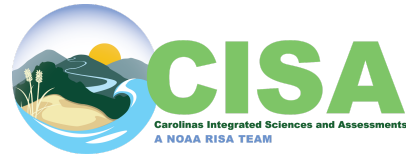


Innovating Approaches to Drought Communications
with North Carolina Decision Makers

Project Nighthawk - Phase 1 Writeup

Team Members

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OVERALL PROJECT PURPOSE & OVERVIEW

This project focuses on improving the usability of drought-relevant information for North Carolina decision makers based on needs identified by the NC Drought Management Advisory Council (DMAC) and constituents such as NC Cooperative Extension agents and public water supply system managers.

The motivation for the project stemmed from needs articulated by North Carolina decision makers for improved drought information and communications. These needs include a better understanding of how drought is monitored, the climatic and environmental conditions (e.g., ENSO and other seasonal differences) that can cause or worsen drought conditions, and drought impacts on various sectors including agriculture, forestry, and water resources.

The project objectives are to:

- Develop tailored, sector-specific information relevant for drought decisions
- Deliver information in accessible and actionable formats
- Improve the transparency of the drought monitoring process through enhanced engagement and communications with decision makers

The project is designed as an iterative process and engages three key sectors affected by drought (agriculture, forestry, water resources) (Figure 1).

- Phase 1 focuses on identifying and refining information needs and gaps in existing drought resources.
- Based on findings from Phase 1, the project team will develop prototype products and information resources in Phase 2.
- Phase 3 will entail the evaluation of new products and resources using focus group discussions and usability testing at conferences, workshops, meetings, and other opportunities as they arise. The project team will modify new products and resources based on this feedback.
- Phase 4 will reconvene the project team, NC DMAC members, and other sector representatives to develop strategies for incorporating new tools and resources into existing drought monitoring and decision making processes.
- In Phase 5 a final project survey will be disseminated to extension agents and water resource managers to assess their potential usage of the new resources developed through the project.

Project Nighthawk

Innovating Approaches to Drought Communications with North Carolina Decision Makers

- Project Objectives**
- Develop tailored, sector-specific drought resources
 - Use accessible and actionable delivery formats
 - Improve drought monitoring process transparency

