TMAC

Technical Mapping Advisory Council Meeting
May 12-13, 2015

TMAC Members

Doug Bellomo
Juliana Blackwell
Nancy Blyler
Richard Butgereit
Mark DeMulder
John Dorman
Leslie Durham*
Scott Edelman*
Steve Ferryman*
Gale Fraser
Carrie Grassi
Chris Jones
Howard Kunreuther
Wendy Lathrop
David Mallory
Robert Mason
Sally McConkey*
Javier Ruiz

Subcommittee Members

Ken Ashe, Amec Foster Wheeler
Dwayne Bourgeois, North Lafourche Conservation, Levee, and Drainage District
Tim Cohn, USGS
Maria Honeycutt, NOAA
Doug Marcy, NOAA
Patrick Sacbibit, FEMA
Jonathan Westcott, FEMA

Speakers and Briefers

Michael Bremer, CoreLogic
Michael DePue, Atkins
Joseph Nimmich, FEMA
Paul Rooney, FEMA

Government Attendees

Kathleen Boyer, FEMA, TMAC ADFO
Mark Crowell, FEMA, TMAC DFO
Michael Godesky, FEMA, TMAC ADFO
Traci Silas, DHS

Registered Public Attendees

David Conrad, Water Protection Network
Christine Gallagher, NOAA
Susan Gilson, NAFSMA
Katie Hermann, Dewberry
Merrie Inderfurth, ASFPM
Gilbert Jones, Dewberry
Tim McCormick, Dewberry
Velma Smith, Pew Charitable Trusts
Jeff Sparrow, Michael Baker International

Support Staff

Angela Bidnick, Booz Allen Hamilton
Kirsten Folkedal, Booz Allen Hamilton
Laura Karnas, Booz Allen Hamilton
Michelle McQueeney, J-M Global
Kimberly Rodgers, LeapFrog Solutions
Meredith Tull, Booz Allen Hamilton
Adam Warfield, Booz Allen Hamilton

**Indicates that the TMAC member also presented during the meeting.*

Purpose

The purpose of the meeting was to allow the Technical Mapping Advisory Council (TMAC) members to (1) receive report outs from the TMAC subcommittees, (2) deliberate on content for the 2015 reports, and (3) discuss next steps for TMAC discussions and report development. Members also received briefings on FEMA's database-driven all digital display status/transition; the lending and insurance perspective; and

map generation and workflow process.

May 12, 2015

Welcome/ Administrative Items

Mr. Mark Crowell, TMAC Designated Federal Officer (DFO), welcomed members to the meeting. He introduced Mr. Mike Godesky, Federal Emergency Management Agency (FEMA), and Ms. Kathleen Boyer, FEMA, who serve as the TMAC's alternate DFOs (ADFO). Mr. Crowell provided an overview of the facility and proceeded with a roll call of TMAC members and subcommittee members. Mr. Crowell reminded everyone of the Federal Advisory Committee Act (FACA) compliance provisions. He also discussed the revised bylaws, noting that in order for a subcommittee to conduct a vote, a quorum of more than 50 percent of TMAC members must be present. Mr. Crowell announced that both the subcommittee and full Council meeting sessions on May twelfth and May thirteenth were open to the public.

Process Schedule/ Meeting Objectives/ Previous Tasks- Status

Mr. John Dorman, TMAC Chair, provided an overview of the agenda and discussed the meeting's objectives, including: (1) review, deliberate, and adopt the 2015 Annual Report and Future Conditions Report topics and table of contents; (2) review and align 2015 topics by goals; (3) discuss broad recommendations, align goals to topics; and (4) discuss writing assignments and page estimation, if time permits. He reviewed the action items from the March 2015 TMAC Meeting and announced that the next TMAC meeting is scheduled for June 23-24, 2015. Mr. Dorman also reviewed the status of previous action items and noted that two items were still outstanding:

1. Mr. Scott Edelman, TMAC member, and Mr. Dorman will complete the task of filling out a subcommittee issue form on a representative issue for members.
2. Mr. Crowell will obtain more information from the FEMA attorneys and Committee Management Office (CMO) regarding the information that members may release to their organization.

Subcommittees – Progress Report Out

Flood Hazards and Operations Subcommittees

Ms. Sally McConkey, Flood Hazard and Risk Generation and Dissemination Subcommittee Chair, reviewed the subcommittee's charge and the high level topics that the subcommittee generated. Mr. Gale Fraser, TMAC member, recommended that the report discuss core hydraulic models. Mr. Dorman noted that it is important to ensure that there is an infrastructure to help align data. Mr. Doug Bellomo, TMAC member, encouraged the TMAC to understand areas where the Federal Government is gaining leverage. Ms. McConkey said that the subcommittee must find or add topics that address forward thinking and addresses data sets and systems, in addition to taking small steps or setting short term goals in order to achieve longer term goals.

Ms. Leslie Durham, Operations, Coordination and Leveraging Subcommittee Chair, reviewed her subcommittee's charge, discussed the table of contents format, the overarching recommendations, and goals. Ms. McConkey and Ms. Durham discussed the 2015 Annual Report's overarching recommendations, including

- Go digital;
- Transition from flood hazard identification to flood risk at the property level;

- Deliver reliable water surface elevations;
- Orient products and services to stakeholders and users' needs;
- Enhance State, tribal, and local community engagement in flood study production; and
- Anticipate and adapt to changing conditions and technologies.

Participants discussed the differences between the terms flood hazard versus flood risk and if the terms were being used interchangeably. Mr. Dorman said that one is identifying the hazard while the other is identifying where the risk is and said that these concepts should be incorporated into the Annual Report.

Members discussed the challenges of incorporating uncertainty and noted the importance of managing uncertainties. Ms. McConkey suggested that one could incorporate uncertainty by examining the uncertainty in all core data, records and topography, and account for that uncertainty when the data is put into the models. This would show that the estimations and parameters entered into the models have inherent uncertainty. Mr. Mallory suggested that risk communication needs to be used to communicate the uncertainty surrounding the hard lines on a flood map to homeowners so they can make a business decision regarding their flood insurance. Risk communication shows there is a lot more to be considered than the exact line. In addition, Mr. Bellomo recommended that the report contain information regarding diminishing returns on narrowing uncertainty bands below certain levels because of the variability in the systems.

Discussing the table of contents, Mr. Edelman recommended that the report contain a section that includes guidance on what will be in future reports (i.e., next steps).

