FINAL REPORT

Hazard Simplification Project: Findings from the October Kansas City Workshop

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Eastern Research Group, Inc.
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Eastern Research Group, Inc. (ERG)

ERG provides environmental, social science, and engineering solutions to climate, weather, and coastal management issues. Learn more at *www.erg.com.*

NOAA's Office for Coastal Management

"Coastal management" is the term used by communities and organizations striving to keep the nation's coasts safe from storms, rich in natural resources, and economically strong. The national lead for these efforts is NOAA's Office for Coastal Management, an organization devoted to partnerships, science, and good policy. This agency, housed within the National Ocean Service, oversees major initiatives that include the National Coastal Zone Management Program, Coral Reef Conservation Program, Digital Coast, and National Estuarine Research Reserve System.

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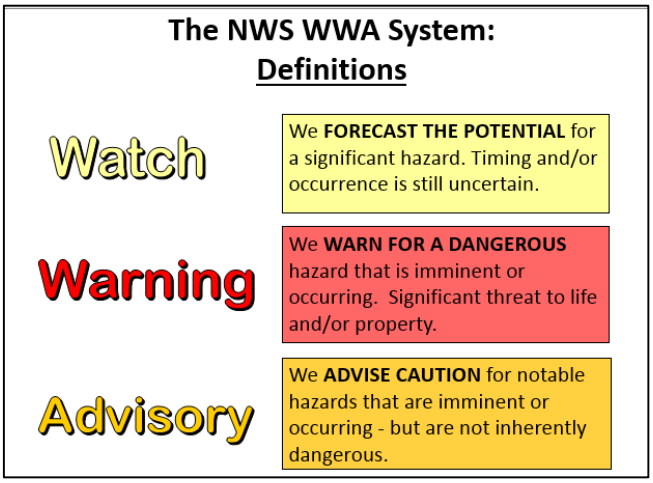
THE HAZARD SIMPLIFICATION WORKSHOP

Overview/Purpose

The National Oceanic and Atmospheric Administration's (NOAA's) National Weather Service (NWS) hosted a three-day workshop with 105 emergency managers, broadcast meteorologists, private industry, and social scientists on October 27–29, 2015, at the NWS National Training Center in Kansas City, Missouri. The goals of the workshop were twofold:

- To develop a set of **language-based prototypes** that could be tested to replace all or parts of the "Watch," "Warning," and "Advisory" (WWA) system that the NWS uses to express forecast water and weather hazards (days one and two).

- To suggest ideas for **WWA "fixes"** that could clarify/simplify NWS hazard messages—and that could be implemented in the short-term (day three).



Day One – Tuesday, October 27

Laura Furgione, Deputy Director of the NWS, opened the workshop via video conference. She welcomed the attendees and provided some context for the workshop. She stated that the NWS WWA products are highly visible to the public, and that the NWS needed the workshop attendees' help in protecting lives and property. She observed that even if NWS forecasts are very accurate, it is a problem if people are not prepared when hazardous weather occurs.

Ms. Furgione tasked the group with considering possible changes to the current system over the course of the workshop and suggested that attendees keep an open mind, since the NWS was open to all suggestions for change—big, small, transformational, or incremental. She said that *"the door is wide open to walk through it or peek through it."* Ms. Furgione also noted that it was important to look at all hazards and that no decisions would be based on the workshop findings alone. The NWS would take the input from the workshop, deliberate, and then do more review and iteration.

Next, Eli Jacks, Chief of the NWS Forecast Services Division, gave an overview of the NWS Hazard Simplification Project, which has been underway for several years, and the research conducted to date as part of the project. This work has included:

- An NWS, **Internet-based demonstration** that asked weather.gov visitors to provide feedback on alternative WWA terminology in the context of winter weather.

- A series of **20 focus groups** in four locations with NWS forecasters, media, emergency managers, and the public to gauge understanding and use of the WWA system, as well as to explore possible change to the system.

- A **survey** of exploratory, sample prototypes at the 2015 American Meteorological Society (AMS) annual meeting (and associated WeatherFest event) with meeting attendees and the general public to help gauge how much change within the current system is desired.

- A group of nearly **800 case studies** submitted by NWS forecasters and NWS partners that offers opinions about the strengths and weaknesses of the current system, provides examples to support these observations, and gives suggestions for improvements.

Mr. Jacks noted that this research indicates that there is a spectrum of understanding of the current WWA system and a difference of opinion on how much change is needed or desired to enhance the present system. However, a number of common themes have collectively emerged across the research, including:

- There is support for a color and/or numbering scheme and symbols.
- "Advisory" is generally misunderstood.
- "Watch" and "Warning" are sometimes confused.
- There is support for an "Emergency" tier for "This one is different!"
- There is support for "is there anything you can do quickly?"
- There is support for "more" rather than less change.

Dr. Gina Eosco, a senior social scientist and risk communication expert with ERG, presented a preliminary look at some of the feedback gathered from the case studies that NWS forecasters and partners submitted to the NWS this past year. Dr. Eosco pointed out that many of the case studies demonstrate support and approval for the current system, but that they also present many ideas and suggestions for improvement, including:

- **Using terms that people understand.** Partners submitting case studies repeatedly stated that they understand the terms, but doubt whether members of the public remember the difference between the terms or understand them at all.

- **Communicating severity more clearly,** noting the current suite of products do not always do this.

- **Communicating timelines and actionable information more clearly**, as well as providing a sense of whether the risk/forecast confidence is increasing or decreasing.

Dr. Eosco stated that a number of ideas related to maintaining or enhancing the WWA terms are emerging from the case studies. These include:

- Eliminate watches but maintain warnings.
- Maintain warnings and keep either watches or advisories.
- Maintain warnings but change watches to "monitor."
- Eliminate advisory (most common).
- Change warning to an action word; include confidence.
- Change it all. Try numbers, color, or action phrases.

Dr. Eosco also made the point that the system must be simple, geared toward users, and work for all hazards. “Some hazard language is very well understood in one location, but that same language doesn’t work in another,” she stated.

Finally, she urged attendees to remember the goals of the NWS Hazard Simplification Project:

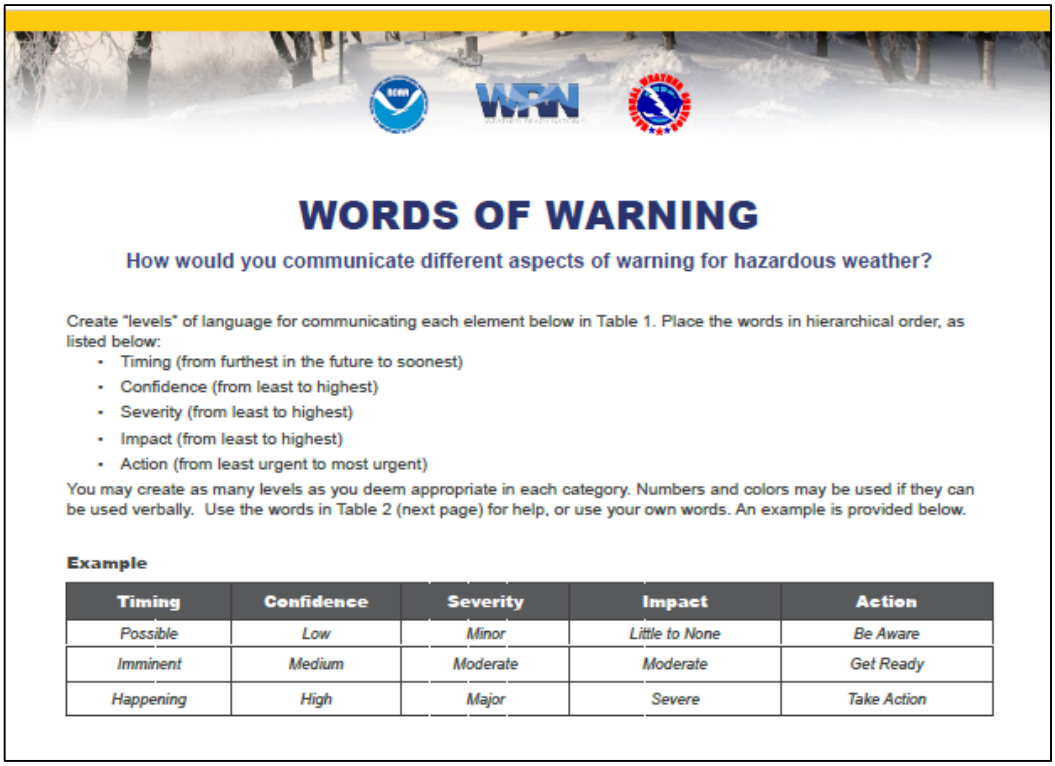
- Improve user risk assessment.
- Expand user awareness.
- Foster user comprehension.
- Provide maximum forecaster flexibility.
- Enable rapid partner decision-making.
- Create a credible, consistent framework.

Breakouts (Morning Session)

Before the workshop, attendees had been split into eight breakout groups (labeled A–H); each group included representatives from the NWS, media, social science, and emergency management community.

Words of Warning Exercise

The breakout groups were tasked with completing a cognitive exercise titled, “Words of Warning.” The purpose of the exercise was to get participants thinking about the key elements of any weather warning system (i.e., timing, confidence, severity, impact, and action) and about possible language to express ranges or levels within each of these categories (see Figure 1).



WORDS OF WARNING

How would you communicate different aspects of warning for hazardous weather?

Create "levels" of language for communicating each element below in Table 1. Place the words in hierarchical order, as listed below:

- Timing (from furthest in the future to soonest)
- Confidence (from least to highest)
- Severity (from least to highest)
- Impact (from least to highest)
- Action (from least urgent to most urgent)

You may create as many levels as you deem appropriate in each category. Numbers and colors may be used if they can be used verbally. Use the words in Table 2 (next page) for help, or use your own words. An example is provided below.

Example

Timing	Confidence	Severity	Impact	Action
Possible	*Low*	*Minor*	*Little to None*	*Be Aware*
Imminent	*Medium*	*Moderate*	*Moderate*	*Get Ready*
Happening	*High*	*Major*	*Severe*	*Take Action*

Figure 1. Participants completed an exercise that asked them to come up with ranges or levels of terms to express timing, confidence, severity, impact, and action for a weather warning system.

Participants were divided into smaller groups of about three individuals to complete the exercise. Upon returning to the plenary, several groups indicated that they could not complete the exercise and that some of the categories were easier to do than others. Observations included the following:

- Some groups felt severity and impact are so tied together that it is hard to differentiate one from the other.

- A number of groups found it easier to find words for the "low" or "high" end of the scales but struggled with the "middle" portion.

- Many groups expressed reservations about using a numbering scale, which could be misconstrued since people do not always take time to read the instructions on a scale (e.g., is 1 high or low?).

What actions should color levels convey?

Black/Purple: Emergency. Immediate, life-saving action.
Red: Warning. Imminent. Act now. Life-threatening.
Orange: Alert. Be aware/stay tuned.
Yellow: Alert. Approaching/potential. Be aware.
No color: No or low risk level.

- Opinions were divided on the utility of color. Some participants felt that introducing a color code would be confusing, especially since many coloring schemes are already widely used in society (such as in hospitals); others thought colors could be useful. Many groups suggested a stoplight-color approach, ranging from low risk (yellow) to moderate risk (orange) to life-threatening situations (red), with an additional color tier (black or purple) to be used for emergencies.

- Confidence was problematic for some groups. One group noted that for some people, confidence means "trust," for others it means "probability/certainty."

Table 1 below presents some examples of the terms that the groups created.

Table 1. Examples from Groups' "Words of Warning" Exercise

Timing	Confidence	Severity	Impact	Action
next week	chance of	Minor	little to none	be prepared
tomorrow	could	moderate	moderate	
today	likely expected	Major	extreme	
Timing	**Confidence**	**Severity**	**Impact**	**Action**
long term	maybe	Green	could be spatial: low (isolated area affected) to high (wide area affected)	none
approaching	slight chance	Yellow		be aware
now	chance	Orange		act now
	is/will	Red		
Timing	**Confidence**	**Severity**	**Impact**	**Action**
expected	potential	minimal	by spatial scale or cost	pay attention
imminent	likely	significant		take action/shelter now
happening	imminent	devastating		

Silent Structured Brainstorming

The next exercise for the breakout groups was individual, silent structured brainstorming. Facilitators asked each group to:

Imagine that you have the power to clear the slate and create a new hazard warning system for the National Weather Service. What new or enhanced language would you propose?

Group D considers ideas in the brainstorming exercise.

Based on this question, attendees in each breakout group wrote their ideas on notes and then shared these notes, one at a time, with the group. After a number of notes were posted, members turned to proposing "themes" under which a number of notes could fall. Each breakout group was limited to no more than four themes to report back to the plenary. Each theme was labeled by group (e.g., A-1, A-2, A-3, A-4; B-1, B-2, B-3, B-4; etc.), and each attendee was asked to align with one theme.

Formation of "Super" Themes

The breakout groups returned to the plenary to present their themes. A representative for each theme described its basic idea and attributes. After several themes had been presented, Dr. Eosco asked the groups to consider if their theme resembled any of those themes already described. If so, like themes were then grouped together (see example in Figure 2) into "super" themes. This process continued until all of the themes were presented and grouped. Table 2 (on page 9) summarizes how all the themes aligned under the super themes.

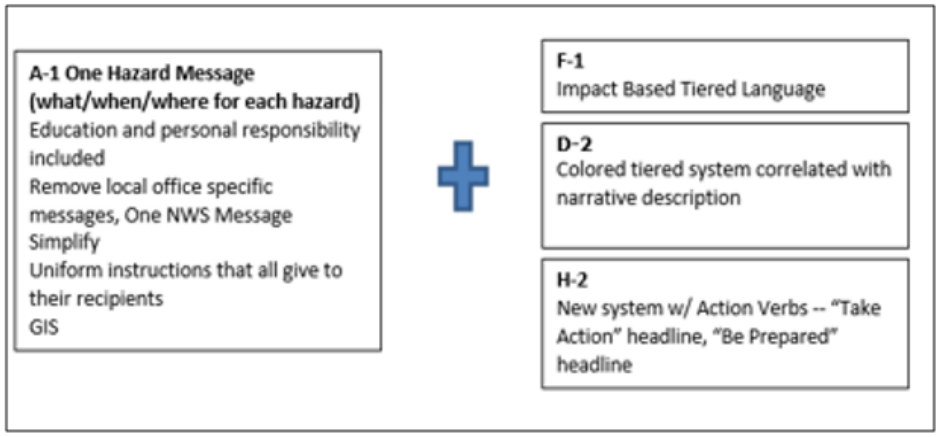


Figure 2. Like themes were grouped together into super themes.