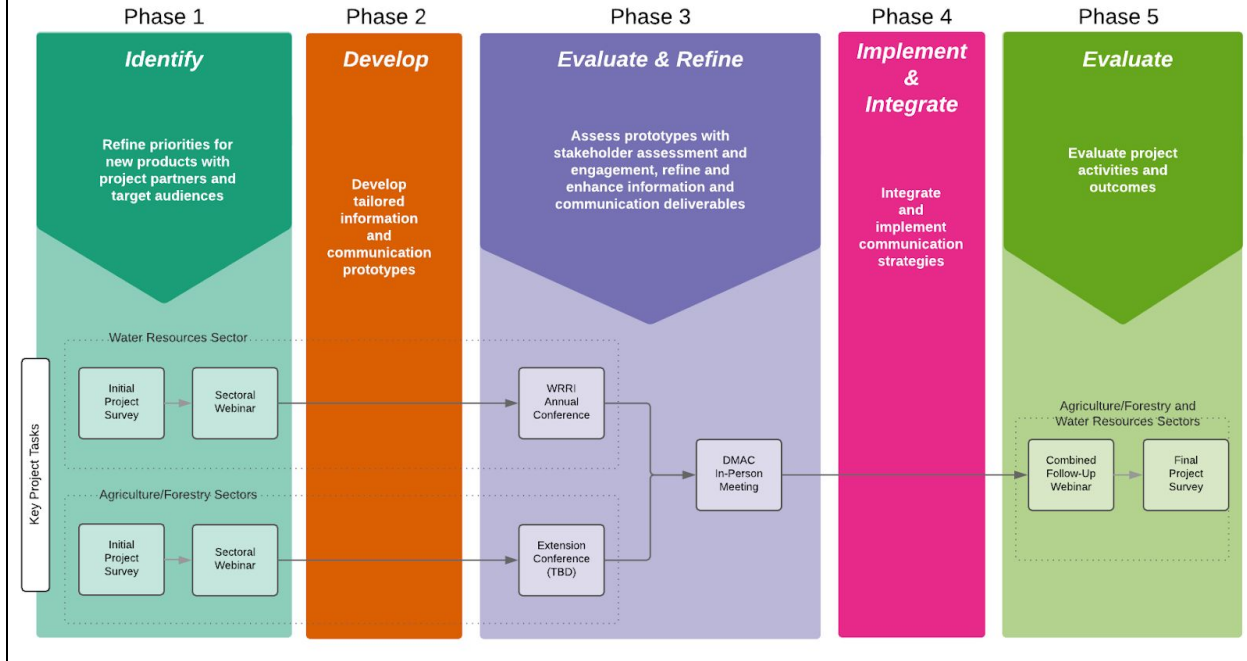


Figure 1. Project components and workflow

PHASE 1 PURPOSE

The purpose of Phase 1 was to identify and refine priorities for new products with project partners and target audiences. The goals of this project are to help make drought information more easily understandable, relevant, and transferable to end-users. To accomplish this, we are targeting decision makers who have both a decision making role (for their own decisions) and a communications role in translating drought info to their constituents, customers, and colleagues. Decision makers from the NC DMAC and three key sectors (agriculture, forestry, and water resources) contributed to an assessment of current drought resources and communication methods through online surveys and follow-up webinars in fall 2018 (Figure 2).

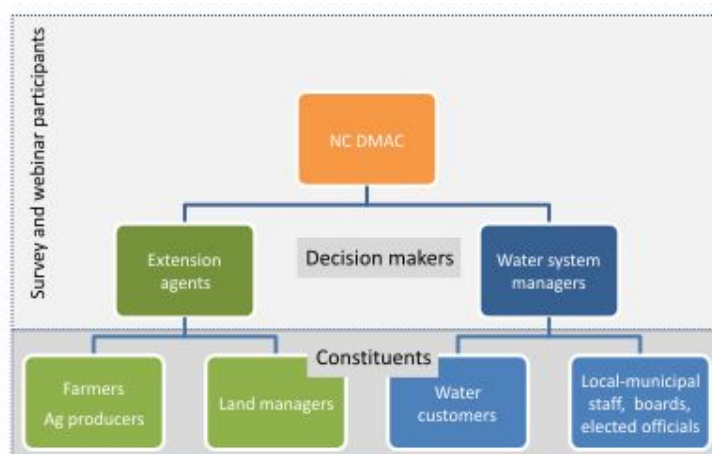


Figure 2. Project participants

Since 2003 the NC DMAC (ncdrought.org) has issued drought status advisories for the state. The DMAC includes a number of agencies and organizations that meet weekly via teleconference to coordinate and exchange information regarding recent conditions across the state. The DMAC's assessments feed into the US Drought Monitor. Participating agencies and organizations include the NC Department of Environmental Quality, Division of Water Resources; the State Climate of North Carolina; NC Cooperative Extension Service; NC Forest Service; NC Emergency Management; National Weather Service offices; the US Army Corps of Engineers; the US Geological Survey; Tennessee Valley Authority; and Duke Energy.

PHASE 1 METHODS

Online surveys: The purpose of the surveys was to collect information from extension agents, water resource managers, NC DMAC members, and other sectoral representatives about their existing information needs, perceptions of drought, and awareness and use of existing resources. The surveys were identical with the exception of three questions about sector-specific decisions and decision calendars.

We developed, pilot-tested, submitted for Institutional Review Board (IRB) approval, and disseminated two surveys. These surveys were developed using NCSU Qualtrics software. Staff

and students at SCONC and CISA, as well as sector representatives within Cooperative Extension and the NC Department of Environmental Quality, helped to pilot-test surveys.

We worked with NC Cooperative Extension personnel to obtain contact information for 307 agents and specialists who work directly with constituents in agriculture or forestry fields. We additionally obtained contact information for 9 individuals within the NC Forest Service from a NC Forest Service representative.

We contacted NC DEQ for assistance with identifying individuals within the water management sector to complete our survey. NC DEQ provided a list of all public water supply systems within the state. Using guidance from NC DEQ, in which it was recommended that we send the survey to medium and large water systems, we sent the survey to systems who served populations of 5,000 or more. This resulted in a total of 183 unique emails sent to public water system representatives. We invited email recipients to forward the survey link to other colleagues, so the number of actual recipients may be higher than those indicated in Table 1.

Initially planned for mid-September, the dissemination of the survey was delayed due to Hurricane Florence, which made landfall in North Carolina on September 14, 2018, and caused significant impacts across the state that required the attention of much of our target audience.

The survey opened on October 12, 2018, and initial invitation emails were sent out on this date. We sent out three additional reminders and extended the deadline by one week to November 2, 2018. Several factors may have contributed to the low response rate (Table 1). This includes the lingering effects of Hurricane Florence; Hurricane Michael, which hit the state on October 11, causing widespread power outages in the central part of the state; and the North Carolina State Fair, held from October 11-21, which may have occupied many extension agents during the time when the survey invitations were first disseminated.