Mr. Bellomo explained that in June 2015, FEMA will present a draft ongoing mapping program and the TMAC will have an opportunity to examine it. Mr. Dornan noted that once the TMAC completes its 2015 reports, it can provide comments to the FEMA Administrator on the program.

Mr. Edelman provided an overview of the process and schedule for both reports (Annual and Future Conditions), noting that the next goal is to complete annotated mark-ups of both reports by the end of June 2015. He said that he anticipates that the majority of the writing will be completed in July 2015, and reminded members that both reports are due in October 2015.

Mr. Dorman announced two anticipated motions for adoption by the end of the TMAC meeting:

1. The TMAC adopts the 2015 Future Conditions Report table of contents as a guide for preparing annotated markups; and
2. The TMAC adopts the 2015 Annual Report table of contents as a guide for preparing annotated markups.

Future Conditions Subcommittee

Next, Mr. Edelman gave a progress report on the Future Conditions Subcommittee. He thanked his committee for their work and reviewed their charge. Mr. Edelman outlined the overarching potential recommendations, including:

- Uncertainty should be included when information is released to the public.
- Continue to allow, incentivize, and encourage state / regional authorities / locals / communities to adopt higher standards.
- Recommend FEMA move towards design elevation criteria that is related to the life of the structure or set a point in time in the future.
- Land use changes should be incorporated to a point in time that is "X" times the life of the structure.

- Underscore the importance of framing risk messages so that individuals will pay attention to the flood risk given our understanding of behavior with respect to low probability-high consequence events.
- Base appropriate land-use measures and zoning restrictions on an evaluation of the expected benefits and costs of these restrictions
- Identify there is a need for well-enforced building codes that reflect the reduction in direct losses and indirect losses from disasters in relation to the costs of meeting the codes.
- The ultimate goal for estimating future flood risk is to provide nearly unbiased estimates of flood risk at any location for any year in the future, as well as to quantify corresponding uncertainties.
- FEMA should use NOAA/NCA or similar global mean sea level scenarios, adjusted to reflect local conditions, including any regional effects (Local Relative Sea Level) to determine future coastal flood risk.
- Future population and land use change impacts on hydrology/discharge should be combined into the existing FEMA riverine study process based on future community build out scenarios to determine future flood risk boundaries.
- Recommendations regarding long term erosion rates, and the do no harm – precautionary principle, as well as the Great Lakes, sea level rise, and riverine situations.

Participants discussed the potential recommendations. Mr. Jones, TMAC member, noted that it would be difficult to adopt anything related to the life of structures, and that build-out scenarios would be more appropriate. Mr. Bellomo, TMAC member, reminded the Council that the report should provide recommendations on how to accomplish things. Mr. Howard Kunreuther, TMAC member, noted that tone of the recommendations should discuss how uncertainty will be incorporated in information released to the public. Ms. Nancy Blyler, TMAC member, offered that the overarching recommendations should be seen as a framework for future work as the TMAC cannot cover the "how to" of everything over the next few months. Members discussed land use measures and zoning restrictions, and Mr. Edelman noted that the Future Conditions Subcommittee will carefully review this recommendation.

Mr. Edelman discussed the Future Conditions level 1 and level 2 outlines and identified the leads for each section. He also outlined the subcommittee's next steps, including additional subject matter expert (SME) presentations, finalizing the level 2 and level 3 table of contents; adopting a style guide, creating annotated mark-ups, finalizing recommendations, receiving approval from Executive Committee on annotated mark-ups, and developing the first written draft.

Database-Driven/ All Digital Display – Status/ Transition

Mr. Dorman introduced Mr. Paul Rooney, FEMA, to discuss the status of FEMA transitioning towards a more digital display. Mr. Rooney noted that there is still a need for a static map product, but that it can be functional, inexpensive, and automated. He explained that FEMA has improved tools and user access and has provided an interactive map in their Map Service Center, as well as a GeoPlatform view. Mr. Rooney noted the many challenges in going digital, including a legacy of unmodernized maps, versioning problems, transition costs, and real estate transactions that depend on the current maps. The long-term vision for FEMA is to have data as a tool to accomplish user's goal. Users would be able to access FEMA's Risk Mapping, Assessment, and Planning (MAP) data through Web services integrated with their own tools so that flood plain data becomes one of many facets in a system. FEMA has implemented several strategies for accomplishing this long-term vision including avoiding FEMA-developed solutions where possible, migrating to data services, incentivizing external solution providers to build tools to communicate FEMA flood risk information, and supporting transition to commercial tools by engaging the private sector. Mr. Rooney concluded his presentation by providing a summary and noting that eliminating static flood insurance rate maps (FIRM) will reduce stakeholder satisfaction; cost savings from eliminating static FIRMs is relatively small; and that legacy/unmodernized inventory is a major challenge.

Mr. Kunreuther asked how Mr. Rooney sees FEMA coordinating all of these efforts and where the private sector can play a role. Mr. Rooney explained that the challenge is connecting with the different stakeholders and assessing their needs. He continued that FEMA first needs to decide what to do about unmodernized inventory. Mr. David Mallory, TMAC member, noted that if the President's budget is fully funded, FEMA may use some of the funds to assist in this effort. Mr. Dorman noted that this concept is about using an integrated database to make digital maps instead making cartographic maps; however, maps can and will still be printed. Mr. Rooney clarified that it is difficult to keep up with tracking the effective date on digital maps if they are constantly revised; static maps help combat this versioning problem. Mr. Fraser recommended including information on the percent of unmodernized inventory and the number of panels in the Annual Report to provide a metric to measure against in the future. Ms. Blyler also noted that static maps are necessary for real estate transactions.

Participants also discussed Elevation Certificates, noting that they are becoming a way to address insurance premiums. Mr. Kunreuther said that a challenge is mapping in terms of risk and noted that understanding where the property is relative to elevation is a critical issue that is missing from the National Flood Insurance Program (NFIP) databases. Ms. Juliana Blackwell, TMAC member, noted that Elevation Certificates are based on a control that may be outdated. She explained that there are uncertainties about the accuracy of the framework that derives the elevation, including the data. Mr. Kunreuther recommended articulating this in a way that FEMA could enable the Certificate to become part of the broader process. Mr. Rooney added that there are deficiencies in flood hazard data and that uncertainties are dominating deficiencies.