New breakout groups were formed based on how the attendees aligned with the super themes. These new groups were instructed to meet together the following morning to work on the next set of exercises.

A description of all of the themes proposed by the breakout groups are captured in Table 3 (on page 10).

Table 2. Summary of Grouped Themes

A-1 (Hazard Impact Messaging)	F-1	H-2	D-2		
A-2 (All hazards action statements (Maintains Warning))	G-1	B-3	B-2	C-4	E-4
A-3 (Tiered System w/colors: Action Based)	F-3	C-2	G-2		
B-1 (Tiered Color Threat Levels)	D-1	H-3			
E-2 (Inform decision making, making choices, action)	G-4	E-3	C-3		
C-1 (Multi-level messaging approach)	H-4				
F-2 (Matrix Based System)	G-3				
H-1 (Partial reform to the current system)	E-1	D-3			

Table 3. All Themes Proposed by Breakout Groups A–H

Group	Theme
A-1	One hazard message (what/when/where for each hazard); education and personal responsibility included; remove local, office-specific messages (one NWS message); simplify and provide uniform instructions that all give to their recipients
A-2	Tiered by action (ready/set/go/stop); no watches/advisories, warnings remain; education and personal responsibility included, short does not mean simple; all messages focus on impacts
A-3	Five-tiered system (Be Informed/Be Aware/Take Action/Emergency); education and personal responsibility included
B-1	Colors: communicate threat/risk levels/actions
B-2	Word categories: communicate threat/risk levels/actions
C-1	Multi-level messaging approach that caters to varying audience types. User-defined (push certain amount of information; users can pull more information from sources); public vs. partner/stakeholder; emergency vs. information
C-2	Simplified, actionable messaging through a tiered or hierarchical approach with three to five levels; risk assessment-based index based on multiple components (high probability, low impact = moderate risk); colors + matching simple, actionable phrases or terms to communicate the risk
C-3	Orient messaging around societal impacts that considers infrastructure, vulnerability, land use, population density, etc.; make the messaging emphasize the impacts; could be a matrix or tiered approach; put the actions or impacts at the forefront of the message
C-4	Simplify/pare down current verbiage and existing products to improve risk communication; talk about things we do not talk about now, such as conveying changes in confidence related to a forecast; consistency of message important; pare down the product suite and current language
D-1	Color-tiered system correlated with narrative description
D-2	Simplify and combine hazards and headlines into two-tiered system
D-3	Re-examine the current system to see what is working and what is not (e.g., replace advisory?); need for education evaluation of understanding
E-1	Reconfigure hierarchy of attributes: hazard, timing, severity/impact, confidence
E-2	Safety/informed decision language at proper time and relevant spatial scale (simplicity, clarity, mitigation/preparation/response; cleanup message content: specific, concise, safety messaging)
E-3	Risk-based messaging vs. hazard-based (simplicity, clarity, mitigation/preparation/response; safety messaging; cleanup message content: specific, concise)
E-4	Keep warning but redesign preparatory messaging
F-1	Impact-based tiered language
F-2	Matrix-based
F-3	Action-based (tiered) language
G-1	Consolidate WWA -> warning + information
G-2	HICA (Hazard/Impact/Confidence/Action) threat hierarchy and hazard-specific threats, actions
G-3	Symbology (color, simplified language, etc.)
G-4	User-centric forecasts
H-1	WWA reform—make adjustments to the current system, including consolidation, better formatting of messaging (e.g. bulleted formatting)
H-2	New system with action verbs—“Take Action” headline, “Be Prepared” headline
H-3	New system with color-worded headlines—“Code Red” or “Red Alert” or “Purple Warning”
H-4	New system with threat/impact headlines—“Tornado Coming!” or “TORNADO”

Day Two – Wednesday, October 28

In the morning of day two of the workshop, the eight new breakout groups (labeled Z to S) refined each of their super themes into a more fully considered prototype and then presented their idea in the plenary. Each group described the key features of its system, along with its strengths and benefits. After each presentation, participants were asked to vote via their smartphones or laptops on whether they thought the prototype should be considered further. The options were 1) would not consider, 2) might not consider, 3) neutral, 4) might consider, and 5) definitely consider.

In the afternoon, each group was tasked with applying its prototype to an actual event (see Figure 3).

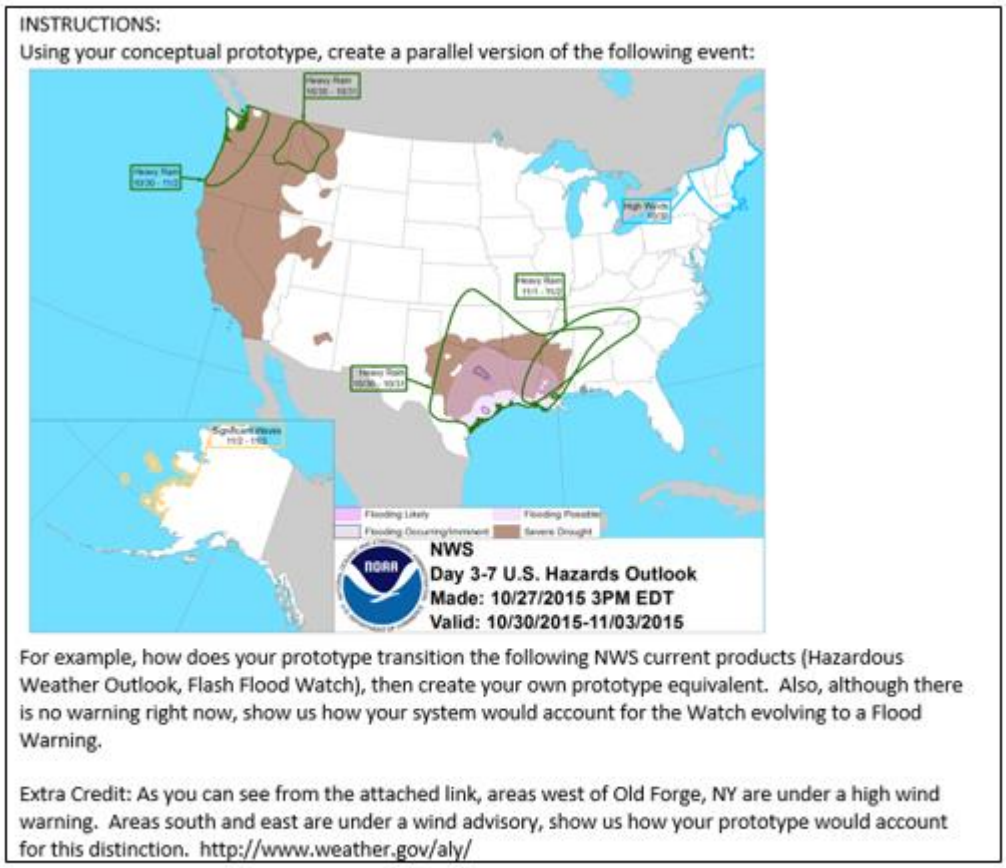


Figure 3. Attendees were asked to apply their conceptual prototype to create a parallel version of an actual event.

A complete summary of each prototype presented (based on the morning and afternoon sessions) is provided in Appendix B. Short descriptions of each prototype are featured on the following pages.

Recurring Conceptual Ideas

By the end of day two, a number of recurring conceptual ideas emerged regarding improvements to the current system and about specific terms and elements that could be included within an enhanced WWA system:

- The system should be **intuitive**; it should not need to be explained.
- It is important to provide a **continuous flow of information** from the preparatory stages of an event to the time it is over.
- The system needs to communicate **risk, impacts, and actions**.

- The system should be **data-driven, geo-located, and user-centric.** Some, like Group U (see boxes below), suggested a data subscription service whereby a user can set thresholds for certain hazards, so the individual gets the information he or she wants based on tolerance level (e.g., inches of snow) for a particular hazard. Others suggested mechanisms, such as an "advanced" button, to provide more information to more power users while keeping the basic message simple.

Day One
Flash Flood Warnings plus Watches
Lengthy description, one size fits all, broad context

"Halloween: Our system has been alerting people in the vulnerable area about an upcoming weather event. It is not expected to have children outside, but is a possibility. Continuous information will be provided during the event.

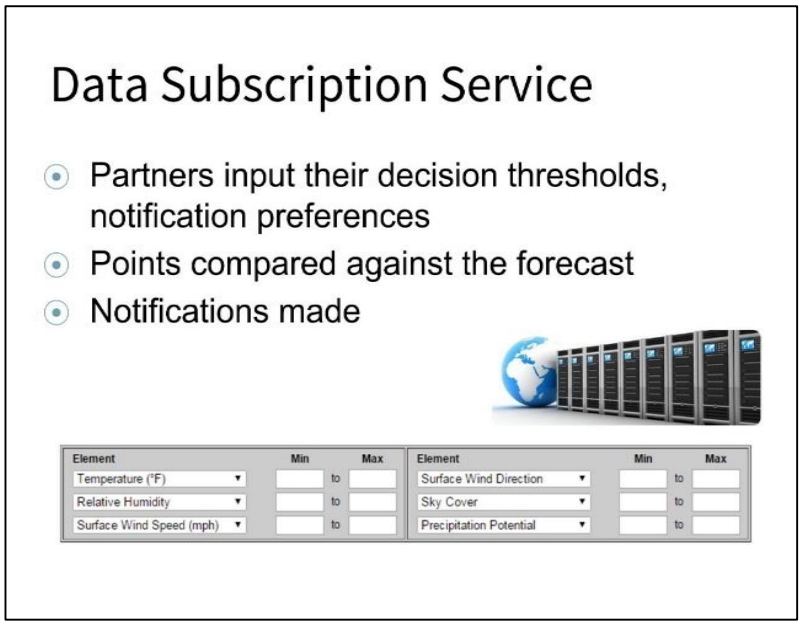
Regional Decision Maker:

High Risk: Take Action Now: Severe disruption to travel, potential loss of property (Updated maps are provided for the expected weather event)

High confidence there will be a lot of rain coming. High resolution products will enable the identification of public assets at risk.

Medium Risk: Prepare for Disrupted normal events: Prepare for delays

Low Risk: Monitor and prepare in the event you need to travel"



Group U's prototype is based on community vulnerability and customized by the user. It features an "upside-down V" delivery system with basic information that everyone can interpret intuitively at the top. As one goes down the V, more details are provided for power users. Behind the scenes is a big data system linked to partners' information.

Common Elements

Among the groups' prototypes, a number of elements were commonly proposed:

- **Tiers.** Many groups organized categories into hierarchical tiers. Some (see boxes for Group W and Group T below) envisioned a matrix that would calculate tiers and messaging based on a combination of factors. In the case of Group T, this matrix could be "behind the scenes."

Yellow	Heads up (for internal/EMs) Be Informed (public)
Orange	Take precaution
Red	Warning - Take action
Purple	Extreme warning/emergency

Group W used a four-tiered color matrix system, where the colors represent different levels of impact. It has two warning levels (warning and extreme warning) and used "be informed" and "take caution" to replace watch and advisory.

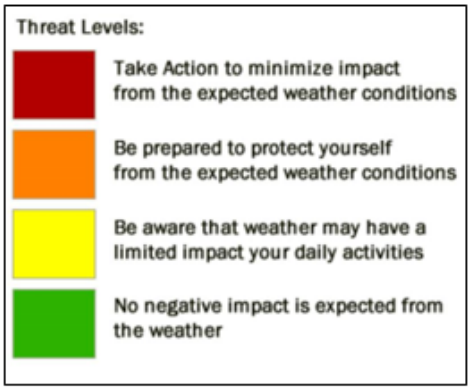
Phenomenon: Snow

	Timing	Severity	Confidence	Likelihood	Vulnerability
	HHH:MM:SS	Meteorologic Character	Deviation	Probability/Odds Ratio	Risk Category (via 3rd Party)
High/Now					
		X		X	
Med/Soon			X		
					X
Low/Later	X				

= MESSAGE → ACTION

Group T's data-centric approach proposed a matrix as one possible way to enhance messaging and decision-making. The matrix would distill data into actionable information, as determined by end-users who need it (and request it).

- **Colors.** Many groups used a color-coded system (most often red, orange, and yellow) to correspond with levels of severity, risk, or impact (see boxes on Group V, X, and Y below). Several groups suggested magenta or black as the highest (often an emergency) tier. One group (Group V) used green as the lowest tier. Table 4 on page 16 provides a comparison of color usage across all prototypes.

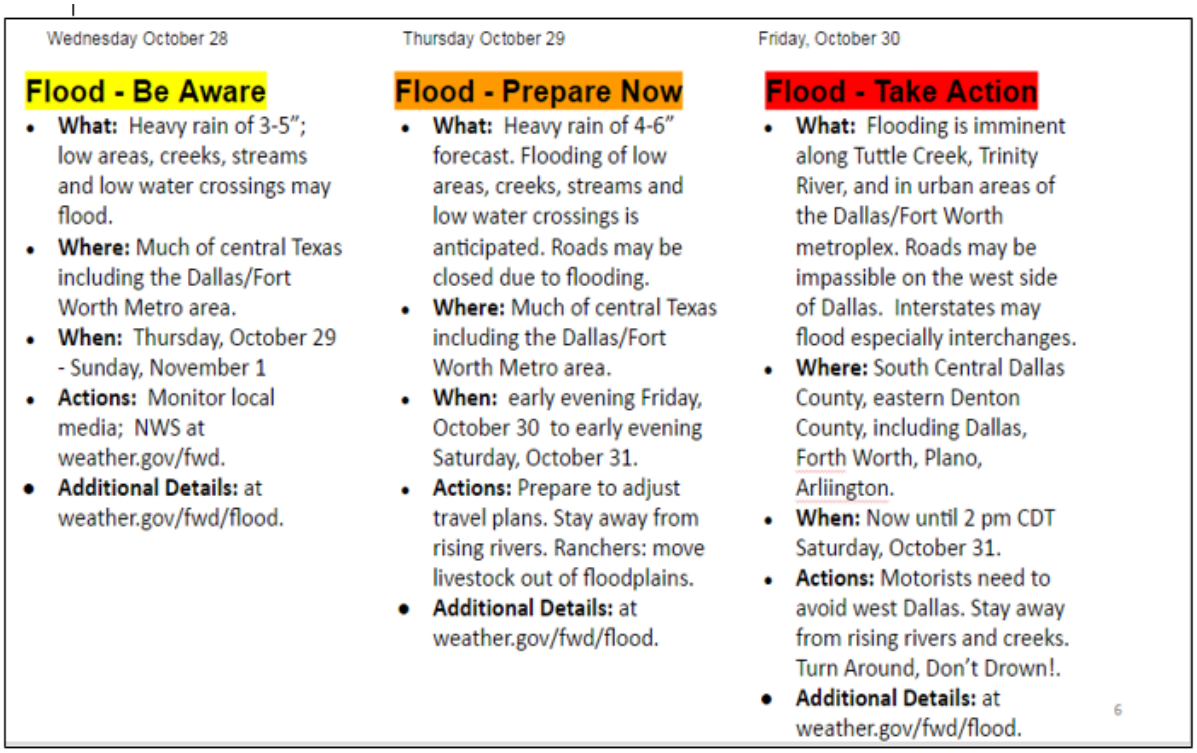


Group V used a four-tier, color-coded system to convey risk. A one-sentence Hazardous Weather Warning would communicate the hazard. The system eliminates advisories but would keep watches for certain events.

