DRAFT Issues List for Use of 2-Dimensional Models on Active Alluvial Fans

This document is an initial and preliminary repository for input of any potential issues and/or arguments that would need to be thoroughly and acceptably satisfied to justifiably and defensibly support the use of 2-D modeling on an active alluvial fan. The issues/arguments listed are from a vast array of sources (including documents and correspondence from previous emails, conferences, phone conversations, committee communications etc.) and do not necessarily reflect the views or experience of the author.

1. There is a need to ensure that current or higher standards are understood, adopted and utilized (can't unjustifiably lower standards). Any and all proposed changes should include clear, detailed acceptable justification as to why the current standards are insufficient to protect people and property and how proposed changes correct the shortcomings without reducing protections elsewhere.
2. It should be considered that since the time that the current regulations were adopted, while they were being enforced, and the current methodologies implemented, there continue to be catastrophic floods that take lives, damage property, and endanger the lives and safety of the general population within these areas. There also continues to be significant and costly legal settlements associated with this type of flooding. With that in mind, it should be clearly explained how a reduction, and not increase, in the protections currently afforded is warranted. It should be shown how the current methodologies and regulations have failed at protecting persons and property, and how the recommendations will correct these shortcomings.
3. Without acceptable justification, there is a need to be conservative. Underestimation of flood risk can lead to fatalities and costly reparations. In general, applying FEMA's current methods to assess flood risk is legally defensible and passes the "reasonableness test". Applying a methodology that underestimates flood risk is not likely to pass such a test.
4. The committee workgroup should poll all 2-D software producers for input on their software's applicability on active fans (keeping in mind that there may be financial conflicts of interests present).
5. The committee workgroup should request input from the ASCE 24 panel of authors.
6. There could be potential significant underlying financial motivations for promoting the use of 2-D models (significant increase in land values, consulting work, tax revenues), which could pose conflicts and significant future issues if detailed, thorough and acceptable justification is not the basis for allowing their use.
7. There is no need for 2-D analyses of active fans where development is proposed. Current regulations don't allow development on active alluvial fans unless structural flood control measures are included. Flowrates used need to be from the apex (calculated using standard hydrology, see 11/18/13 FEMA response letter), and the required structural measures can be analyzed using standard deterministic methods. Also see ASCE 24.
8. 2-D models have still never been approved by FEMA for use on active fans.
9. NRC 1996 document, "Alluvial Fan Flooding" National Research Council, 1969.
    a. Development pressure will try to reduce special flood hazard areas and costly mitigation requirements and maximize areas where elevation of fill, or less, can be offered to mitigate the underestimated risk.
    b. Areas on alluvial fans with uncertain flow path flooding cannot be reliably analyzed with deterministic models. Deterministic models applied to the existing condition alluvial fan

topographic surface provide only a snapshot based on pre-flood topography, of the surface that represents the sum of past floods. On active alluvial fan surfaces, the flood itself changes the topography by erosion, deposition, and avulsion processes that are themselves unpredictable. "Alluvial Fan Flooding" clearly states: "For risk assessment under alluvial fan flooding, existing channels cannot be relied on to convey the 100-year peak flow, so their role is ignored. For riverine floodplain management, however, the channels are significant." Further, "...floodwater surface elevations computed using pre-flood topography are not a comprehensive indicator of true hazard for alluvial fan flooding situation as they are for riverine flooding."