During the 3-week period when the survey was open, 100 participants opened the ag/forestry survey, with 52 surveys completed, and 48 surveys partially completed. Basing response rates on surveys that were fully completed, we estimate a ~16% response rate. This is an estimate because it is possible that some people shared the survey with others. The partially completed surveys had a 2-81% completion rate. A total of 40 participants opened the water resources survey, of which 22 were completed and 18 were partially completed. We estimate a 12% response rate, using the completed surveys. Partially completed water resources surveys had a 5-81% completion rate.

Table 1. Online Survey #1 - Response Rates

	Agriculture & Forestry		Water Resources	
Invitations sent	316		183	
Surveys opened	100	31% of invitees	40	22% of invitees
Surveys completed	52	16% of invitees	22	12% of invitees
Surveys partially completed	48	2-81% completion rate	18	5-81% completion rate

The survey consisted of 36 multiple choice and open-ended questions. The project team generated summary statistics and graphs, and also reviewed open-ended responses to identify any common themes or specific recommendations regarding drought information needs or priorities.

Follow-up webinars: The purpose of the webinars was to share results from the initial survey, discuss preliminary ideas for resources and tools to develop as part of the project, and obtain feedback from participants in order to refine and prioritize the list of ideas. NC DMAC members, other drought information providers who wrote letters of support for the project (e.g., USDA Southeast Regional Climate Hub, Southeast Regional Climate Center, National Weather Service offices), and key sector representatives (Cooperative Extension personnel, water system managers) were invited to participate. Separate webinars were conducted for the agriculture and forestry (November 28, 2018) and water resources (December 5, 2018) sectors. Table 2 lists the participating organizations and number of participants.

Table 2. Organizations participating on the webinars

Agriculture and Forestry	Water Resources
November 28, 2018	December 10, 2018
8 participating organizations 14 total participants	14 participating organizations 17 total participants
CISA (2) National Weather Service (5; Raleigh, Blacksburg, Wakefield) NC DEQ, Division of Water Resources NC Forest Service NC State Cooperative Extension (3) SCONC (2) USDA Southeast Regional Climate Hub	CISA (2) City of Durham (2) Cube-Hydro Duke Energy Fayetteville Public Works Commission National Weather Service (Raleigh) NC DEQ, Division of Water Resources (2) Orange Water and Sewer Authority (OWASA) SCONC (2) Southeast Regional Climate Center Town of Cary US Army Corps of Engineers US Geological Survey

The first part of the webinar included a project background and review of the informed consent process, to include information about participant selection, the potential risks and benefits of participation, and confidentiality. As this research project involves human subjects and has been reviewed and approved by the NCSU IRB, project documents, presentations, and other materials will not include individuals' identities or link responses to specific individuals.

The second part of the webinar was organized around three themes - communication channels and formats; drought information use, preferences, and potential gaps in existing resources; and the North Carolina and US drought monitoring processes. For each theme, survey results and discussion questions were presented. Examples of existing resources currently available in North Carolina, through national-, regional-, or state-level agencies (e.g., NC DMAC, SCONC, NOAA), and example resources and graphics from other states, were also included. During the

final part of the webinar participants were asked additional questions intended to facilitate discussion about priorities for new products to be developed as part of Project Nighthawk.

The project team recorded and took notes during the webinars. Notes were compared with the webinar recording transcript to develop a final document with key discussion points and recommendations from the webinars.

Post-webinar surveys: Webinar participants received a link to a brief (3 questions) follow-up survey. The follow-up survey was created using NCSU Qualtrics software. It provided, in part, another opportunity for participants to voice their opinions in an anonymous manner. There were two open-ended questions and a third question that asked respondents to rank product priorities. The choices were based on topics discussed on the webinar. Seven attendees (total from both the agriculture and forestry and water resources webinars) responded to the follow-up survey.

PHASE 1 INITIAL SURVEY RESULTS

Survey results were separated and analyzed by sector (i.e, agriculture and forestry, water resources) as we expected that the different sectors would identify different needs and priorities. Summary graphs were developed for each sector; key points are highlighted below.

First, when considering the numerous communication channels and formats we asked about in the survey, we found that they fell across a spectrum (Figure 3) according to the effort and amount of translation required for a user to understand how it might affect their own sector or decisions.

For example, many web-based tools provide access to raw data and observations, requiring users to manipulate and visualize the data, then understand its connections to their impacts. On the opposite side of the spectrum, formats such as blogs, factsheets, and webinars are designed to do this visualization and translation directly for users.

In addition, communication formats tend to fall into two categories: ones that are accessed individually on a user's own time, and ones that are accessed jointly, often with guidance or explanations from information providers or intermediaries.