CURRENT WWA	NEW HEADER	VERB/COLOR?	IMPACT
Emergency	Warning	Take Action	Widespread/Catastrophic
Warning		Take Action	Life-Threatening
Advisory		Take Action	Potentially Dangerous
Watch	Potential*	Prepare	Higher Risk
Outlook		Be Aware	Lower Risk

*Will replace some current advisories.

Group X's prototype used three tiers for immediate hazards and two tiers for prospective hazards. The prototype maintains "warning," but "potential" replaces current "watches" and "outlooks." Current advisories could be captured by either the warning or potential category.



Group Y's prototype focuses on telling a story. It begins with an action phrase and uses a four-tier color scheme based on impacts. The rest of the messaging provides what, where, and when information, as well as more details.

- **WWA concepts and terms.** Some groups maintained certain current WWA concepts and words, most often "warning." Only one group maintained advisory (see box describing Group S's prototype at right). A number of groups maintained the watch concept but suggested rewording the term "watch." Two groups suggested reordering the current terminology used to "a warning for X." Table 5 on page 16 provides a look at how different groups addressed the current WWA terms.

- **Action terms.** Many groups included short, actionable language, such as "be aware," "be informed," "prepare now/be prepared," "take caution," and "take action." The phrases were used as headlines, paired with a tier/color, or used in the body of the message.

Watch for _____
Advisory for _____
Warning for _____

- **What:** < Lead sentence summarizing situation>
- **Where:** < Describe in language with link to map >
- **When:** < Words with link to timeline >
- **Actions:** < Enter calls to action>
- **Impacts:**
- **Severity:**
- **Confidence:**

&&

- Polygon Points:
- Time…Motion…Location:
- Other Related Hazards:

$$

Group S maintained the current system but reordered the terminology (e.g., a warning for tornado) and added color coding.

- **Clear and prominent timing information.** One group's prototype (see box on Group Z below) was timeline-based. Another (see box on Group T below) envisioned that every alert message disseminated would be numbered in sequence.

BULLETIN - EAS ACTIVATION REQUESTED
FLOOD MESSAGE #1
Audience: Public
Source: National Weather Service Group T
Issued: 1200 pm CDT Thursday, Oct. 29, 2015

Alert Level: **Be Aware**
What: Widespread flooding.
Where: [Your current location – populated by database]
When: Saturday afternoon and evening
Recommended Actions: Monitor forecasts.

Expected Impacts: Squaw Creek and other nearby rivers may flood. Water in basements, flooded roadways.
Forecast **Severity:** 2-4" additional rainfall expected, with rainfall rates of 1" per hour.
Likelihood: 40% likelihood of flooding on Oct. 31.
Observations: Ground is saturated and river levels are above normal.
For more information: weather.gov/flood#650

Group T's prototype is a matrix-based, data-centric information system that feeds messaging in any format and leverages existing user communication. Messages are numbered and include alert levels; what, where, and when information; recommended actions; expected impacts; likelihood; odds ratios, etc.

Time Frame: 3 Days Out

San Antonio NWS Flooding Timeline: 10/28-10/31

- Prepare for possible Halloween Flooding in South Central Texas
- Plan alternative routes due to minor flooding
- Bastrop residents beware of higher flood risk in the Hidden Pines burned area.
- Turn Around Don't Drown

Preparedness Video: https://www.youtube.com/watch?v=tYBo6t4_6_U

[Computer coded information for CAP/Tracking/GIS]

Group Z's prototype "blows up the existing system" by focusing on societal impacts rather than meteorological criteria. The prototype is timeline-based and puts the most important information first. It includes a call to action and tells people what they can do to mitigate the impacts. It also relies on partner collaboration and includes links to more information.

Table 4. Comparison of Color Use and Tiers Across Prototypes

Group	Color-Integral	Color-Optional	Tiers	Notes
Z		X	4	Focus on societal impacts.
Y	X		4	Three tiers are based on impact and action. Additional tier for emergencies. Also “all clear.”
X		X	2 basic 5 sub-tiers	Two basic tiers: warning and potential. Embedded in warning are three tiers for immediate hazards and two tiers for prospective hazards. Based on impacts.
W	X		4	Based on impacts.
V	X		4	Based on probability and severity.
U		X	3	Based on risk.
T			3	Based on a matrix that considers timing, severity, confidence, likelihood, and vulnerability.
S	X		3	Maintains current system.

Table 5. Comparison of WWA Term Usage Across Prototypes

Group	Watch	Advisory	Warning	Notes
Z	Replaced by actionable information conveying risk and mitigation.			
Y	Replaced by identification of hazard type and action statement: “be aware,” “prepare now,” and “take action.” Based on action/impact.			
X	Replaced by "Potential."	Captured by potential or warning, depending on type.	Maintains.	Will have a pre-watch, preparatory message. Flips order: A warning for X; a potential for X.
W	Replaced by "Be informed."	Replaced by "Take Caution."	Uses warning and extreme warning.	Focus is at the warning level.
V	Keep watches for some higher-end events, but replaces the word "Watch." Possibly retains tornado and hurricane watch.	No advisories.	One sentence (hazardous weather warning) replaces all individual warnings.	
U	Provides risk levels (low, medium, high) and keywords, including “monitor,” “prepare,” “enact,” and “take action.”			
T	Rewords.	Possibly rewords.	Maintains.	Could maintain products; sets alert levels (action) based on a matrix that considers timing, severity, confidence, likelihood, and vulnerability.
S	Maintains.	Maintains concept but could change word.	Maintains, but will not be used for some hazards.	Flips order: A warning for X; a watch for X.

Polling Results

After each prototype was presented in both the morning and afternoon sessions, participants were asked to vote via their smartphones or laptops on whether they thought the prototype should be considered further. The instructions were:

On a scale of 1 to 5, how much would you like to see this prototype considered further?
1= would not consider
2= might not consider
3= neutral
4= might consider
5= definitely consider

Overall, the presentations in the afternoon session received less favorable responses than the presentations in the morning sessions. Exceptions to this trend were the prototypes presented by Group Y and Group V, which gathered more favorable responses in the afternoon session. The top three-ranking prototypes across both sessions were Y, T, and X (see Figure 4 below) based on the combined responses for "might consider" and "definitely consider."

Prototype Y scored above-average favorable responses in both the morning and the afternoon sessions. Prototype V went from having the least favorable response in the morning session to having the fourth most favorable ranking in the afternoon session. Prototype Z went from being the second most favorable prototype in the morning to the least favorable in the afternoon session. Prototype T was the third most favored option in the morning and the second most favored option in the afternoon. Figure 5 on page 18 shows the responses for each prototype in the morning and afternoon sessions.

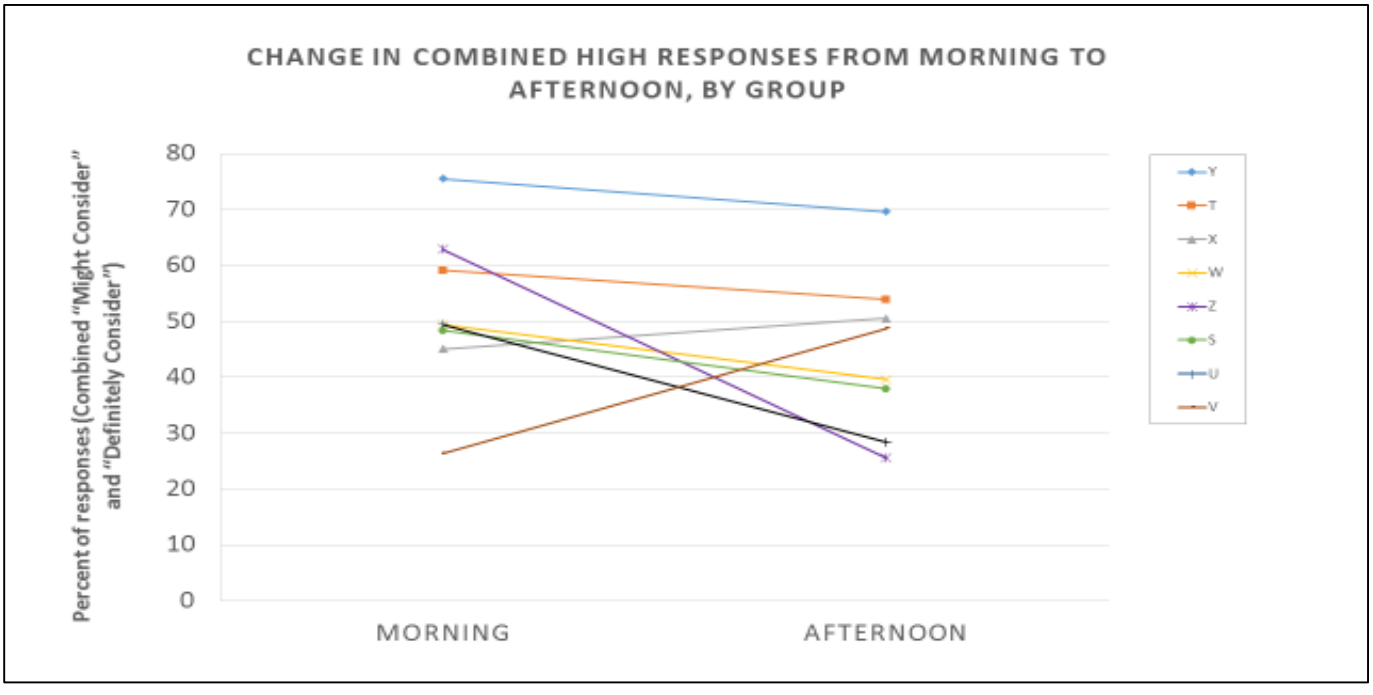


Figure 4. Results of prototype polling.

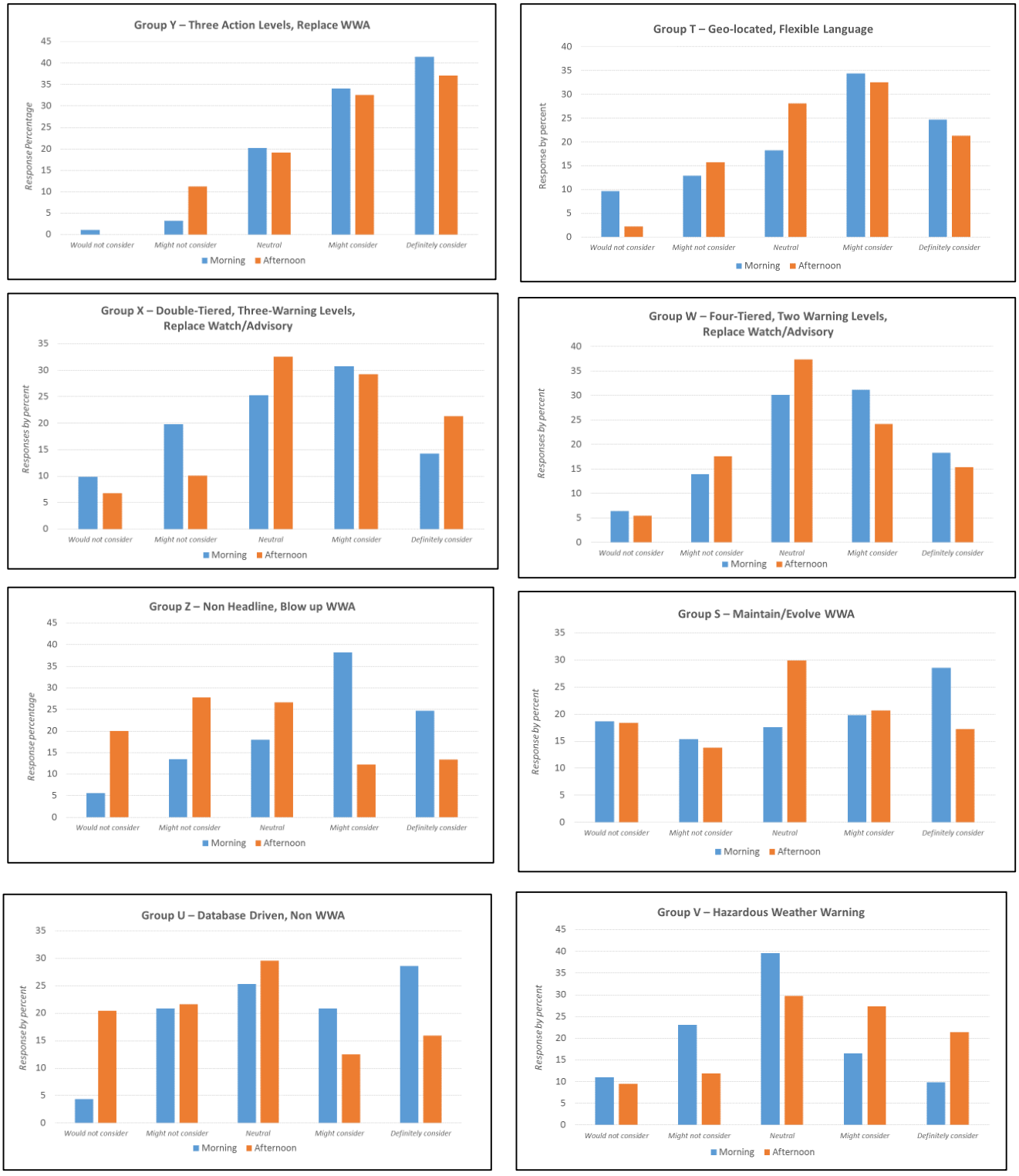


Figure 5. Responses for each prototype in the morning and afternoon sessions.