Lending and Insurance Perspective

Mr. Dorman introduced Mr. Michael Bremer, CoreLogic Flood Services. Mr. Bremer discussed using FEMA flood map data to make flood determinations. He provided a background and overview of flood determination services which include providing determinations to Federally regulated lenders for compliance purposes. The companies track loans and determinations for revisions to the FIRMs, notify lenders, and provide flood data to insurance companies for policy ratings. The core product is the Standard Flood Hazard Determination Form.

Mr. Bremer walked the members through the process of making and tracking flood determinations, and the federally regulated lender process for revising flood maps after FEMA issues new flood data. He also discussed the following mapping issues and challenges:

- Drawing different conclusions – Companies are legally required to base determinations on flood maps, but things happen on the ground that change flood zones and it takes a while for changes to be reflected in the FIRM;
- Discrepancies between FEMA products – Raster Flood Insurance Rate Maps (RFIRM) and Digital Flood Insurance Rate Maps (DFIRM) – both maps have equal legal authority; and
- Close calls and map differences – Companies are arriving at different conclusions due to interpreting maps differently.

Mr. Bremer offered several recommendations from industry for the TMAC's guidance on the NFIP, including:

- Produce map products that are manageable by the users.
    - Ensure pursuit of precision is balanced by usefulness of maps and information.
- Develop technical map correction process for errors identified between the Letter of Final Determination and effective date.
    - Flood determinations companies work with DFIRM and RFIRM data prior to effective date and identify technical errors.

    - Processes for identifying and correcting maps prior to release can reduce costs associated with Letters of Map Change.
- Ensure non-regulatory zones or areas mapped on FIRMs are distinguishable.
    - Regulatory FIRM products must clearly communicate and delineate necessary flood zones associated with regulatory uses.
- Distribute Letters of Map Revision (LOMR) in digital format and incorporate into FEMA digital map platforms.
    - In certain cases, flood determination companies use raster FIRMs or digitize LOMRs themselves to incorporate into mapping systems.
- Incorporate critical data for regulatory purposes (e.g., CBRS boundaries and corporate limit boundaries) into FIRMs in timely fashion.
    - Inconsistent CBRS or boundary data causes consumer impact in terms of invalid NFIP policy issuance or incorrect rating.
- Require consistent standards and implement effective metrics for mapping contractors.
    - Inconsistency in product quality, delivery, and processes between contractors.

Mr. Edelman inquired about raster generated maps and life of loan processes. Mr. Bremer noted that there are raster based maps for many generations of maps and that companies archive old maps in case a claim comes in that was based on an old determination. Mr. Bellomo noted that FEMA is required to update the NFHL; however, there is a lag in the process. Mr. Bremer explained the life of loan process, noting that the loan is tracked until it is paid off or transferred from one bank to another. He noted that there is an annual refresh on which loans to track; however, most determination companies track loans that they likely do not need to continue to track.

Mr. Bellomo noted that from a risk communications perspective, these mapping challenges are very scary. Homeowners and lenders view the flood maps in black and white – as safe or unsafe, inside the flood hazard area or not. The biggest disservice to the people is how the administrative process communicates risk to the borrower and the banker. Mr. Bremer agreed with Mr. Bellomo's points, noting that the close call determinations are challenging because the water does not stop exactly at the line on the flood map. If the home is not within the line, the homeowner is not federally required to purchase insurance, and it becomes a business decision for the family instead of a matter of safety.

Remarks from Deputy Administrator, FEMA

Mr. Crowell introduced Mr. Joseph Nimmich, Deputy Administrator of FEMA, to provide remarks. Mr. Nimmich thanked the TMAC for their hard work and emphasized the importance of the implications of their reports. He explained that when communities are able to understand the risk they face, they can better prepare. Mr. Nimmich said that it is vital for FEMA to communicate both the risk and mitigation abilities to address those risks to communities. However, the ability to articulate the risk in ways that people can understand it, internalize it, and not resist it is challenging. Mr. Nimmich noted that if communities can understand the risk, they can adjust to the economic environment and plan for the long-term. He added that part of the task that the TMAC is taking on will be changing the way that flood insurance is discussed. There needs to be a discussion within the TMAC council communication and education, not simply whether or not people are in the floodplain. Mr. Nimmich noted that FEMA has become more State focused rather than just a Federal entity. This allows FEMA to be better positioned to have a working dialogue with the States in order to help advise them to better accomplish tasks. Mr. Nimmich said that the TMAC should challenge FEMA with how they could improve the NFIP. He concluded his remarks by stressing that he will work to ensure resources are allocated in order to help implement the TMAC's recommendations.

Subcommittee Breakout #1: Report Topic Discussion

Mr. Dorman stated that the breakout objectives are to: (1) review, refine, and flesh out table of contents topics, outline, and sub-headers as communicated by the Council; (2) review, confirm or re-align 2015 topics by goal; (3) discuss and incorporate the broad and specific recommendations and align to 2015 topics; and (4) establish writing assignments and define page estimations for each topic and components.

Flood Hazards and Operations Subcommittees

Ms. McConkey informed participants that the Operations Subcommittee and the Flood Hazards Subcommittee have developed a combined list of topics for the report. Ms. Durham reviewed the table of contents, noting that the first part of the report will be the same as the Future Conditions Report and will include an introduction, TMAC activities, and the purpose.

Participants discussed the differences between the goals, topics, overarching recommendations, and recommendations. They noted that the goals are the TMAC's goals. In addition, the subcommittee Chairs noted that there are both low level and overarching recommendations. Mr. Jones recommended having a discussion of the goals at the beginning of the report so that the discussion progresses from general to more specific.

Mr. DeMulder reminded subcommittee members of Mr. Nimmich's remarks and said that they should think about the document in terms of where they want resources allocated for activities that are most critical. Mr. Fraser agreed and recommended including this information in an Executive Summary. Mr. Bellomo recommended tracking the recommendations back to the goals. Mr. Dorman agreed and suggested that the subcommittee sort the recommendations by goal to see if the topics speak to the recommendations or if additional topics are needed.

Mr. DeMulder said that instead of having a recommendation regarding future FEMA topography, he recommended noting that this can be met by sufficiently investing in QL2 data. Mr. Godesky reminded participants that they cannot recommend a specific dollar amount.

Subcommittee members categorized the recommendations under specific goals and assigned leads to each recommendation. The assigned person will be responsible for refining the recommendation.

