 1/23/18
- ¹⁴ Caltrans Climate Change Vulnerability Assessment Summary Report, District 4, 2018.
- ¹⁵ Dahl, KA, et al 2017 Effective inundation of continental United States communities with 21st century sea level rise. Elem Sci Anth, 5: 37. DOI: <https://doi.org/10.1525/elementa.234>
- ¹⁶ Such an effort has been initiated by Caltrans District 4. Caltrans Climate Change Vulnerability Assessment Summary Report, District 4, 2018. (see Figure 13)
- ¹⁷ Climate Change and Extreme Weather Adaptation Options for Transportation Assets in the Bay Area Pilot Project Technical Report. http://files.mtc.ca.gov/pdf/MTC_ClmteChng_ExtrmWthr_Adtpn_Report_Final.pdf

I appreciate the efforts MTC is making to protect the bay area from sea level rise. I live in east Corte Madera, in Marin County. We get 3-4 feet of water covering our entire back yard during king tides. My kids could drown in this. I can't let them outside during king tides. But, I did not see any reference to flood risk in eastern Corte Madera in the report. During regular high tides, we get 1-2 feet of water covering a portion of the back yard. We are not legally able to modify the back yard to prevent flooding due to the fact that the Bay Conservation & Development Commission will not issue a permit for this work since the back yard is adjacent to bay shore. When my grandfather purchased the house in the early 1960's, there was a boat access. We have a boat ramp and dock - neither have been used in over 30 years. This is because the slough needs to be dredged and Marin Audubon opposed the dredging due to impact on the Clapper Rail and Salt Marsh Harvest Mouse. My grandfather worked a hard labor job for decades to save up for a house where he could use his boat to fish. He was angry about the way environmental regulations usurped the rights of property owners until the day he died. Many of our neighbors at that time were also upset and sold their homes. I consider myself an environmentalist, but I firmly believe that the conservation extremist groups in Marin are preventing successful adaptation to climate change. I commute 1-2 hours via car from East Corte Madera to Alameda for work (each way). I have a boat ramp in my back yard - I could get a hybrid or electric boat and use this for transportation. I could put a bike in the boat and use that after arriving in Alameda. There are only a few channels around the bay that can accommodate ferries, but we could have fleets of hybrid and electric Uber boats taking people in all directions, all over the bay, if we allowed more dredging along the bay shore. I believe that the grave risk posed by climate change strongly outweighs the biodiversity concerns of conservationists. Preserving species biodiversity in wetland areas will not matter at all when climate change and sea level rise wipes out most species on our planet. I believe that we need major and serious CEQA reform to allow for successful regional adaptation to climate change and sea level rise. In Marin, the conservation extremist groups have been fighting against bike infrastructure for decades due to vague and unsubstantiated claims about bike infrastructure being bad for endangered animals in Marin. 80% of Marin is open space. Mountain biking routes are bike infrastructure in Marin and mountain biking is the safest and greenest way to travel between east and west Marin. Groups like Marin Audubon also fight against paved bike infrastructure. They have opposed the critical need for widening the Mill Valley - Sausalito bike path, which is heavily used by Marin to SF bike commuters. Narrow paths create too much bike-pedestrian conflict. Marin Audubon is currently opposing adequately wide SMART bike paths in Terra Linda and they are suing the county over the Road & Trails management plan. It is deeply upsetting to me that the "environmental" organizations in Marin fight against bike infrastructure so intensely. If we don't reform CEQA, we must exempt climate change, sea level rise and bike infrastructure projects from CEQA. Nothing will ever get done without change to the CEQA law and/or exempting important climate change projects.

This comment is not intended to reflect a negative view of the work of the many well-meaning and dedicated people working to save the bay. Hopefully, my concerns have already been taken into account and incorporated in the plans and timing for filling in the Bay. Filling of the Bay has for many years been viewed as detrimental for a variety of reasons. The change in policy to now fill the Bay for the laudable purpose of preservation or restoration of habitat should proceed with caution.