Plenary Discussions

During the plenary discussions, which followed the prototype presentations, attendees differed on whether the public **understands the basic terms of the current system**. One of the social scientists stated that the literature shows that the term "warning" is well understood, but other terms are not.

One emergency manager challenged the group to ask members of the public if they understand the terms, emphasizing that education is important. Others stated that even if people do understand the terms, they may not have the knowledge to make appropriate decisions. Any new system needs to be directed at the very personal process of **human decision-making**. One attendee stated that it is important to tell people what the hazard is and what they need to do about it. "We know that when people are in danger, they need specific information that tells them what to do, not necessarily that it needs to be shorter, like a word or symbol," she said.

The group also discussed the need for **baseline data**—both to understand how to make the current system better and to be able to determine whether any new system is working better than the present one. The need for data also carries over to the importance of doing real-time experiments. A social scientist stated that you can ask people, "Would you take protective action in x situation and they'll say yes, but if you test in an active environment, the percentage goes down." Another social scientist stated that we do not have information about what people are doing and why: "We need the diagnosis and treatment." A broadcast meteorologist also suggested that social science is needed in the mobile environment to discern what messages are being disseminated and what people are doing with this information.

Another area of discussion centered on **meteorological criteria.** Throughout the workshop, attendees frequently mentioned the need for flexibility for forecasters to use their discretion in applying criteria and deciding when to issue products. Some advocated for taking forecasters out of the meteorological criteria business, thereby eliminating the back and forth tugging that can sometimes occur when forecasters are unsure whether to issue a product. Some attendees suggested replacing meteorological criteria with societal-based impact criteria. They suggested the focus be on the impact-based "why" versus the meteorological "why." Others suggested integrating more flexible meteorological criteria. Another suggestion was for the NWS to partner more with other agencies on criteria, such as the U.S. Department of Agriculture for frost/freeze products.

Attendees disagreed about the need for meteorologists to communicate **impacts**. Some stated that impacts are inherently difficult to predict, and that the NWS should stick with meteorology. One attendee stated that it is difficult enough to communicate the meteorology to the public, especially with forecast uncertainty, and that communicating impacts and actions presents an additional challenge. Additionally, some forecasters expressed concern that they may not have all of the societal impact data they need to convey impacts effectively.

Day Three – Thursday, October 29

On the morning of the last day of the workshop, Eli Jacks presented an overview of each prototype and asked each group to provide any clarifications needed. The group then broke back into their original breakouts (A–H) to consider possible "repairs" that could be done to the current system in the short-term. Each group listed its top repairs and returned to plenary for discussion.

Table 6 on page 24 lists the phraseology and formatting repairs provided by the groups. Table 7 on page 25 lists policy, training, and other repairs suggested.

The top repairs cited by the groups included:

- **Consolidate and/or eliminate some products** (seven groups). Suggestions included eliminating redundant products, eliminating frost/freeze products, consolidating certain groups of products (e.g., winter, tropical, flood, wind), eliminating transition warnings, and redefining the criteria for certain products (e.g., severe thunderstorm warnings). Many attendees advocated for eliminating (or not issuing) **advisories**; however, attendees cautioned that it would also be important not to simply increase the number of warnings in this case.

- **Improve formatting** (four groups)**.** Many suggestions were provided to improve formatting, including bullets, colors, and boldface, as well as adding who, what, where, and when details.

- **Simplify language and make language consistent** (three groups) and **actionable** (two groups). Suggestions focused on shortening and simplifying language (e.g., by deleting unnecessary words and phrases) and adding short action statements.

- **Put the hazard/most important message/impacts up top** (four groups). Attendees wanted to maintain the hazard specificity of the current system, but reorder the information to provide the most important points at the top of the message. Attendees suggested placing prominent hazards upfront in the WWA product, such as in the title or the phraseology (e.g., change "Tornado Warning" to "A warning for tornadoes"; instead of "Severe Thunderstorm Warning," use "A warning for large hail, damaging wind, dangerous lightning"). Another idea was to take the tags at the bottom of a warning and put them at the top of the message. It was also noted that the warning name could emphasize the main threat, but additional hazards could be included via a simplified message.

- **Make information more social media friendly.** Suggestions included parsing information, enabling auto Tweets, and adding Web links (two groups), as well as using social media platforms as a test bed to try out some of the new ideas proposed throughout the workshop (two groups).

- **Enhance internal training** (four groups). Groups suggested providing a number of training courses for NWS forecasters, such as communications training and "know your CWA [county warning area]" training. Another suggestion was to provide consistent training with national center involvement to empower forecaster discretion.

- **Enhance timing of information** (four groups). Groups called for on-demand extraction capabilities, paying more attention to product effective time rather than issuance time for some

products, using a "breaking news" model, and paying attention to constituent delivery times.

- Consult and integrate **social scientists/multidisciplinary teams** on products, research, and messaging (three groups). Attendees called for a stronger integration of social science in the NWS field and the creation of a NOAA entity dedicated to social science integration into operations.

Attendees also made the following suggestions:

- **Build up data and tailor messaging to the needs of different users**. Attendees said that it was important to focus on what information means to the end-user and how the information is used, and then craft messages to meet those needs. Attendees suggested building up the data that is pushed out to end-users and providing a way to drill down to different layers of information based on users' needs.

- **Focus efforts on risk mitigation and address human decision-making**. Attendees stated that the headline, product name, and colors are not necessarily saving lives. Modern technology has allowed us to focus on individuals and to personalize alerting/warning. Therefore, as one participant noted: "if most people who die in floods are drivers, then we need to focus the message more on preventing flood-related vehicle deaths. If most of the people who die from lightning are recreationalists, then we need to focus our message to people on those activities."

- **Take advantage of the private sector's strengths in information dissemination**. Attendees suggested that the private sector can facilitate the personalization process. The private sector focuses on pushing out information to users. The private sector can help push information to the public early and reiterate the message.

- **Tell a story.** Telling the user a story is good for encouraging the public to take action in long-duration hazards with plenty of lead time. Short-fused hazards may not afford enough time to tell a story. Some attendees thought graphics could be more helpful in short-fused events.

- **Think of communication as an ongoing dialogue.** It is important to communicate new, oncoming hazards and to update users on ongoing hazards (sequential messaging).

- **Keep existing systems in mind but look to future technology.** System changes will require minor to major changes in software, which could be a challenge in a resource-constrained environment. However, attendees suggested that the NWS not lose sight of what could be done in the future, particularly considering how databases are already being used to understand people's preferences. NOAA may be able to tap into these databases. An added benefit could be a societal confirmation of messages; when people are getting the same information from five to six databases, then everyone is communicating the same message.

- **Improve accessibility**. Attendees called for more multi-language capacity to reach non-English or English-as-a-second-language users.

- **Change must be incremental**. The group agreed that the system cannot simply be changed tomorrow. There are too many components and changes that must be proposed, tested, and phased in incrementally.

Closing Remarks

In closing, the group discussed that while it was important to focus on changes that can be made in the short-term, the NWS should also envision the warning system 20 years from now. Attendees suggested that pilot sites and test beds (possibly also social media) could be used to test big modifications. They also stated that it would be extremely important to use the momentum from this workshop to implement easy fixes to demonstrate that change is possible.

Conclusion and Next Steps

The new prototypes created by the workshop participants indicated that a spectrum of change is desired among the attendees—from "blowing up the system" altogether (e.g., by replacing current WWA products with colors, tiers, impact messaging, and actionable phrases) to simply enhancing the present system by maintaining the WWA construct, but perhaps changing the word "advisory" and not issuing warnings for certain hazards. In the participants' polling on the different prototypes presented (indicating whether prototypes should be considered further), Prototype Y scored consistently above-average support. Prototype Y was one of the prototypes that represented a greater change from the current WWA system, doing away with WWA language and instead focusing on a color-coded, tiered hierarchical system that tells a story and puts actionable phrases at the forefront of the messaging.

Group Y Prototype

While the workshop's charge was for participants to consider possible new *language* for the current WWA system, the groups also presented more than just language considerations in their prototypes—venturing into conceptual, operational, design, delivery, and verification aspects of a warning system, perhaps indicating that it is difficult to separate the language from the current system—without considering these other factors, all of which work together to convey warning messaging.

As far as short-term improvements to the system, a clear majority of the participants favored consolidating and/or eliminating some products. Additionally, there were many suggestions to improve the product formatting, such as by including bullets, colors, and boldface, as well as adding who, what, where, and when details.

Following the workshop, the NWS will consider all of the feedback gathered to determine if any immediate improvements can be made to the current system, as well as what longer-term changes might be explored further. Notably, while many productive suggestions came out of the workshop, any

significant change to the present system would need to be deliberated both within the NWS and external to the agency.

Additionally, the NWS is currently gathering baseline information on the perceived strengths and weaknesses of the present WWA system through the hundreds of case studies submitted to the agency this past year from NWS forecasters and partners, as well as through a study examining the degree to which WWA is institutionalized within society. This information, along with the workshop feedback, will be taken into account as the NWS considers any enhancements to the current WWA system.

Table 6. Formatting, Web, and Language Recommendations

Recommended Repairs	GROUPS								
	A	B	C	D	E	F	G	H	TOTAL
Social media friendly	x				x			x	3
Simple and most important message up top; Impacts up top	x		x	x					4
Add who, what, where, and when details		x			x				2
Add Web links and graphics to warnings					x				1
Implement mixed case for 2016 convective season			x						1
Number messages			x		x				2
Simplify language; Make language consistent	x			Change severe thunder-storm to damaging thunderstorm				x	3
Change to “watch for,” “warning for”	x							x	2
Add colors	x							x	2
Add boldface					x				1
Add action phrases		x	Change overview to action statements	x					2
Embed preparedness information (watch)	x								1
Put timing in Mass News Disseminator (MND) instead of headline (Flood warning until 2 p.m. CDT)		x							1
Simplify map			Also add icons		x				2
Add NOAA Weather Radio (NWR) link on warning product on website			x						1
Add layers for more power users				x					1

Table 7. Policy, Training, and Other Recommended Repairs

Recommended Repairs	GROUPS								
	A	B	C	D	E	F	G	H	TOTAL
Reduce number of products		Eliminate transition warnings	Consolidate hazard types	Eliminate frost/freeze products, eliminate or do not issue some advisories, examine fire WWA products	Narrow winter and flood suite	Consolidate tropical, flooding, winter, wind	Consolidate redundant products, examine product approval process	Consolidate products; redefine criteria for some products (e.g., severe thunderstorm warnings)	**7**
Enhance training	Increase communication skills in the NWS and hire people with these skills		National center involvement; empower forecaster discretion		Communication training and hire communication experts	Know your CWA			**4**
Enhance timing	Provide on-demand information extraction capabilities		Pay more attention to product effective time		Try breaking news model	Constituent-driven delivery times			**4**
Use social media and briefings to test new prototypes			**x**	**x**					**2**
Increase/coordinate public education			**x**					**x**	**2**
Provide multiple languages			**x**			**x**			**2**
Allow temporal flexibility in Hazardous Weather Outlook (HWO)					**x**				**1**
Allow local flexibility with societal impacts				Update policy directive					**1**
Expand impacts catalogue						**x**			**1**
Consult social scientists/others on products, research, messages					Establish multidisciplinary team	**x**	**x**	**x**	**3**

Appendix A: Agenda for NWS Hazard Simplification ("HazSimp") Workshop National Weather Service Training Center (NWSTC)

October 26, 2015 – Monday

3:00 – 5:00 PM – Workshop Registration
Location: Embassy Suites Hotel

5:00 PM – Welcoming Social Hour
Location: Embassy Suites Lobby

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DAY 1: CLEAR THE SLATE (NWSTC)
October 27, 2015 – Tuesday

8:00 AM – Registration (NWSTC)
Registration open for attendees to check in if they did not Monday evening

8:30 AM – Welcome, Logistics, and Opening Remarks (NWSTC Auditorium)
Eli Jacks, Acting Chief, NWS Forecast Services Division
Laura Furgione, NOAA Deputy Assistant Administrator for Weather Services (via video conference)

9:00 AM – Introduction to the Workshop (NWSTC Auditorium)
Eli Jacks and Dr. Gina Eosco, Eastern Research Group (ERG)

9:30 AM – Break

9:45 AM – Breakout Groups: What Are the New Words? (Assigned Breakout Rooms)
Participants break into groups to explore enhanced or new warning language.

12:00 PM – Lunch

12:45 PM – Plenary: Group Presentations of Themes (NWSTC Auditorium)
A representative from each breakout group presents its top four themes; common themes across groups are merged and voted on.

2:00 PM – Breakout Groups: Building the Prototype (Assigned Breakout Rooms)
Breakout groups are reconfigured based on Super-Themes from the previous plenary session with the goal of each group producing a final, refined prototype by the end of the day.