Future Conditions Subcommittee

Mr. Edelman took roll, and discussed the four remaining SME presentations. Mr. Steve Ferryman, TMAC member, will arrange for a Great Lakes SME presentation for the Future Conditions Subcommittee. The subcommittee discussed the varying levels of the current report outline and the style in which they are going to write. Mr. Kunreuther suggested that the subcommittee provide literature or references to document their findings. Mr. Edelman will work with FEMA's contractor to develop a template for the Future Conditions Report.

Mr. Crowell questioned the topic of watershed hardening and its relevance to the Future Conditions report. The group discussed various ways to explore this topic and decided to revise the topic to shoreline hardening as "future conditions" covers more than sea level rise; it should also cover jetties, seawalls, and soft solutions to protect the shoreline. The members discussed the topic of uncertainty and noted to make sure their recommendations in the report are in line with Presidential Policy Directive 8 *National Preparedness*.

The group discussed water requirements, and changed it to "water data needs". The group debated different approaches for future condition calculations and mapping, and decided to include riverine and coastal erosion. Mr. Jones suggested changing "coastal erosion" to "evolving geomorphology" to demonstrate the changing of the floodplain – erosion, accretion, and deposition. The members agreed. The Risk Management Philosophy section is a section that will likely need to be revisited and updated routinely. Subcommittee members assigned various other writing assignments, including:

- Water data needs section – Mr. Robert Mason, TMAC member, and Mr. Tim Cohn, SME
- Geographic coastal approaches section – Mr. Jones and Mr. Jonathon Westcott, SME.
- Best available riverine science section -Mr. Mason and Dr. Katherine White, SME.

Mr. Edelman and Mr. Kunreuther led the discussion around design elevation. Mr. Kunreuther recommended exploring the elevation certificates and emphasized the importance of Elevation Certificates in the design elevation section and throughout the report. The group discussed the need to clearly define "critical facility" in discussing safety in design elevation. It was noted that FEMA has clearly defined "critical actions" because Federal funding is tied to actions defined as critical; however, the idea of "critical facilities" must be further explored and defined.

Subcommittee Report Out

Flood Hazards and Operations Subcommittees

Ms. McConkey reviewed the potential recommendations and invited subcommittee members to make comments about any of the recommendations. She said that members have been assigned to the different recommendations and these individuals will better refine and articulate the recommendations. Ms. McConkey noted that topics are placed under goals and that the recommendations are aligned under the goals.

Mr. Bellomo said that the TMAC is charged with communicating the risk to the homeowner and that conceptually, the Council should address risk assessments. Mr. Mallory asked what the subcommittee envisioned for the creation of a flood risk management group. Mr. Dorman responded that the TMAC is providing FEMA with recommendations, and the Council may suggest that FEMA create a flood risk management group to act as an operational working group.

Mr. Kunreuther suggested that if the subcommittee begins to write and finds that certain topics cut across several goals, they might want to rethink the organizational structure. Mr. Bellomo agreed and suggested creating a chart to see where items overlap from an organizational perspective.

Ms. Carrie Grassi, TMAC member, expressed confusion as to why moving from the 100 to 1,000 year line would fall under the topic of uncertainty, as one tries to explain the range and nuance of risk and the other explains uncertainty in the models. Mr. Dorman explained that there is uncertainty in moving from the 100 to 1,000 year line.

Future Conditions Subcommittee

Mr. Edelman discussed the potential dates and times for the remaining SME presenters, the assigned section authors for the outline, and the level of documentation the subcommittee is considering. Mr. Edelman shared the new subtopics under Approaches for Future Conditions Calculation and Mapping section. He noted that the subcommittee is finalizing the level 2 outline and discussed proposed net tasks. Mr. Crowell said the subcommittee anticipates that the potential recommendations will be brought forth to the full TMAC council at the June 2015 meeting.

Public Comment Period

Mr. Crowell announced that, per FACA, members of the public were invited to provide written comments on the issues to be considered by the TMAC. Two comments were provided, displayed as received below:

1. *Source: Scott Wegner, 6238 State Highway 71, Sparta WI 5465*

Date: April 21, 2015

Subject: Approximate zone A concerns

Comment: What is the time table do eliminate and correct approximate zone A flood designations that were set using contour interpolations on a 20 ft contour map? I have found that many areas have been included in Zone A approximate floodplains that would not be considered flood plains If detailed hydrologic studies were done.

I have had a professional engineer/licensed land surveyor do elevation mapping and I have a Wisconsin DOT bridge hydraulic report with the calculations used in computing the 100 year design flow and determining what the 100 year flood elevation is above the bridge and below the bridge. My property is on the immediate downstream side of the bridge and the lowest elevation on the lot 7 feet above that. But because I am in this approximate zone A piece of crap flood zone that isn't reality I have to spend my time and resources to prove this is wrong. Is FEMA going to compensate the landowners for the loss in property values because you have slandered the titles of their properties with this crap?

13 south western Wisconsin counties received grant funding in 2010 to have LIDAR surveys and mapping done. In 2015, I can have my local land conservation office print a contour map showing 2 ft contour intervals. FEMA will not accept these maps without a PE field verifying the elevations. I have the accuracy report from the LIDAR study showing the study met FEMA standards. And I still have to spend money to prove that the map is accurate.

The sad part about this is The LIDAR data is all been applied to a GIS platform and it should be relatively simple to incorporate that into some modeling software to come up with a realistic floodplain in these areas. If you can't do that, then why can't you contour interpolate from the 2 ft contour map? Then let's see where the boundaries end up on the map.

The people in these areas have put up with this long enough. It is time fix this NOW!!!!

2. *Source: Alan R. Lulloff, P.E., CFM*

   Date: May 7, 2015

   Subject: ASFPM comments to the TMAC
   Comment: Comments are provided here on two issues: map accuracy and Cooperating Technical Partners.

   Map accuracy – Flood hazard maps are one of the most valuable products the federal government provides to communities. However, instead of being welcomed as an important tool for managing flood risk and community planning, the mandatory flood insurance requirements associated with the FEMA Special Flood Hazard Area (SFHA) mapping can create significant angst within a community. When owners of buildings within the mapped flood hazard area are required to purchase flood insurance, they often feel betrayed. "You gave me a permit to build here; therefore, it should be safe. How can it be that I am now informed that my building is in a flood hazard area?"

   This is a challenging enough situation. However, when there are instances that the new flood maps incorrectly show well-sited homes or businesses in the flood hazard area, it unfortunately shifts the focus from avoiding flood hazard areas or mitigating flood risks, to questioning the accuracy of the maps.