My primary concern is the manner and timing in which fill is to be added to the marsh/undeveloped portions of the Bay to adjust for sea level rise. For short duration rises in sea level reflected at the Golden Gate the marsh/undeveloped portions of the bay allow for spreading of the water entering through the Golden Gate thereby dissipating and reducing the elevation impact of the rise. Some of the short term rises could be storm surges or even tsunamis. The volume of the space that assists in dissipating the impact is the area above the level of water that would be present absent the short period rise. Such water levels vary and are affected by winds, tides, precipitation, a variety of inflows, atmospheric pressures, the hydraulics of bay waters, geologic changes in the bay region, fill and other factors. The unnecessary filling and reduction of such space is my concern. It would appear that the negative impact on attenuation of short period sea level rises would be substantially less if fill was only added, as water levels rise, and then only to reduce the depth of water in areas that would always be submerged. The comment in the Estuary News that caught my attention was that "the region needs 300 million cubic yards more than it has"- "Assuming 3.5' of sea level rise" presumably by 2100. If implemented, placement of such amount of fill would result in a massive filling of the Bay equivalent to over 53,128 acres (roughly 83 square miles) 3.5 feet deep. Such filling would be in addition to the regular occurring deposit of fill. The NOAA sea level site shows mean sea level for San Francisco (the Golden Gate), with some caveats, as having risen about .64 feet or about 7.68 inches in 100 years and mean sea level for Alameda as having risen about .24 feet or about 2.88 inches in 100 years. It is not clear as to what part of historical mean sea level rise at the Golden Gate is due to short period rises but the difference in comparison to Alameda would indicate that it could be significant.

I have attached copies of the recent NOAA graphs for the Golden Gate and Alameda. Sea level rise or fall appears to be very location specific. See for example the NOAA plot for Juneau Alaska which shows a mean sea level **decline** of about 4.31 feet or 51.72 inches in 100 years (copy attached). There is substantial uncertainty as to future sea level rise at the Golden Gate and even more so within the Bay. Maintaining the ability of the Bay to attenuate future short period rises in sea level, particularly storm surges and tsunamis deserves consideration and net reduction rather than addition of fill may be appropriate. Importing fill from areas outside the Bay rather than using fill dredged from the Bay to raise the marsh/undeveloped portions of the Bay will likely increase the harm. The addition of fill, even that which is dredged from the Bay, to reduce water depth for marsh restoration should only take place as the sea level rise actually occurs. Filling prematurely will cause harm which could have been avoided. Regarding of marsh/undeveloped land to enhance or maintain habitat can in many cases be accomplished without importing fill to the project site. Avoiding degradation of the capacity of the Bay to attenuate short period sea level rises should be a requirement when developing the undeveloped portions of the Bay including development for habitat purposes.

Public Comment to Draft 'Raising the Bar' Report
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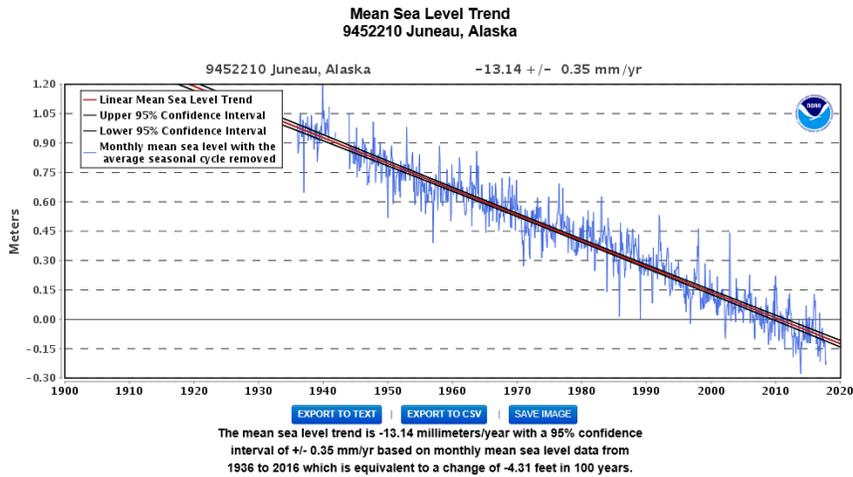
Received 1/16/2018

Thanks for your efforts.
Dante John Nomellini Sr.