4:15 PM – Break

4:30 PM – Presentations (NWSTC Auditorium)
Mike Gerber, NWS: New Dissemination Protocols
John Ferree, NWS: New Hazard Services Software
Jennifer Sprague, NWS: Formalizing Social Science within the NWS Change Process

5:00 PM – Closing Remarks - Expectations for Next Day (NWSTC Auditorium)
Eli Jacks, NWS

DAY 2: GETTING TO FINAL FOUR
October 28, 2015 – Wednesday

8:30 AM – Plenary: Day 1 Summary and Goals for Day 2 (NWSTC Auditorium)
Eli Jacks, NWS

8:40 AM – Prototype Presentations: The Path Forward (NWSTC Auditorium)
A representative from each breakout group (developed by the close of Day 1) presents its refined prototype. Group Q&A and voting conducted following presentation of each prototype.
Dr. Gina Eosco, Facilitator

9:40 AM – Break

10:10 AM – Prototype Presentations: The Path Forward (continued) (NWSTC Auditorium)

11:10 AM – Plenary: Voting and Group Discussion (NWSTC Auditorium)
Participants vote again on all prototypes. Dr. Gina Eosco, Facilitator

11:30 – Lunch
Attendees pick up lunch and go to breakouts to "look under the hood" of their group's prototype. (Assigned Breakout Rooms)

1:45 PM – Break

2:15 PM – Plenary: Group Presentations by "Salespeople" and "Critics" (NWSTC Auditorium)
A representative from each breakout group presents the key pros and cons for implementing its prototype. Group Q&A and voting conducted following presentation of each prototype.
Dr. Gina Eosco & Eli Jacks, Facilitators

3:15 PM – Break

3:30 – Plenary: Group Presentations by "Salespeople" and "Critics" (continued) (NWSTC Auditorium)

4:30 PM – Plenary: The "Final Four" (NWSTC Auditorium)
Review all voting results and discuss with group to determine which prototypes should be considered for further testing after the Workshop. Dr. Gina Eosco & Eli Jacks, Facilitators

5:30 PM - Closing Remarks (NWSTC Auditorium)
Eli Jacks, NWS

DAY 3: OPTIONS FOR IMMEDIATE "REPAIR"
October 29, 2015 – Thursday

8:30 AM - Plenary: Day 2 Summary and Goals for Day 3 (NWSTC Auditorium)
Eli Jacks, NWS

8:45 AM – Plenary: Review of Case Study Feedback (NWSTC Auditorium)
Dr. Gina Eosco, ERG

9:15 AM – Breakout Groups: What Can We Fix Now? (Assigned Breakout Rooms)
Participants break into original breakout groups from Day 1 to explore their top three to five suggested "repairs" to the current warning system.

11:30 AM – Pick up Lunch

12:00 PM – Plenary: Group Presentations of Repairs (NWSTC Auditorium)
A representative from each breakout group presents its top three to five repairs to the current warning system.

1:30 PM Break

2:00 PM – Plenary: Group Discussion (NWSTC Auditorium)
Review with participants the presented repairs and discuss those that rise to the top (considering factors such as highest priority, most urgent, greatest impact).
Eli Jacks & Dr. Gina Eosco, Facilitators

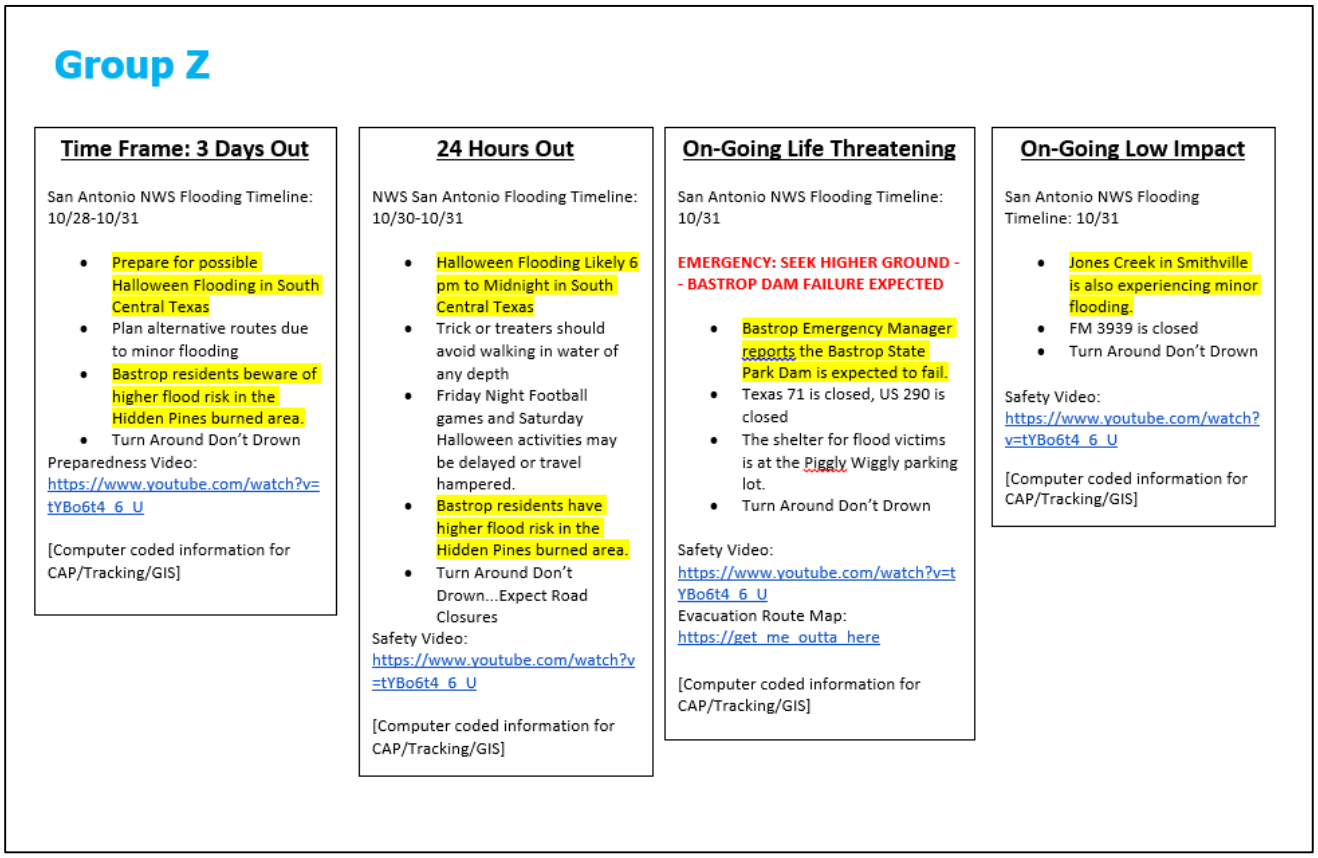
3:30 PM - Closing Remarks/Next Steps (NWSTC Auditorium)
Eli Jacks, NWS

3:45 PM - Adjourn (NWSTC Auditorium)

Appendix B: Prototypes

Group Z Prototype: "Blow up" WWA, Timeline-Based, Hazard Messages

This prototype "blows up the existing system" by focusing on societal impacts rather than meteorological criteria. The prototype is timeline-based and puts the most important information first. It includes a call to action and tells people what they can do to mitigate the impacts. Additionally, the system builds in collaborations with partners, as well as access to their datasets and outreach tools (e.g., links to preparedness and safety videos, evacuation maps). With this approach, messaging is an ongoing discussion, with information continually disseminated (even days in advance) to aid in preparation. This temporal flexibility also enables the forecaster to update information whenever needed. Because the system requires new language, new verification processes, training, education, and cultural change, it will take time to implement. The system does not require a complete overhaul of existing software, however.



Key Features:

- Focuses on **risk and mitigation**: a key feature of the system is that it tells people what is actually going to happen and what they can do to mitigate the impacts—will give actionable information.
- Positions the most important information and actions to take at the **top** of the product. Uses bulleted hazardous information messages and provides a timeline with additional links and information.
- Provides temporal flexibility and focuses on a **continuous flow of information.** Messaging must be a continuous discussion (what/when/where/duration/severity).

- Shifts from meteorological criteria to impacts criteria and uses some sort of **baseline impacts catalogue** collected from partners/the public. Impacts will also be part of the verification system. Conveys general impacts during long-range events and specific impacts during short-fuse events. For long-range events, the language will be more general; for short-fused events, the information will be more actionable.
- Emphasizes **collaboration and partnerships**, including those with nontraditional partners (e.g., groups that work with elderly populations).
- Able to adapt to a **color or number system**—this will be universal to ensure consistency. If color coding is used, it needs to be universal across all parts of the agency; suggest "stoplight" colors.
- Emphasizes collaboration and will be partnership driven.
- Provides **flexibility for forecasters** because it takes them out of the meteorological criteria business. Eliminates the back-and-forth tugging of whether to issue a product.
- Requires a **robust, streamlined dissemination** platform, such as a **user-defined App** that would embed graphics, etc. Individuals could set thresholds for certain hazards, so they get only the information they want based on their tolerance level (e.g., inches of snow) for a particular hazard. To reach the non-smartphone crowd, legacy technologies, text products, NWR, and websites will all still be used.
- Requires **external education and cultural change**. The system will use new verbiage, which could mean a long time horizon for acceptability. Verification, education of Congress, and protocols established by existing laws all would need to be addressed.
- Only requires **software adjustments**, not a complete overhaul. It will be important to consider where technology could be in the generations ahead, so that the system can work in the future.

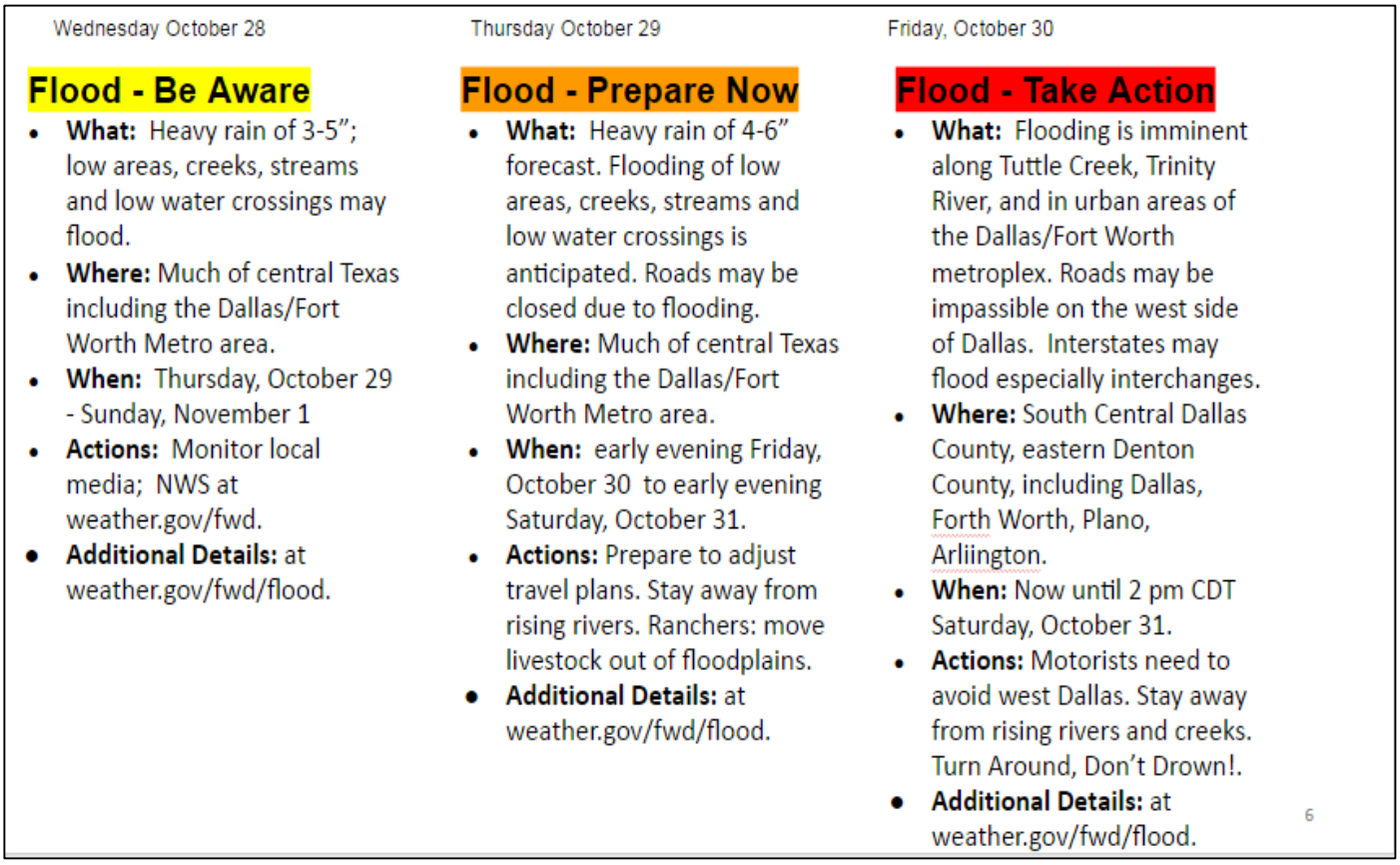
Prototype Z Comparison to Current Approach and Strengths and Limitations

Current WWA Approach	Approach with Your Prototype
Meteorological-based criteria	Actionable impact-based
Watch, upgrade, or downgrade	Continuous flow of information
Warning issued, then wait	Updates based on current conditions, changes (snow squalls)
Collaboration issues based on office boundaries	Improved based on limited specific products
Criteria-based; impacts from onset not communicated	Forecaster flexibility based on situational awareness
No collaboration with nontraditional partners because of NWS criteria	Ability to use nontraditional partners and their datasets for increased collaboration
Does not promote partner relationships and public needs	More dialog allows for more flexibility with partner needs
Locked by agency policies and directives	Flexible to societal and technological changes
Benefits	**Shortcomings**
Will leverage findings from current workforce management analysis	Will require development of robust internal/external dissemination platforms
Does not require a lot of forecaster training from office to office	Cultural change
Simplification of backing up Weather Forecast Offices (WFOs)	External education and outreach
Actionable impact-based	Potential for long time horizon acceptability
Continuous flow of information	Verification
Updates based on current conditions/changes	Educate Congress
Improved based on limited specific products	
Forecaster flexibility based on situational awareness	
Use nontraditional partners and their datasets for increased collaboration	
More dialog allows for more flexibility with partner needs	
Flexible to societal and technological changes	

Group Y Prototype: Action-Based, Tiered System with Colors

This prototype provides a color-coded, simplified action message upfront (take action, prepare now, be aware). The short message will convey who, what, where, when, and why. This prototype focuses on messaging and telling a story, taking a hierarchical approach based on action (and impact). The system will have three tiers, with an additional, higher tier for real emergencies.