   Streams gages and HWMs on streams with no gages document historic flood events. Floodplain engineering modeling that has been calibrated or validated against historic flood events can be deemed "accurate." The reason it can be deemed accurate is that while the uncertainty can never be reduced to zero, it can be quantified. In instances where engineering models have not been

calibrated or validated against historic flood events – the uncertainty is unknown. No accuracy "uncertainty" can be determined; therefore, these maps can then be appropriately deemed inaccurate.

Unfortunately today it appears that most flood studies (~90%) are not calibrated or validated against stream gages or highwater marks. ASFPM recently conducted a study to identify best practices and provide recommendations for policy that would make HWMs more useful and the collection of HWMs more consistent. One of the four recommendations includes establishing a "nationwide geospatial database for archiving high water mark data and making it available to the public," similar to the Texas Highwater Mark Inventory*. Through a collaboration with federal agencies, local governments and the private sector, the Texas floodplain management program has compiled a collection of over 15,000 HWMs that are accessible via the Texas Natural Resource Information System (TNRIS).*

Cooperating Technical Partners - In developing the Flood Map Modernization Plan, FEMA conceptualized the Cooperating Technical Partners (CTP) initiative to increase involvement in map production through formalized Federal-State-regional-local partnerships. The intent was to facilitate and capitalize on these State, regional, and local efforts and coordinate them with FEMA's flood mapping efforts in a consistent way rather than on an ad hoc basis. Today there are more than 200 CTPs. Most CTP Task Agreements are collaborative efforts to maximize the extent, accuracy, and utility of flood studies to best meet local and Federal needs while minimizing costs. This cost-shared approach to funding flood mapping activities allows FEMA and other Federal agencies, States, regional and local governments to leverage their available resources, and maximize output.

According to the 2004 GAO report on Flood Map Modernization: "Since 2000, FEMA has leveraged millions of dollars in funding from 171 partners (states and local communities) for producing maps through its CTP program. For example, from fiscal years 2000 to 2002, FEMA used $70 million of its federal map modernization funding along with state and local funds to develop what FEMA has estimated to be more than $155 million worth of new mapping data."

CTP agreements are not simply contracts to produce flood maps but partnership agreements with State, regional and local government agencies and federally-recognized tribes that have constitutional and legislated authorities associated with public safety, land use, water and stormwater management. Maps produced by these partners generally undergo a higher level of independent technical review and demonstrate a higher degree of public acceptance. These partners do not "leave the room" but "live with" the flood maps produced.

Below are links to the ASFPM High Water Mark study and another document called Strategies to Improve Community Acceptance of Flood Engineering Studies and Maps that we feel could be useful to TMAC.
http://www.floods.org/ace-files/Projects/ASFPM_HWM_Report_Final_201406.pdf
http://www.floods.org/ace-files/Projects/Strategies_for_Improving_Community_Acceptance_of_Flood_Engineering_Studies_and_Mapping.pdf

Respectfully,

Alan R. Lulloff, P.E. CFM
Science Services Program Director, ASFPM

Mr. Crowell called for additional public comments. Ms. Merrie Inderfurth, ASFPM, offered the following comment:

I hadn't heard anyone mention an executive summary. I assume that's a part of the process. Given that we have changing Congress, and a lack of recollection of history, some substantive background in the form of an executive summary pointing out some of the key things that may not be obvious to all readers (e.g., difference between flood insurance rate map and other data on future conditions). Just the basics would be helpful in an executive summary.

Adjournment

Mr. Crowell thanked participants for the discussion and said that the meeting to reconvene at 8:00 a.m. on May 13, 2015.

Day 2: May 13, 2015

Call to Order/ Roll Call

Mr. Crowell opened the meeting, provided an overview of the facility, and took roll call of TMAC members. He then introduced Mr. Dorman to facilitate the remainder of the day.

Map Generation: Workflow Process

Mr. Dorman introduced Mr. Michael DePue, Atkins, to discuss the overall process and steps of map generation. Mr. DePue reviewed the steps of the condensed mapping cycle, including: (1) inventory management; (2) discovery/scoping; (3) data acquisition; (4) engineering; (5) regulatory and non-regulatory product production; (5) due process and appeals resolution; and (6) project close out. He explained that inventory management is a rigorous process as there are thousands of maps to be managed. Mr. DePue continued that the discovery and scoping phase determines the requirements for product updates, and the challenges of this phase include local staff turnover and stakeholder acceptance. To combat these challenges, he noted that it is beneficial to complete this step as rapidly as possible to ensure continual buy-in from local staff. Discussing the third step, Mr. DePue said that data acquisition depends on ideal topography and aircrafts to obtain the information and that there are certain time windows for aerial topography and a need for the right weather conditions. This step sets the entire process for the mapping process. He noted that there is a lot of innovation in drone technology, sonar, three dimensional imaging and new sensors. According to Mr. DePue, the engineering phase creates new models and data for the needed products. He explained that economy of scale is challenging as there is a large set-up premium.

Mr. DePue said that regulatory and non-regulatory products have become more database driven over time and the quality has improved due to increased consistency. He explained that there is a need for a fully modernized base to make the process easier, as there is a problem of integrating modernized and unmodernized maps. Mr. DePue stated that the due process and appeals process is driven by regulations and that this is the entry point to many flood mapping challenges. Finally, Mr. DePue said that the project closeout phase archives timelines and requirements and ensures they have strong checks for compliance.

Next, Mr. DePue reviewed the perceived credibility of the mapping process. He explained that perceived credibility is a strong function of perceived negative impacts of the product, perceived product quality, usability of products, perceived engagement of stakeholders, and use of local data in the process. It is a moderate function of the speed of the project from start to finish and perceived positive impacts of the products. In summation, Mr. DePue said that the mapping cycle has improved dramatically although it is a longer process as there is more time for better outreach and communication.

Mr. Jones asked how long it takes to complete various phase of the process now, as opposed to the previous mapping process. Mr. DePue stated that data acquisitions and engineering phases take less time and are less expensive than before. He said that both discovery and due process take more time. He explained that while the process has seen an overall increase in time due to better outreach, the

mechanics and technical parts of the process are faster. He stated that the fastest time to complete the mapping process is several months. Ms. McConkey noted that the funding cycle, among other things, may add additional time to the process.