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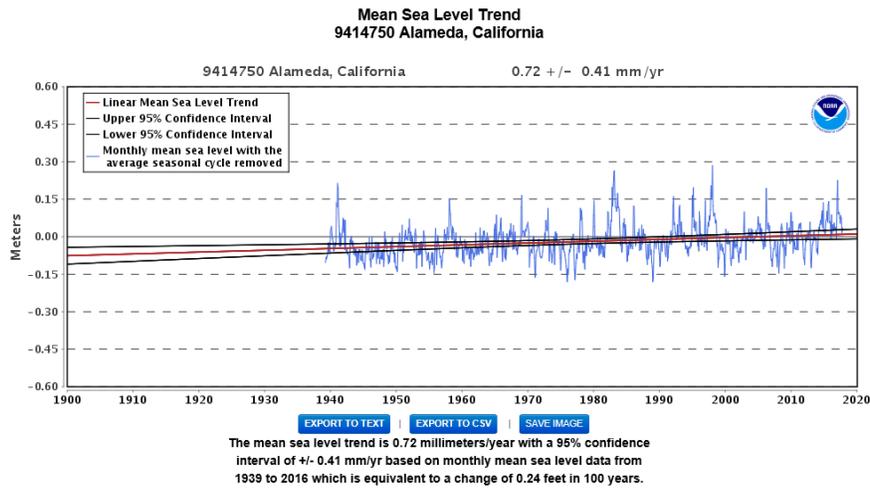
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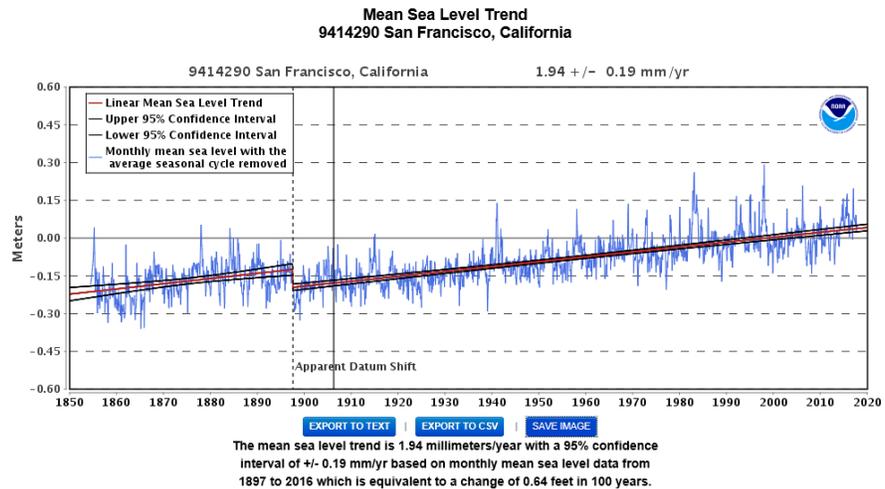
The plot shows the monthly mean sea level without the regular seasonal fluctuations due to coastal ocean temperatures, salinities, winds, atmospheric pressures, and ocean currents. The long-term linear trend is also shown, including its 95% confidence interval. The plotted values are relative to the most recent [Mean Sea Level datum established by CO-OPS](#). The calculated trends for all stations are available as a [table in millimeters/year and in feet/century](#) (0.3 meters = 1 foot).

If present, solid vertical lines indicate times of any major earthquakes in the vicinity of the station and dashed vertical lines bracket any periods of questionable data or datum shift.



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[Metadata: Apparent datum shift]

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