Hazard	Threat Levels/Color	Action	Threat	Impacts
	Purple/black	**Take action**		
	Red	**Take action**		
	Orange	**Prepare now**		
	Yellow	**Be aware**		



Key Features:

- Focuses on simplified action message upfront to **tell a story** (who, what, where, when, why)**.**
- Focuses on **action first.** Marries **action and impact.**
- Includes three basic tiers based on impact that are **color-coded:** take action (red), prepare now (orange), and be aware (yellow). Also, "all clear." Color scheme should be tested.
- Uses a **higher tier** (black or magenta) for real emergencies.
- Background information (computer-coded information for Common Alerting Protocol [CAP]/geographic information system [GIS]/NWR/etc.) accompanies all messages.
- A "vehicle" is used to deliver the message via NWS systems, Internet, social media, smartphones, etc.
- Uses a **hierarchical** system (most urgent to least urgent)
    - Immediate Action or Risk Death/Life-Threatening
    - Respond/React/Take Protective Action
    - Be Prepared to Take Action

Prototype Y Comparison to Current Approach and Strengths and Limitations

Current WWA Approach	Approach with Your Prototype
Product-centric	Focus on messaging—tell a story; no "Products"
Focuses on phenomenon and actions typically are listed last (focuses on the "why")	Begin with action (simplified three-tier): 1) Take Action, 2) Prepare Now, 3) Be Aware (red, orange, yellow) Additional (purple/black) tier for highest impact—"Emergency"
Does not typically include much impact information; that which is included is done inconsistently	Color scheme accompanies the message Message could be based on "Impacts"' or based on "Tiers" Two ideas could be vetted to see which resonates more with partners and public
	Remainder of short message conveys the "what, where, when, duration, confidence, impacts"

Benefits	Shortcomings
Get people's attention	As with any changes in the program, we will need to educate the user community
Convey clear intention (what you want people to do) upfront	
Conveys high-level information with the details in the message (including links for more rich content)	
Marries action and impact information in a simple format	
Concept works well with current technologies, including social media, mobile apps, and even NWR	

Group X Prototype: Multi-Tiered Warning System

This prototype uses three tiers for immediate hazards and two tiers for prospective hazards. The prototype maintains "warning," but "potential" replaces current "watches" and "outlooks." Depending on the type, current advisories could be captured by either the warning or potential category. The prototype also will have a pre-watch, preparatory message. The main message will be very short and direct—mobile-friendly. The system also provides two levels of information in the form of an "advanced" or "detailed" button that provides more information for more sophisticated users.

CURRENT WWA	NEW HEADER	VERB/COLOR?	IMPACT
Emergency	Warning	**Take Action**	Widespread/Catastrophic
Warning		**Take Action**	Life-Threatening
Advisory		**Take Action**	Potentially Dangerous
Watch	Potential*	**Prepare**	Higher Risk
Outlook		**Be Aware**	Lower Risk

*Will replace some current advisories.

GROUP X

WARNING for FLASH FLOODING for DALLAS COUNTY through 7 p.m.

Threat: Life-threatening flash flooding
Timing: Through 7 p.m.
Impacts: Home flooding in Grand Prairie
Rush hour traffic stoppages and backups due to heavy rain
Closed roads due to high water

Locations: Dallas, Grand Prairie, south half of Dallas County

Actions: Stay out of flowing water
Evacuate low areas in Grand Prairie
Turn Around, Don't Drown

Detailed Information:

Threat: 2-4" of rain have fallen over Dallas County, an additional 2-4"is forecast. Tuttle Creek is currently over its banks. By 7 pm, widespread flooding is likely across the entire county.

Timing: (advanced info on timing)

Impacts: Water will likely be over roadways within 1/2 mile of the Trinity River, in the area south of I-30.
Rush hour traffic will be slow due to poor visibilities caused by heavy rains. Expect numerous accidents.

Locations: (add'l specific info on Locations impacted)
Low-lying areas in/around Grand Prairie
Areas within 1/2 mile of the Trinity River
All roads in/around Dallas County

Actions: Do not walk or drive into flooded areas.
Persons in low areas near Grand Prairie should move to higher ground

Key Features:

- **Blows up advisory** (but have to be careful about some user communities—e.g., marine).
- Keeps the **warning** (must have clear action beneath this word).
- Uses **concise messages**; this will be especially important for short-fused warnings where there is limited time to warn people.
- Provides different levels of information for **different users**: 1) concise message boiled down plus 2) more in-depth information for people that need more detail; for example, public version plus an "advanced" button.
- Focuses on **impacts and actions**; keywords are "be aware," "prepare," "take action."
- Uses three tiers for immediate hazards and two tiers for prospective hazards:
  - Three warning levels replace warning/advisory.
  - **Potential** replaces watch/outlook.
  - Some current advisory aspects could be down in "be aware."
- Adds a **pre-watch** (a preparatory message, but NOT watch).
- Come up with structure first, then come up with colors later.
- Main message is short and direct.
  - An advanced option is available for additional information.

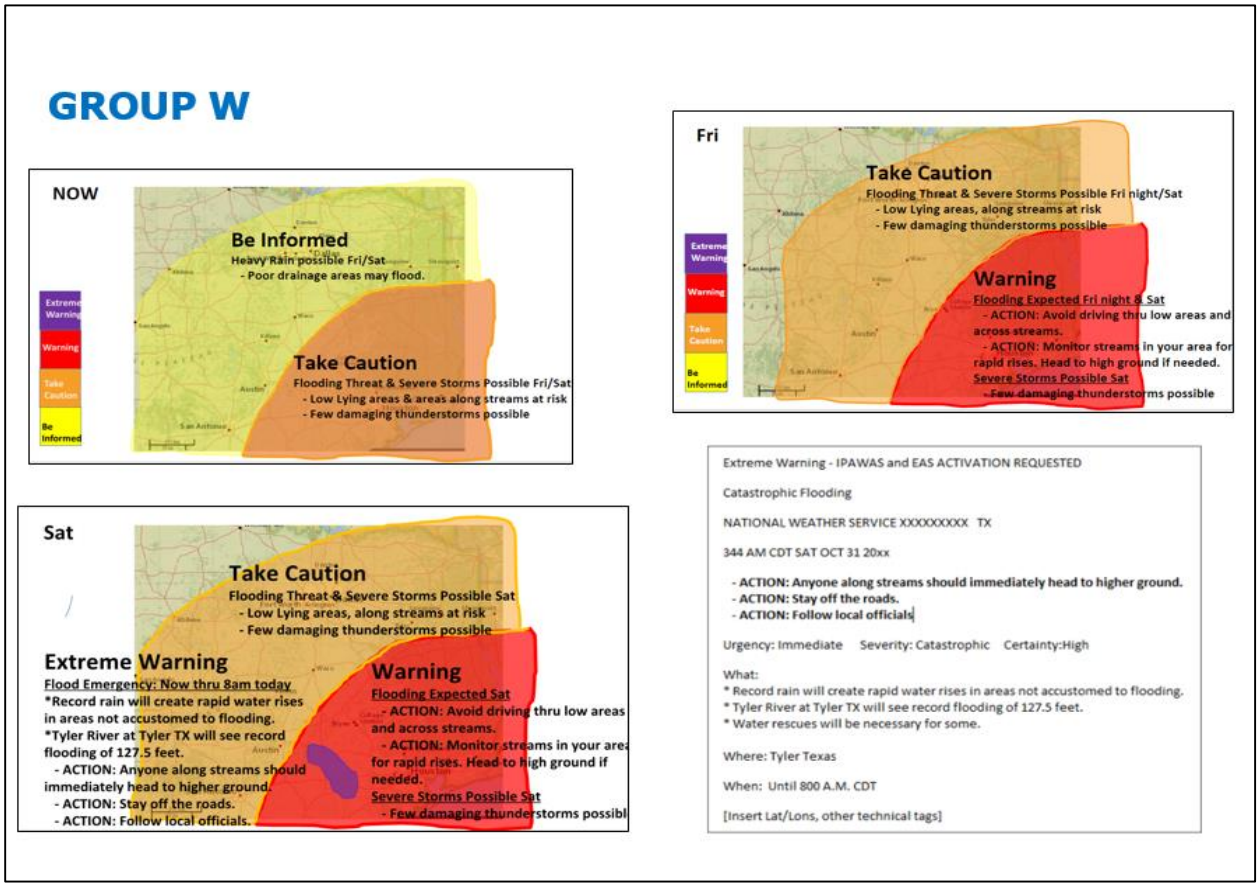
Prototype X Comparison to Current Approach and Strengths and Limitations

Current WWA Approach	Approach with Your Prototype
Dense fog advisory could be preceded by Special Weather Statement or HWO	Fog warning (or visibility warning) could be preceded by a Special Weather Statement or HWO
Atlanta event: Winter storm watch Winter weather advisory (with temperature dropping)	Snow potential (but could be heavy snow potential) Warning for … (heavy snow, ice and snow, blizzard—forecaster fills in for what the specific hazard is; do it differently for winter because of the variability) Handle non-precipitation events similarly Pre-watch/What to do prior to "watch" time?
Flood watch, flood warning, flash flood warning, areal flood warning, etc. Multiple flood products (e.g., eight issued in SC)	Flood potential message x number of hours before Flood warning Flash flood warning Flash flood emergency (rarely gets used)—some concern raised that "emergency" is unnecessary or that a warning would be issued that is NOT an emergency; another option is to leave the emergency language up to the local public safety community
Before watch Hurricane watch Hurricane warning	What to do pre-watch? Hurricane risk area (similar to tornado risk area) Keep hurricane watch because of international consistency; others think hurricane watch should be hurricane potential
Before watch, tornado watch, tornado warning	Need to formalize the pre-watch, tornado risk area; have smaller/shorter duration areas Tornado potential, tornado warning
Benefits	**Shortcomings**
Fewer products	International rule challenges; also Federal Communications Commission rules
Better, differentiated words	Need to consider across a broader type of user (e.g., fire where with red flag)
Clarifies special cases (by getting rid of advisory)	Need for broader feedback
Better public understanding	Massive education—internal NWS and external
Able to talk to different audiences with varying needs/knowledge	May be better wording than "potential"
Two tiers of information are mobile-friendly	May not be consistent across all hazards

Group W Prototype: Four-Tiered Matrix System Based on Impacts (Maintains Warning)

This prototype uses a four-tiered, color matrix system where colors represent different levels of impact. This prototype is graphical (maps) and provides action statements linked to locations. The system provides two levels of warning: warning and extreme warning. Be informed and "take caution" replaces watch and advisory, respectively. The focus is at the warning level. Users also have the ability to click and get more information—all on map with action statements.

Yellow	**Heads up (for internal/emergency managers) Be Informed (public)**
Orange	**Take precaution**
Red	**Warning—Take action**
Purple	**Extreme warning/emergency**



Key Features:

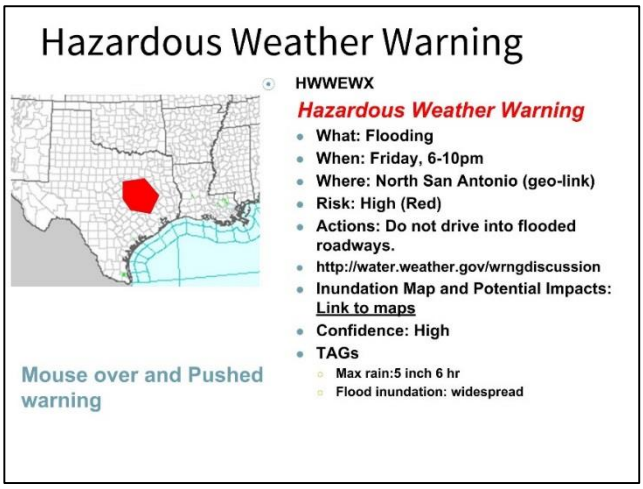
- Is **impact-based**, not criteria-based.
- Uses different colors to communicate different levels of impact and threat-specific recommended actions. Colors communicate **the nature of urgency**. Will need **testing for colors and meaning**; also need to test for color blindness and potential issues with mid-level colors and desensitization.
- **Uses two warning levels:** warning and extreme warning. Focuses on **action at warning level.**
- "Be informed" and "take caution" **replace watch and advisory**.
- Would need additional research for messaging terminology (e.g., "alert"), but timing details will be part of the message.
- Provides a **graphical presentation** with the ability to click and get more information—all on map with action statements.
- Uses common dissemination methods.
- Is more **geared to the public** and is not intended for long lead time, pre-event decision support services to emergency managers and partners.
- Could be enhanced with **icons** for different hazards.

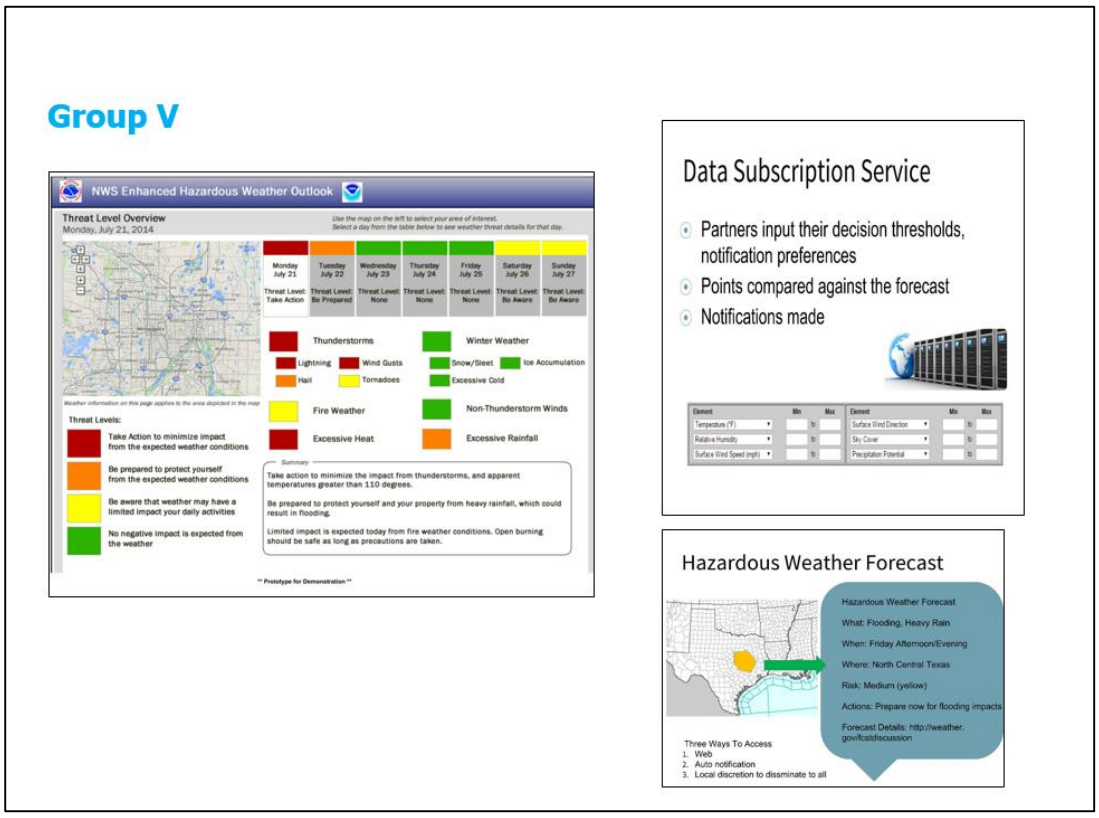
Prototype W Comparison to Current Approach and Strengths and Limitations

Current WWA Approach	Approach with Your Prototype
In the current system, we use colors to communicate threats	Colors to communicate the different levels of impact and threat-specific recommended action
Outlook	
Watch, Advisory	Yellow = Heads up
Warning	Orange = Injury, property damage
Warning	Red = life threat
Emergency	Purple = Massive infrastructure loss
Benefits	**Shortcomings/ Challenges**
Focused on impacts	System is not intended for long lead time, pre-event decision support services to emergency managers and partners, but for public information.
Easier to understand	Need to test colors and meaning, media and dissemination systems.
Framework can be applied across all seasons and disciplines	Accessibility—need to test for color blindness and low-vision audience
Easily adaptable to other systems related to text, graphic, reducing the numbers of products, etc.	Education and outreach, both internal and external
Logic is linear	
Minimizes over-warning	

Group V Prototype: Four-Tiered Matrix System with Database Subscription Service

In this system, a single "Hazardous Weather Warning" is issued for life- or property-threatening situations. Current watches, outlooks, and advisories are provided by a selective push/pull data service with user-defined thresholds. The prototype uses a four-tiered, color-coded hierarchical system based on risk probability and severity. It also provides who, what, and where tags and simple call-to-action statements.