Mr. Fraser asked when information becomes the best available information for the community to use. Mr. Bellomo answered that this is a challenge, but FEMA released a technical bulletin that outlines the use of preliminary data as best available and encourages local governments to use it. Mr. Bellomo will provide TMAC members with a flow chart that illustrates the map generation workflow.

Ms. Carrie Grassi, TMAC member, asked where the map generation process would benefit from the most improvement. Mr. DePue emphasized the need for better coordination in the process among those generating the maps and the communities providing mapping data. He said that the mapping process can be delayed due to communities providing mapping data very late in the process and expecting it to be incorporated in the maps. He explained that being able to alleviate delays would benefit the workflow process, and noted that is where outreach helps. Mr. Bellomo said that data is constantly available and that there will always be an issue with last minute and new data. He added that FEMA must be willing to not incorporate it; there needs to be more rigor in the decision-making process in terms of what data to include and to defer the data that is not used to the next cycle, instead of constant updates. Ms. Durham noted that LOMR's are useful for incorporating late data from communities.

Ms. Grassi inquired as to the improvements that could be made in the discovery process. Mr. DePue explained that both inventory management and discovery are relatively young processes, with room to grow. He said that the discovery phase involves a lot of travel and visiting of communities; however, better media and Web technology could reduce travel and speed up the timeline. Mr. DePue continued that there are many efficiencies of performing engineering on a hydraulic unit code (HUC) 8 scale. He noted that some States have large communities, especially with township systems that make working with a HUC 8 schedule more complicated. According to Mr. DePue, using a HUC 8 schedule is good at the county level.

Several members discussed the possibility of instantaneously producing new maps and if constantly changing maps would be good for map generation and communities. Ms. Durham suggested that it may be time to consider separating the insurance from the development, and identifying hazards and communications risks. She suggested that these studies be performed first so that development occurs at a higher standard prior to insurance being involved for due process. Mr. Fraser said that the Government could produce guidelines, allowing communities to add additional layers to it. Ms. Grassi noted that the knowledge and the checks and balances from the community are important to have in the process. Members acknowledged that having a process in place is important, as well as community engagement. Mr. Kunreuther said that there is an opportunity for the TMAC to provide mapping guidelines regarding communicating risk and engagement. Mr. Bellomo also noted the importance of looking at investing in technology to ensure it is credible. Mr. DePue added that the concept of actionable risk is constructive and aids this process of generating good mapping products and informed community outreach.

Subcommittee Breakout #2: Report Topics

Flood Hazards and Operations Subcommittees

Mr. Dorman explained the goal structure format for the subcommittee members, noting that recommendations will be placed under each goal. He mentioned that by outlining the report by goal, the TMAC can easily see the progress that has been made towards achieving them. Ms. Wendy Lathrop, TMAC member, recommended that the subcommittee develop a matrix in order to see the progress against the goals. She expressed concern with the format, noting that the same background information could be used to support multiple goals. Mr. Bellomo said that many items do not require much background and that the sections under each goal will have to provide details of the program. He noted that the items under each goal may be altered for each report. Mr. Butgereit reminded participants of the

importance of aligning the topics and recommendations back to the legislation. Participants discussed the various approaches and decided to go with the outline as currently organized by topic rather than by goal.

Participants expressed concern that the write up for each goal may vary greatly in length, thus diluting some of the goals. Ms. Blackwell recommended addressing the goal and specific recommendations in the executive summary. She explained that once this is described in a condensed format, the report can later provide a more detailed description of the goals. However, several participants stressed that the executive summary needs to be high level and condensed. Ms. Lathrop said that the executive summary could address the goals and tie the recommendations together. In addition, Ms. Blyer recommended that the subcommittee map the recommendations to the goals.

Continuing to discuss the report's format, several participants recommended structuring the report based on topic. Mr. Luis Rodriguez, FEMA, said that using the goal approach is a good way to track the progress of recommendations. Participants agreed that the Executive Summary will be driven by the goals.

Next, subcommittee members reviewed the list of topics to determine if they should be included in the Annual Report and added performance metrics as a topic.

Future Conditions Subcommittee

Mr. Edelman took roll and then noted that he revised the table of contents to reflect the updates made during the May 12, 2015, subcommittee breakout session. Mr. Edelman explained that the last section of the report will include possible unintended consequences or implications for future conditions. He noted that this section will develop as the report develops.

The subcommittee discussed flood insurance rating premiums that will need to change to reflect risk and if that is considered an existing risk or future risk. The members discussed what a future conditions map would look like, and if such a map might help the country move from the current inside the flood line versus outside the flood line mindset. Mr. Westcott suggested that the TMAC provide guidance for future conditions rather than attempting to codify with rules and policy as they cannot be updated frequently.

Members discussed the "do no harm" principle, a precautionary principle used in economic analysis surrounding the question of whether doing something is better than doing nothing. The group discussed deterministic scenario approaches versus probabilistic approaches. Mr. Edelman suggested that the subcommittee should create a table in the report, illustrating which scenario to pick based on the particular situation, for new or retrofit construction, in order to receive NFIP Community Rating System credit. Mr. Edelman emphasized the need for some type of national standard, particularly so the U.S. Department of Treasury can justify the investments in these programs. He envisions the table as a good starting point for a standard. Mr. Doug Marcy, SME, suggested that creating a table would be difficult due to changes along the coast and in varying communities. There is varying future risk in different parts of the country and varying future conditions across the board. The group discussed the possibility of a national standard and came to the consensus that the Nation should have a consistent future conditions layer, that local communities should be encouraged to adapt to their individual needs.

Subcommittee Report Out

Flood Hazards and Operations Subcommittees

Ms. Durham informed TMAC members that during its breakout session, the subcommittee discussed goals and topics. She noted that the group is currently revising its topics list.

Future Conditions Subcommittee

Mr. Edelman said that the subcommittee had an engaging conversation regarding if the United States should have a national standard for future conditions in climate change. He added that the subcommittee will continue to discuss this issue. Mr. Edelman said that the subcommittee also developed additional considerations regarding the implications that future conditions mapping may have on people.

Subcommittee Breakout #3: Report Structure

Flood Hazards and Operations Subcommittees

During the breakout session, participants agreed to the draft topics included in the 2015 Annual Report. Participants also agreed to keep the overarching recommendations in the report. Mr. Bellomo noted that FEMA receives criticism regarding performance metrics. He suggested that the TMAC develop a recommendation regarding FEMA developing performance measures to track its success. He said that the TMAC should specifically state how to track measures as it will help to drive budget decisions. Mr. Rodriguez recommended tying the performance metrics to the overarching goals. Participants agreed that performance metrics would be a topic in the report and the subcommittee will determine its location at a later date. Participants also agreed to lead authors for several sections.