10. No one is currently prohibiting adoption of more conservative mapping (adding 2-D results where worse).
11. Flowrates cannot be reduced due to infiltration across the fan surface (see 11/18/13 FEMA response letter).
12. Flooding can change due to each storm, or during a storm. Would need to remap after every storm.
13. Here is a thought experiment. Run the model. Push the run button again. And again. And again. Are all the answers the same? If yes, this means that the model is not modeling sediment transport or flow path uncertainty and can be rejected for active fans or fans where future flow path uncertainty cannot be neglected.
14. FEMA staff has stated that they have not seen any recent breakthroughs in the technology of predicting avulsion, erosion and deposition. It is FEMA's understanding that the science of water and sediment transport haven't fundamentally changed since Hans Albert Einstein, except that computers make applying the complex modeling equations easier to solve than before.
15. Active areas should not be mapped as Zone A – as it might give the impression that LOMR-F is appropriate.
16. Adding stochastic component properly to a 2-D model results in the Fan model.
17. 2-D models cannot predict avulsions, address flow path uncertainty, model random processes, or completely consider probability.
18. FEMA's FAN program handles avulsion, erosion, sedimentation, flow path uncertainty, and it considers the dynamic environment, such as alluvial fan flooding, to produce AO flood insurance Zones with defined depths and velocities. The AO Zone with depths and velocities is the method that FEMA uses to identify to the public areas that are subject to alluvial fan flooding, and is also used for flood insurance rating purposes.
19. FEMA staff has stated that an endless list of misapplications of a certain model - because FEMA staff relented under marketing pressure, does not make failure to comply with FEMA regulations acceptable.
20. Flow path uncertainty does not vanish by applying deterministic "hydraulic analysis methods" on active fan surfaces, no matter how detailed or complex the deterministic methods are. The more esoteric and unexplainable the model, the greater the illusion of flow path certainty. "Outcomes in observation of a random variable [say avulsion] are affected by an extremely large number of causative factors. Determinists in natural sciences sometimes contend that the search for deterministic relations will include with time more and more causative factors to explain effects on a random variable. Following this reasoning, it could be expected with time to continuously extend the deterministic explanation and description of present-day hydrologic

random phenomena and substantially restrict the application of probability theory in hydrology. This reasoning has a fundamental weakness. A finite number of causative factors taken into any deterministic equation could rarely exhaust all causative factors involved in the outcome of a hydrologic random phenomenon. If the causative factors are also random variables, which they are more often than not in hydrology, these cause-effect deterministic relationships, as stated previously, are nothing else than functions of random variables."

21. Can't map areas as inactive below active areas.
22. Distributary and sheet flow are not at all like active alluvial fan flow.
23. Slug scenario: smaller storms can produce "slugs" that block current channels and redirect flow/cause avulsions during future storms.
24. Unpredictability simply can't be modeled through deterministic analytical methods
25. FEMA maps risk, and 2-D does not take into account basic alluvial fan parameters that adequately establish this risk.
26. Deterministic 2-D modeling can underestimate the depth, velocity, and threat of an active alluvial fan channel.
27. Many areas where 2-D has been promoted as being used on active fans may actually be inactive.
28. Some are proposing further categorization, which could possibly create further confusion or facilitate unsafe development. Need to further define any proposed different categories and provide detailed, scientific, data (and logic) supported acceptable justification to support the need for new distinctions (increased safety, protection?) and why they are alluvial fan flow (active or inactive) or not. Some proposed categorizations may actually be riverine.
    a. Debris and water flow fans. "Water flow fan" would need to never have debris (what about burn areas)?
    b. Channelized flow vs sheet flow.
    c. High hazard, low hazard.
    d. Avulsion risk area.
29. If new terminology or categorization are to be used to redefine the requirements as outlined in the Code of Federal Regulations, the Code would need to first be modified to include these items. If not, the requirements of the current Code language needs to be followed.
30. It's just as important to ensure that inactive areas are not wrongly categorized as active, as the other way around to ensure that any inaccurate conclusions are not used to prove that software is appropriate and allowable on active fans (when the supporting analyses/data were not actually from active fans).
31. It has been suggested to update the Fan program? What is recommended? Justification and supporting science would be required for changes.
32. Inappropriate use of 2-D modeling can produce inappropriate results that exploit high-intensity short-duration hydrograph and topographic spreading and dissipation of the flow by internal loss schemes.