Key Features:

- Uses an **enhanced database** with an interactive interface for specific events. The public can subscribe for alerts. A limited amount of information will be pushed out; more information can be pushed out depending on user-defined thresholds.
- Maintains **local flexibility** to define significant threats to life and property (informs what the local office pushes out). Local offices would work with the emergency management community to define their criteria for receiving notification. The approach will also help reduce over-warning and target vulnerable populations.
- Reserves a **single warning** (hazardous weather warning) for significant threat to life/property. Uses warning only when response is needed. Otherwise, information will be provided in the headline or in the forecast/database.
- **Gets rid of advisories** but keeps watches (hazardous weather watch) for some higher-end events; replaces the word "watch" (possibly retains tornado and hurricane watch).
- Uses what/when/where tags and short calls to action.
- Uses a **four-tier, hierarchical system** with a color-coded map based on risk probability and severity. Colors are paired with statements: be aware, be prepared, and take action. Provides specific meteorology information based on the specific event and supplementary information via color code, icon imagery, text, and links.
- Places an emphasis on **continually producing updated information.**
- Leverages current technology, and changing the system will be a largely incremental process.

Prototype V Comparison to Current Approach and Strengths and Limitations

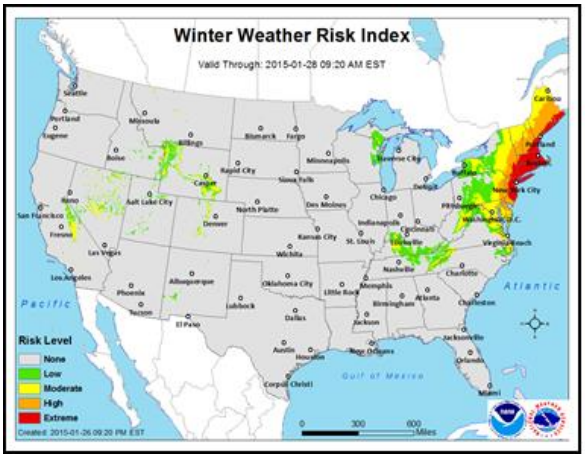
Case Study: Winter Storm, 7" to 10" of snow expected over a 12-hour period

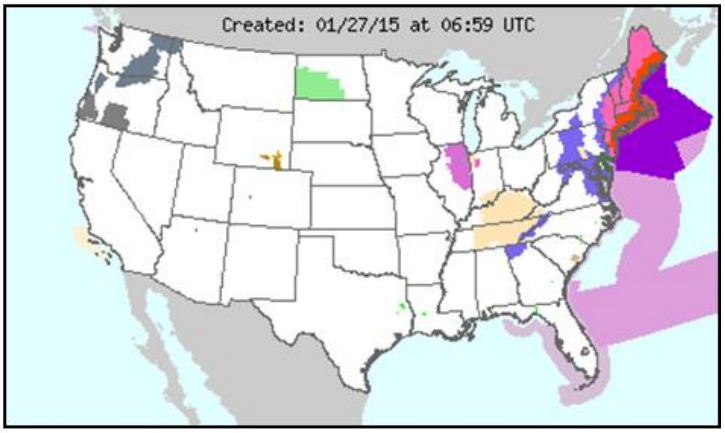
Current WWA Approach	Approach with Your Prototype
Four days out: HWO issued at 4 a.m. pushed to all	Graphical risk map available and updated as needed, reflecting thinking concerning severity and probability. Some users receive automated notification after their user-defined threshold is exceeded.
Three days out: Conference call, social media, update HWO	Graphical risk map updated with current thinking about severity and probability. Increased confidence makes it more likely that risk threat level will be raised even if predicted severity is unchanged. Some users receive notification after user-defined threshold exceeded.
Winter storm watch issued two days ahead—pushed to all, conference call, social media	Subscribers continue to receive notification after user defined threshold exceeded. *In some local offices,* criteria met for pushing information out to all users: climatologically rare, increased vulnerability (timing, events). Some local offices may add safety and preparedness information.
Winter storm warning one day ahead—pushed to all, conference call, social media	*Based on local criteria* at some offices, issue consolidated hazardous weather warning, improved and simplified messaging. Other offices continue to provide updated risk maps, but only subscribed users receive notification based on provided thresholds.
Benefits	**Shortcomings**
Generation of pre-defined products, which are pushed to everyone, is limited to those situations for which specific action is needed to limit a significant threat to public safety.	Requires substantial information technology (IT) infrastructure work to accommodate the new data-basing schema, enhanced data services, and information delivery mechanisms.
More emphasis on continually producing updated threat/risk condition information, which is easily accessible and configurable for individual or organizational needs. Users can determine their own notification thresholds for severity, timeframe needed to facilitate decision-making, and method by which the information is delivered (text, email, selected social medium, or app-based direct messenger, etc.) User may also choose to be notified only if they are located within the affected warning area. (*Proposed risk/threat matrix based on severity/confidence, not severity/impacts.*)	Need to flesh out the issue of how best to communicate high-end event information under what we currently call watches.
Warning product suite employs language that is simple, clear, specific, actionable, and framed in a "bottom-line upfront" format.	Important and non-trivial challenges associated with changes in policy, re-education of partners and users,

	as well as navigating the culture change within the NWS.
Single "Hazardous Weather Warning" headline—with supplementary information available via color code, icon imagery, text, and links; scales across all weather, water, and climate threats.	There are probably some issues we have not yet considered to ensure there is no detriment or degradation of services the current system offers.
The change is incremental, not revolutionary. It builds on what the NWS does well rather than completely re-engineering its mission delivery model. Also leverages enhanced data services and key partners (media, private sector, emergency managers) to get watch/advisory/outlook information to the public.	*Not really a shortcoming but certainly an important requirement:* Close collaboration with emergency managers, media partners, and others who use NWS information to make risk management decision and/or communicate weather information to the public. This will be particularly critical in designing practices for conveying information currently contained in watch and advisory level scenarios.
Preserves current array of Storm Prediction Center (SPC)/National Hurricane Center (NHC) products	Potential lack of change to SPC/NHC business model could be interpreted as inconsistency
	Need to figure out how to deal with situations where weather hazard rapidly morphs from current "advisory" level into a warning level—with no advisory/watch, does there need to be some interim product (get ready/outlook) to prepare public for that potential?

Group U Prototype: Data-Centric, Risk-Based System Customized to User Needs and Vulnerability

In this prototype, data is the top, highest-level priority, from which information/products can be derived. A matrix was suggested as one possible tool to distill the data and pre-computed user decisions into actionable information, as determined by end-users who need it (and request it). This prototype conveys risk information (low, medium, high levels) based on community vulnerability and customized by the user. It features a risk-based map (see sample maps below) that would also include specific, recommended actions for different groups. The delivery system is an "upside-down V." At the top of the V is basic information that everyone can interpret intuitively. As one goes down the V, more details are provided for power users. Behind the scenes is a large data system linked to partners' information. There would still need to be a consideration for those sectors of the populace that are not sophisticated users; thus, the NWS could use the lowest thresholds of the matrix to generate watch/warning products.





Day One	Day Two	Day Three	Day Four Through Seven	Day Eight through Fourteen
Flash Flood Warnings plus Watches Lengthy description, one size fits all, broad context "Halloween: Our system has been alerting people in the vulnerable area about an upcoming weather event. It is not expected to have children outside, but is a possibility. Continuous information will be provided during the event. Regional Decision Maker: High Risk: Take Action Now: Severe disruption to travel, potential loss of property (Updated maps are provided for the expected weather event) High confidence there will be a lot of rain coming. High resolution products will enable the identification of public assets at risk. Medium Risk: Prepare for Disrupted normal events: Prepare for delays Low Risk: Monitor and prepare in the event you need to travel"	Mix of various Flood Watches " Regional Decision Maker: High Risk: Take Action Now: Severe disruption to travel, potential loss of property (Updated maps are provided for the expected weather event) High confidence there will be a lot of rain coming. High resolution products will enable the identification of public assets at risk. Medium Risk: Prepare for Disrupted normal events: Prepare for delays Low Risk: Monitor and prepare in the event you need to travel"	Hazardous Weather Outlook "Regional Decision Maker: Provided updated GIS layers for expected flooding event High Risk: Enact your flooding mitigation plan is encouraged. Take precautionary action and remain extra vigilant. Follow orders and any advice given by authorities under all circumstances. Medium Risk: Consider enacting your flood mitigation plan. Flooding expected of neighbors and infrastructure Saturday, October 31, 2015. Take precautions where possible and ensure you access the latest weather forecast. Low Risk: Be monitoring in the event the flood mitigation plan may need to be enacted. Be aware and ensure you access the latest weather forecast for up to date weather information. Grandma: There is an abundant amount of rain coming, you live in an area below sea level, please take the necessary precautions to stay safe.	Hazardous Weather Outlook "Regional Decision Maker: Provided with a GIS framework that identifies how varying risk areas are identified in jurisdictions Medium Risk: Prepare to enact your flood mitigation plan. Flooding expected of neighbors and infrastructure Saturday, October 31, 2015 Low Risk: Monitor the potential for flooding this weekend Grandma:	CPC Outlook broad probability for certain thresholds "Regional Decision Maker: Hazards plus verbiage outlining the possibility of additional rainfall Our system would recognize the vulnerabilities of the impacted areas. In addition, the activities anticipated for impacted days. Grandma:

Key Features:

- Configures matrix/tools differently from problem to problem and user to user. Focuses on the individual elements that drive the matrix/tools and how forecast guidance can inform each element.
- Provides **numbers** (likelihood) to users, as opposed to words, which cause more inconsistency in interpretation.
- Is information-centered to **convey risk based on vulnerability;** prioritizes risks and actions.
- Provides basic information that everyone can interpret intuitively and more detailed, granular information for power users. **Language is customized by user**.
- Uses a **color-coded, action-oriented map** (a simple three- to four-color map for the public and a hyper-pixilated one for high-end users).
- Provides **risk levels** (low, medium, high) and keywords, including monitor, prepare, enact, take action. The words will be simple and understandable and will specify when to be aware and when to take action.
- Identifies vulnerabilities of certain communities and **focuses on vulnerabilities in specific hazards**. Vulnerability is both static (roads, demographics) and dynamic (land conditions, time of day, perception of risk, behavior preference).
- Uses a **targeted database** based on risk. Information is pushed out based on how impactful the event is. Database can be linked to partners' information. Emphasizes **collaborating with partners** well in advance in a preparatory mode and sharing information earlier.
- Uses an impacts engine and built GIS layers.
- Provides a continuous flow of information.

Prototype U Comparison to Current Approach and Strengths and Limitations

Current WWA Approach	Approach with Your Prototype
Winter storm watch: (timing, accumulation, wind, geography, impact statement, action statement)	Hyper-pixelated maps for decision-makers. Different variable map sets available for roads, land use, utilities, etc. Text will be contingent upon the conditions. Simple, action-oriented map and words for the public specifying when to be aware and when to take action.
Hurricane warning: (strength, geographic area, observations, current expected impacts, update schedule)	Risk-based map is entirely different than a hazard-based system. Out of the risk mapping will fall recommended actions for specific groups at specific times. Encode based on risk and time, so the ultimate end result is recommended actions. Possibly use shading to demonstrate time (darker shades could mean more imminent—lighter shades = more time.
	Low risk, medium risk, high risk, extreme risk
2-inch snow storm (advisory)	Low or medium risk (color + action)
Benefits	**Shortcomings**
Accounts for vulnerability; applies to all hazards	Design mostly under the hood, not necessarily specific end-user product.
Prioritizes actions, more closely aligns to decision-making	Light on details (colors/risk levels) of delivery of end product at this time
Contextualizes weather into an actionable format	High-end user outreach could be extensive
Improved consistency—office to office, shift to shift, year to year	Requires more from stakeholders or databases that may not be as complete as needed
Uses climatology, frequency of occurrence to help scale	Requires evolution of staff skill sets
Utilizes, evolves/expands impacts catalog	Short-term heavy workload (but long term simplifications and workload reduction)
Dynamic with both place and time	Final vision of delivery leveraging technology—too far down the road from where we are currently
Provides a more objective approach to understanding impacts (effective corporate knowledge transfer)	
Risk model is a functional, tangible framework to build a Weather-Ready National (WRN) that is well understood, vetted, and researched by a broad spectrum of our communities.	