Future Conditions Subcommittee

Mr. Edelman took roll and reviewed the subcommittee's accomplishments. He noted that it has become evident that the subcommittee will need to be diligent and take their time in discussing basic concepts before the report writing can begin. He encouraged section leaders to work with their writers to develop the sections to a point where the whole subcommittee can comment on the content. The group discussed the process of reviewing content and decided that leveraging the TMAC SharePoint site to break up the various sections, and "check out" the sections so that one author will work on it at a time, is the best way to ensure revisions are saved.

The group then walked through potential recommendations, focusing on the recommendation that uncertainty should be included when information is released to the public. Mr. Jones questioned whether uncertainty should be explicitly communicated to the public or inherently in the product, noting that explaining the process may add more confusion. Participants discussed various ways to include uncertainty in products. Ms. Grassi suggested that uncertainty of future conditions might need to be mapped as a non-regulatory product. Mr. Westcott suggested that it should be regulatory information for building decisions, but not for insurance rating. Mr. Edelman reminded the subcommittee that the legislation calls for ensuring that FIRMs incorporate climate science going forward, but that there can be non-regulatory information on the FIRMs.

Subcommittee Report Out

Flood Hazards and Operations Subcommittees

Ms. Durham discussed the flood hazard and operations subcommittee joint session. She noted that the subcommittee agreed on the organization of the 2015 Annual Report and worked through several key topics. Ms. Durham said that Mr. Dorman will draft the executive summary. This section will outline the goals and highlight some of the recommendations under each goal. The report will be a topic-driven discussion and recommendations. Ms. Durham also reviewed the topics and the assigned lead authors for each section.

Future Conditions Subcommittee

Mr. Ferryman walked through the current table of contents and the general overview of the Future Conditions Report. He said that the subcommittee spent a lot of time discussing existing products versus

future products and incorporating uncertainty. Mr. Ferryman noted that the report will include a recommendation on uncertainty, including both current and future considerations of uncertainty. He said that the group also concluded that climate change, as it related to riverine, is included in their purview. Mr. Fraser asked for the best available alluvial science to be included in the range of best available climate sciences, and the group agreed to discuss that at the next meeting. Mr. Bellomo noted that it is important to document all assumptions and Mr. Dorman asked the subcommittee to look at the "how"" when developing recommendations in the Future Conditions Report.

2015 Reports - Content Adoption, Deliberation and Vote

Ms. Durham made a motion to adopt the 2015 TMAC Annual Report table of contents subject to future amendments made by the Council. Mr. Crowell announced that, per FACA, members of the public were invited to make comments on motions made.

Mr. David Conrad, Water Protection Network, made the following comment:

> *The non-regulatory uses of FEMA's risk assessment information is going to be increasingly important in the future. Communities need to increase focus on land use management. Coastal communities need to understand their increasing risk as they are determining land loss. There are increasing needs as communities change. Many economies of communities are dependent on natural resources like beaches, shores and natural habitats that are subject to increasing risk. I urge both reports to bear in mind the community needs for new types of risk information and support new challenges and decisions – don't just focus on special flood hazard areas and focus on communicating risk in ways that inform and empower communities as they face their future.*

Jeff Sparrow, Michael Baker International, made the following comment:

> *The group is doing a lot of great work and there are a lot of good recommendations coming out, but make sure you think about some of these things- Joe Nimmich talked about the idea of being inside or out of the flood line and the need to change the conversation around this. Yes, it's a technical mapping advisory council, but what are the products that can drive the change that can help the community and help homeowners understand the risk and the actions they can take? Insurance is just one of the steps they can take to mitigate risk – flood mapping isn't just supposed to be about insurance. How can we achieve the mission of mitigation actions by producing new products to help save life and property? Changes in GIS and automation mean we have a lot more products that can help. The conversation is changing around resiliency and risk reduction. The reports are really important to funding important changes for the future. Uncertainty is a technical concept – how do you boil it down to a concept that people can understand?*

Following the deliberations, Mr. Dorman called for a vote on the 2015 TMAC Annual Report Executive Summary, subject to future amendments made by the Council, which the TMAC members unanimously approved. Mr. Dorman also called for a vote on the 2015 TMAC Annual Report table of contents, subject to amendments made by the Council, which the TMAC members also unanimously approved.

Next, Mr. Edelman made a motion to adopt the 2015 TMAC Future Conditions Report table of contents, subject to future amendments made by the Council. Mr. Crowell announced that members of the public are invited to make public comments on the motion. While the public was offered the opportunity to speak, no comments were received. Following the deliberations, Mr. Dorman called for a vote on the 2015 TMAC Future Conditions Report table of contents, subject to amendments made by the Council, which the TMAC members unanimously approved.

Public Comment Period

Mr. Crowell announced that, per FACA, members of the public were invited to provide written comments on the issues to be considered by the TMAC. Two comments were provided, displayed as received below:

1. *Source: Jack Xu, Santa Clara Valley Water District*

   Date: May 7, 2015

   Subject: To TMAC DFO

   Comment: These comments are in regards to CTP mapping procedures.

   When we perform a detailed 2D overland/storm sewer analysis, there may be locations where flooding occurs due to pipe overload and localized sinks in a 1% flood that are not naturally connected to a waterway. These are traditionally not modeled, and don't show up often, if at all, on FIS maps, since they are not naturally connected. Will we be adding these now and subjecting people to the 100-yr floodplain? These parcels are at risk of flooding from storm sewer backups, but not in the defined floodplain in the traditional sense.

   With 2D software that draws flood boundaries using mesh polygons (such as FLO2D), the resulting flood maps are usually jagged and coarse, depending on the mesh size. Is there a procedure to smooth out the lines to replicate the current FIS maps?

   Thank you.

2. *Source: Paul A. Osman, Manager, Statewide Floodplain Program Programs, on behalf of the Illinois Department of Natural Resources (Bruce Rainer, Governor; Wayne A. Rosenthal, Acting Director)*

   Date: May 4, 2015

   Subject: FEMA Docket ID FEMA -2014-00222
   Comment: Please accept these comments from the State of Illinois' on how to improve Flood Insurance Rate Maps and flood risk outreach efforts.

   With over 15% of Illinois' land area prone to flooding, and one of the nation's largest inland systems of rivers, lakes, and streams, this state has a long and tumultuous history with flooding. However, a state-based mapping program, strong regulatory compliance, and proactive mitigation actions have all worked together to drastically reduced the state's exposure to flooding. With a focus on these three disciplines, Illinois has led the nation in overall reduction of flood losses. For these reasons, we have a vested interest in the Technical Mapping Committee's recommendations and we believe our experiences can help lead to programmatic improvements nationwide.

   For over 40 years FEMA has invested time, resources, and funding to build strong state-administered floodplain management, outreach ,engineering and mapping capabilities Unfortunately, with increasing regularity, FEMA appears to be ignoring proven state expertise and funding short-term outside contractors who are unfamiliar with local floodplain management and mapping issues. This has not only cost more and delayed mapping efforts but perpetuates the stereotype of FEMA unaccountability among state and local officials.

   At the onset of map modernization, the State of Illinois developed a business plan to build our state mapping capabilities and to work closely with our local officials. Using in-house expertise and a long-term vision of accurate and efficient mapping, we have now produced digital maps for the majority of counties in the state. We are one of only a few states in the nation which completed this effort entirely in-house with state CTP staff. We now have dedicated staff, institutional knowledge, and proven expertise which results in flawless risk identification and mapping efforts at a much lower cost to FEMA.

However, good floodplain management and risk identification is not always tied to technical improvements or quantifiable metrics. Perhaps the most important consideration in good floodplain management is the human factor. Many states have developed long-term and trusting relationships with community officials. These relationships provide immeasurable benefits to FEMA and continue far beyond any contract period. As has been proven many times in the past, the strategy of using ill-informed FEMA contractors without delegating the state as a managing and supporting partner becomes painfully obvious at the local level. It ultimately reflects badly not only on FEMA's credibility but also on our own state credibility. In our experience, building long-term and trusting relationships are perhaps the most important aspect of a strong local program committed to risk awareness and risk reduction. Unfortunately, this key component has all but disappeared from current FEMA strategies.

In FEMA projects where the state has not been delegated management or mapping roles, state staff continue to find ourselves spending an ever-increasing amount of our valuable time conveying our knowledge and appropriate files to FEMA contractors so they can begin to understand the very basics of local floodplain mapping and mitigation issues. Often, long-known floodplain management issues gathered from state input are simply repackaged and presented to FEMA as a mitigation action item. It is difficult to justify the time and effort it takes for state staff to educate, train, and facilitate these short term contractors when we are fully capable of doing the work much more effectively and efficiently in-house.
Furthermore the time necessary for short term contractors to research and learn the very basics of state programs, local flood history, and local problems; then meet with local officials (many times), and compile documentation (already evident to state staff) quickly adds up to a costly and time consuming waste of everyone's resources. Many of these "mitigation action" programs can take years to accomplish and ultimately do little more than frustrate local officials and delay mapping rather than inspire true mitigation actions. Many of these programs have already dragged on for years with absolutely no accomplishments to show.

It appears obvious that an increasingly large chasm separates those states which have proactive floodplain programs from those states with little or no state programs. These contractor-driven programs may be necessary in those states with little or no state programs but they only serve to frustrate the good states. Unfortunately, current FEMA strategies do not differentiate between the "good" states and the "not-so-good-states". ***Illinois strongly believes that a state ranking system should exist where the proven and qualified states are given more autonomy to administer FEMA mapping and floodplain management programs.*** *This process would avoid unnecessary costs, expedite the mapping process, and most importantly, built strong partnerships at the local level where program benefits are most effective.*

We hope the TMAC will encourage FEMA to prioritize and incentivize states with strong in-house floodplain management, outreach, and engineering, and mapping capabilities when making future decision related to mapping and floodplain management.

Sincerely,

Paul A. Osman
Manager, Statewide Floodplain Programs

TMAC Member Discussions, Next Steps

Mr. Dorman announced that the subcommittee chairs will work with the TMAC members and continue report development. He added that the TMAC should add additional amendments to the Annual Report. Mr. Dorman said that he hopes the reports will have annotated mark-ups by the June 2015 meeting and

the recommendations will be discussed at that time. Prior to the next meeting, the subcommittees should continue to work on report story boards and begin to write the reports. Mr. Dorman and Mr. Edelman will work to determine a style guide for the reports. Mr. Mallory requested a presentation from a Community Engagement and Risk Communications contractor on risk communications and how messaging is developed and delivered, to get an alternative perspective.

Adjournment

Mr. Dorman and Mr. Crowell thanked members and Mr. Crowell adjourned the TMAC meeting.

Action Items

- Mr. Edelman and Mr. Dorman will complete subcommittee issue form on a representative issue for members.
- Mr. Crowell will obtain information from the FEMA attorneys and CMO officer regarding the information that members may release to their organization.
- Mr. Ferryman will arrange for a Great Lakes SME presentation for the Future Conditions Subcommittee
- Mr. Edelman will work with FEMA's contractor to develop a template for the Future Conditions Report.
- Mr. Bellomo will provide TMAC members with a flow chart that illustrates the map generation workflow.

Appendices

- Appendix A: 2015 TMAC Annual Report Executive Summary
- Appendix B: 2015 TMAC Annual Report Table of Contents
- Appendix C: 2015 TMAC Future Conditions Report Table of Contents

Certification

I hereby certify that, to the best of my knowledge, the foregoing minutes are accurate and complete.

John Dorman
TMAC Chair

Appendix A: 2015 Annual Report Table of Contents

See below for the 2015 TMAC Annual Report Executive Summary, subject to future amendments made by the Council, which the TMAC members unanimously approved.

TMAC - 2015 Annual Report - Executive Summary
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13-May-15

Section

Appendix B: 2015 Annual Report Table of Contents

See below for the 2015 TMAC Annual Report Table of Contents, subject to future amendments made by the Council, which the TMAC members unanimously approved.

TMAC - 2015 Annual Report
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Appendix B: 2015 Annual Report Table of Contents

Appendix C: 2015 Future Conditions Report Table of Contents

See below for the 2015 TMAC Future Conditions Table of Contents, subject to future amendments made by the Council, which the TMAC members unanimously approved.

TMAC - Future Conditions Committee
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April 7, 2015; May 8, 2015; May 12, 2015

Appendix C: 2015 Future Conditions Report Table of Contents