Group T Prototype: Matrix-Centered, Customer-Defined, Non-WWA

This system is directed to individual decision-making and recognizes the personal process behind human judgment. It is a matrix-based, data-centric information system that feeds messaging in any format and leverages existing user communication. Products are derived by users, who set their own thresholds based on their unique situations and needs. The system enables both new and traditional tools for communication (e.g., matrices) while retaining existing warning strategies and products for some sector of the populace, as needed. The system does not limit legacy products but enables the NWS to grow. Messages are numbered and include alert levels; what, where, and when information; recommended actions; expected impacts; likelihood; odds ratios; etc.

Phenomenon: Snow

	Timing	Severity	Confidence	Likelihood	Vulnerability
	HHH:MM:SS	Meteorologic Character	Deviation	Probability/Odds Ratio	Risk Category (via 3rd Party)
High/Now					
		X		X	
Med/Soon			X		
					X
Low/Later	X				

= MESSAGE → **ACTION**

BULLETIN - EAS ACTIVATION REQUESTED
FLOOD MESSAGE #1
Audience: Public
Source: National Weather Service Group T
Issued: 1200 pm CDT Thursday, Oct. 29, 2015

Alert Level: **Be Aware**
What: Widespread flooding.
Where: [Your current location – populated by database]
When: Saturday afternoon and evening
Recommended Actions: Monitor forecasts.

Expected Impacts: Squaw Creek and other nearby rivers may flood. Water in basements, flooded roadways.
Forecast Severity: 2-4" additional rainfall expected, with rainfall rates of 1" per hour.
Likelihood: 40% likelihood of flooding on Oct. 31.
Observations: Ground is saturated and river levels are above normal.
For more information: **weather.gov/flood#650**

Based on Gregg et al. 2012, Recommended revisions to warning product prototypes of the NWS Pacific and West Coast/Alaska Tsunami Warning Centers

Order of items will be tested.

2

Key Features:

- Uses messaging language that is **driven by key hazard characteristics** (e.g., timing, severity, confidence).
- **Maintains warning.**
- **Rewords watch and possibly advisory.**
- Is **database-driven.**
- Provides a **numerical uncertainty** aspect.
- Provides **personalized information** that can get pushed to cell/mobile.
- Does **not shorten messages**; provides all necessary information.
- Could provide larger/smaller products—driven by database and user.
- Uses a simple **numerical system to label messages.**

Prototype T Comparison to Current Approach and Strengths and Limitations

Current WWA Approach	Approach with Your Prototype
Product-centered	Data -> Information (user-specific)
Human-derived products	Feeds any messaging techniques
Limited product set (defined by NWS)	Retains existing warning strategies, as necessary
	Adapts to end-user needs
	Offers data mining for end-users and vendors
Benefits	**Shortcomings**
Strives to meet diverse needs of users	Words vs. numbers
Enables messaging of forecast likelihood, odds ratios	Who considers vulnerability (impacts)?
Legacy product generation	Data formats and ease of portability
	Consideration of weather elements to meet user needs

Group S Prototype: Evolved WWA

This prototype maintains a three-category system that follows the current watch → advisory OR warning. It reorders the terminology (e.g., a warning for tornado) and adds color coding to the WWA product. The prototype maintains the words "watch" and "warning." It also maintains the advisory function, but another word could be used to replace the term "advisory." The system also consolidates product types.

Watch for _____
Advisory for _____
Warning for _____

- **What:** < Lead sentence summarizing situation>
- **Where:** < Describe in language with link to map >
- **When:** < Words with link to timeline >
- **Actions:** < Enter calls to action>
- **Impacts:**
- **Severity:**
- **Confidence:**

&&

- Polygon Points:
- Time...Motion...Location:
- Other Related Hazards:

$$

Proposed Modified System

WFUS54 KCRP 242044
TORCRP
TXC007-409-242115-
/O.NEW.KCRP.TO.W.0055.151024T2044Z-151024T2115Z/

BULLETIN - EAS ACTIVATION REQUESTED
WARNING FOR TORNADO
NATIONAL WEATHER SERVICE CORPUS CHRISTI TX
344 PM CDT SAT OCT 24 2015

- What: Tornado over Ingleside on the Bay until 415 PM CDT
- Where: Located over Ingleside on the bay...moving northeast at 25 mph.
- When: Until 415 pm CDT
- Actions: Heavy rainfall may hide this tornado. Do not to see or hear the tornado. **TAKE COVER NOW!** To report severe weather contact your nearest law enforcement agency. They will send your report to the National Weather Service Office in Corpus Christi.
- Impacts: Flying debris will be dangerous to those caught without shelter. Mobile homes will be damaged or destroyed. Damage to roofs...windows and vehicles will occur. Tree damage is likely.
- Severity: Moderate
- Confidence: Moderate - Radar indicated

&&

- Polygon Points:
  LAT...LON 2783 9724 2784 9724 2783 9723 2788 9727
  2804 9722 2803 9715 2797 9719 2803 9713
  2803 9704 2798 9708 2797 9707 2797 9709
  2795 9706 2794 9711 2791 9707 2793 9712
  2791 9714 2786 9710 2789 9715 2782 9720
- Time...Motion...Location: 2044Z 212DEG 21KT 2782 9724
- Other Related Hazards: Hail..1.00in

$$

Key Features:

- **Reorders words**: "A watch for _____"; "A warning for _____" ; "An advisory for _____."
- Some **hazards will not have a warning**.
- Enables **watch to be issued earlier in advance**.
- Uses **consistent formatting** in all product messaging and across all hazard types.
- Education on the terminology is crucial.
- Maintains **"advisory" function**, but would require research into the effectiveness of the term "advisory." Advisory could be replaced with another noun.
- Adds **color-coding** to the WWA name.
- Consolidates product types.
- Labels and tags each component so that a user can configure what order they want to see the information and parse for dissemination.

Prototype S Comparison to Current Approach and Strengths and Limitations

Benefits	Shortcomings
Flexibility	Limited color scheme during complex events
Consistent format of messaging across all timelines, hazards, and levels of severity	Where is the dividing line between outlooks and watches? Do we issue tornado watch at 8 a.m. for 4 p.m. event? What about multi-day events?
Consolidation of products	Coordinating various NWS entities responsible for issuing different hazard products may be difficult during complex events
Largely works within the current NWS infrastructure and workforce training	Alliteration issue ("WAtch" and "WArning")
Consistent with legacy and future external dissemination formats and systems	Uncertain thresholds
Preserves the integrity/special nature of "warnings"	
Placeholder for continuous flow of information	

Appendix C: Short-Term Repair Recommendations

Group A – Recommended Repairs			
1	Reorganize the layout (all products); impacts to the top.		
2	Headlines: Watch for ____, Be Aware, Take Action.		
3	Traffic light theme.		
4	Social media friendly formats, including Instagram, Snapchat, Periscope.		
5	Billboards, electronic road signs.		
6	Look into making calls to action simplified and more consistent within all products.		
7	Need some level of severity in products.		
8	Remove unneeded words/phrases in products (e.g., SPC public watch product).		
9	Increase communication skills within the NWS and look for that skill in new hires.		
	Description	**Pros**	**Cons**
1	Improve communication and messaging skills	Effective messages, enhanced credibility	Training expenses (time and money)
2	Social media friendly formats, including Instagram, Snapchat, Periscope	Flexibility to reach more users	Slow to implement across agency
3	Reorganize product layout, impacts on top. Headlines: Watch for ___, Be Aware, Take Action	Don't bury the lead	
4	Simplify calls to action and remove unneeded words and phrases. Preparedness info embedded in product (watch)	Clarify message	

Group B – Recommended Repairs			
	Description	**Pros**	**Cons**
1	Reduce number of current products and eliminate the need for transition warnings. Examples: Flood Watch/Flood Warning/Flash Flood Warning. Hazardous Wx Outlook/Winter Storm Watch/Winter Storm Warning for Snow and Ice.	Use fewer Valid Time Event Codes (VTECs).	Software overhaul. Disabling the VTEC code is not so simple. Impact on dissemination. Education and outreach efforts.
2	Bullets of what/actions/where/when/ additional details. REGARDLESS OF ORDER—CONSISTENT ACROSS ALL WFOs.	Consistency. Simple and intuitive. Hazard action-based.	Software component. Impact on dissemination.
3	Timing is part of the MND title rather than in the headline. E.g.: Flood warning until 2:00 p.m. CDT	Shorter, more concise.	IT and dissemination.
4	Replace attribution statement in the products with the action phrases: Be Aware. Prepare Now. Take Action. The NWS in Kansas City says: “Take Action.”	Iterative step toward actions. Quicker crawls. Infers urgency.	Educational and outreach efforts.
5	NWR link on warning products within the website.	Allows the warning to be heard.	

Group C – Recommended Repairs	
***1**	#1 Have a core, simpler basic message that is mobile friendly and includes action. Add the advanced feature for people who want more. First line of any product used conveys action. Change overview (used optionally above headline) to action statement (like prepare now). Develop brief, bulleted calls to action. CONS: Time and resources to implement; current lapse in NWS IT contract support to implement change until 2017. Not sure overview is used much—challenges with automated parsers. For example, limit to one call-to-action statement for short-fused events; more is not better. CONS: Policy not known. Need coordination at WFOs. Also every critical message should say what we know, what we do not know, and when we will know more.
2	Pay more attention to effective time rather than issuance time for some products. CONS: For long-fused warnings, people might wait until it is too late to act.
3	#2 Consolidate hazard types (e.g., flood product suite).
4	#3 Leverage social media and emails for communication and possibly as a testbed. For example, use Facebook/Twitter to test new prototypes and action wording—real-time testing PRO: Organic sharing. CONS: Low visibility to the public.
5	Coordinate public education by entire weather enterprise—WRN project to create something for elementary school curriculum? Single consistent toolbox for warning coordination meteorologists? PROS: Existing mechanisms/relationships in place. CONS: Human resources and funding.
6	*Forecasters uniformly feel empowered to use their discretion when issuing products—cultural change and management training required. To do this: add consistent training for managers; national centers play a more active role in regional-scale events (esp. flood, winter). CONS: Cultural feeling that offices must be consistent; negative reinforcement when forecasters use discretion and there is a problem.
7	Implement mixed case for short fused warnings for 2016 convective season
8	#4 Revisit the simplified WWA map; could add emojis. PROS: People understand these colors/icons. CONS: Web infrastructure.
9	Number messages sequentially for each weather event in the MND heading. CONS: Easier for some products than others
10	Tailor meteorological criteria to different regions for the severe thunderstorm warning.

Group D – Recommended Repairs	
1	Restructure WWA products to put the most important information at the top of the message.
2	Utilize social media to test new communication techniques.
3	Tweak the existing WWA templates to incorporate some of the wording strategies discussed this week. BE INFORMED—WINTER STORM WATCH. TAKE ACTION—ICE STORM WARNING.
4	Consider eliminating (or just not issuing) some advisories. The same information would still be shared via social media, graphics, forecasts, HWOs, etc.
5	Update NWS Directives to allow for more local flexibility with regard to product guidelines based more on societal impacts.
6	Eliminate frost/freeze hazard products. Message the information in other ways.
7	Examine fire weather WWA products and dissemination (including public display on WWA maps).
8	Change “Severe” thunderstorm to “Damaging” thunderstorm

Group E – Recommended Repairs	
1	**Explore methods of improving hazard communication:** 1. Expand experimental auto-Tweets of convective warnings to include impact graphics for snow/rainfall. 2. Investigate models of using color, bold texting. 3. Rearrange phrases aimed at Web/mobile device users; add graphical components to Web links of warnings. 4. Experiment with using the “breaking news” model to convey hazard information and tell stories about what is unfolding (primarily via social media).
2	Narrow winter and flood product suite: watch/warning/advisory for winter weather and flood; add hazard-specific tags (snow amount, wind, etc.).
3	Reduce number of colors on National WWA map to three: watch/warning/advisory and click/hover for details.
4	Reformat warning messages to the what/when/where/risk level and actions.
5	Charter multidisciplinary policy review team to identify existing barriers that contribute to user confusion and limit forecaster flexibility; i.e., allow to change order of cancellation, new, continued, etc.

Group F – Recommended Repairs	
1	Apply risk communication science to current products.
2	Completed research (consult social science community).
3	Product/headline consolidation: winter, flooding, tropical, wind.
4	Expand impacts catalog to support impact-based warning.
5	Know your CWA training.
6	Geolayers.
7	Climatology of impacts database.
8	Shift to constituent-driven delivery deadlines.
9	Important broadcast times (30/60 minutes before).
10	Public safety decision points.
11	Multi-language capability (Spanish, French, other languages in CWA).

Group G – Recommended Repairs			
	Description	Pros	Cons
1	Problem: Messages are not driven by social and behavioral science. Repair: Application of social and behavioral scientific findings to NWS messages (e.g., Gregg et al. 2012 for Tsunami findings).	Simple. Already implemented in tsunami messaging. It DOES apply to all hazards.	May be perception of testing needed for all hazards.
2	Problem: NWS product redundancy Repair: - Identification and consolidation of redundant products (HazSimp research a la Ansorge et al.). - Examination of product approval process (10-102).	Reduces confusion and simplifies messaging.	Beyond simple administrative fix.
3	Problem: Display and retrieval of forecast information (weather.gov). Repair: Improve weather.gov data services (with HQ authorization) for on-demand information extraction capabilities, enabling Wx partners to meet user needs	Better clarity and application for end-users.	
4	Problem: Issuance of products driven by Meteorological criteria, public needs information grouped by event (instead of hazard) Repair: Continuous flow of information, group messages by event, number messages sequentially (weather.gov repair)?	Clarity of messaging.	
5	Problem: NWS Meteorologists have no required training in communications (or systematic evaluation of) written communication. Use of technical language and Met-Jargon prevalent in products. Repair: - Provide training to NWS Meteorologists. - Hire communication specialists for QC and training. - PPD8.	Consistency and clarity of messaging.	Resources needed for this.
6	Problem: HWO restricted to zero to seven days. Repair: Allow temporal flexibility in HWO.		

Group H – Recommended Repairs	
1	Change “[Haz1] Watch” + “[Haz2] Watch” to “Watch for [Haz1], [Haz2].
2	Consistently format all hazard messages (e.g., bulleting, CAP, “nuggetizing” for stakeholders).
3	Examine the consolidation of existing WWA products.
4	Potentially redefine criteria for certain products (e.g., Are there too many severe thunderstorm warnings?).
5	Increase public education on the existing terms, <u>especially</u> “Advisory.”
6	Implement color-coding for category levels based on severity of event.