While survey results did not indicate a consistent preference for any one particular communication format, they did reveal several general preferences that this spectrum helps to illustrate. Those include:

- At least **partially synthesized**/translated information
- Exploring **individually** on their own time
- Data and reports **pushed to them** (instead of going somewhere to find it)
- A **variety of formats**, from alerts to factsheets to infographics
- Accessing data both **online** and **offline**

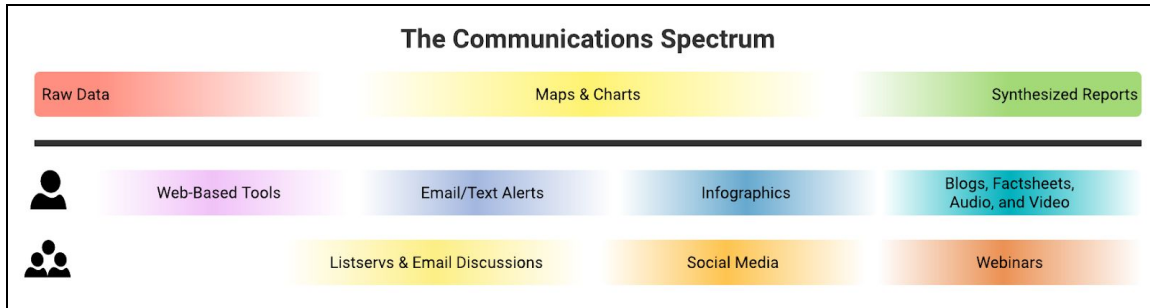


Figure 3. The communications spectrum - ways of interacting with data and information

Agriculture and Forestry Results

- Geographic scales: Respondents ranked the usefulness of particular geographic scales in this order - county (most useful), state of North Carolina, Southeast region, river basin, national (least useful).
- Type of climate information used: Responses indicated that users are most interested in current, short-term (i.e., over the next 1-7 days), and anticipated conditions, impacts, and forecasts. Climatology, past events, analogs, and drought causes may be less useful by comparison. Responses also indicated that precipitation and temperature observations and outlooks are most used/useful for drought monitoring compared to other types of drought monitoring products and tools (e.g., drought indices).
- Information time scales and decision calendars: Current conditions and short-range forecasts are used more in decisions such as planting, agricultural management, harvesting, prescribed burning, and resource allocation (Figure 4). Respondents indicated using long-range outlooks and past data for decisions about purchasing seeds or other inputs, equipment or other supplies, and insurance, and long-term planning decisions. In terms of seasonality, the decisions that were tied most to a specific season include planting (spring), agricultural management (summer), harvesting crops (fall), long-term planning (winter), and purchasing seeds or other inputs (winter).
- Drought monitoring processes: Survey results indicated that a majority of respondents lack familiarity with the US Drought Monitor and how it is created. Similarly, responses to items about the NC DMAC and USDM of NC map indicate that participants lack familiarity with both; in particular, 52% of respondents indicated that they were not aware of the NC DMAC. Additionally, the majority of respondents from both sectors were either unsure or incorrect about how often the NC DMAC meets. However, despite the apparent lack of awareness of national- and state-level monitoring processes, responses also suggested that the maps developed through these processes are used for decisions or trigger actions. The majority of respondents indicated that they use the USDM and the USDM of NC Maps to monitor drought conditions or to communicate drought conditions to colleagues, constituents, or customers. Responses about specific actions triggered by the USDM of NC map were reallocating resources to affected areas; irrigation; reporting conditions, such as to USDA National Agricultural Statistics Service (NASS); notifying farmers and producers of conditions or actions they should take; and providing more education and communication about drought and drought-mitigation actions.

	Winter	Spring	Summer	Fall
Planting				
Agriculture management				
Crop harvesting				
Forest management				
Resource allocation				

Figure 4. Decision calendars - usefulness of **current conditions** and **short-range forecasts** for informing agriculture- and forestry-related decisions

Water Resources Results

- Geographic scales: Respondents ranked the usefulness of particular geographic scales in this order - river basin (most useful), county, state of North Carolina, Southeast region, national (least useful)
- Type of climate information used: While all time scales of information are either very or moderately useful, responses indicate that current conditions and short-range (1-7 day) forecasts are the most useful for drought decision making. In comparison, responses suggest that long-range (monthly, seasonal, or annual) forecasts, climatology, past events, analogs, and drought causes are less useful. The most useful products appear to be precipitation outlooks and forecasts and resources that provide information about streamflow and reservoir levels.
- Information time scales and decision calendars: Survey results did not demonstrate clear patterns in the types of weather, climate, or drought information needed for decisions related to purchasing equipment or other supplies, or about resource allocation. Current conditions and short-range forecasts were selected most for decisions about reservoir management, water conservation, and communications (Figure 5).
- Drought monitoring processes: Close to 50% of respondents replied that they were very aware of both the NC DMAC and the NC drought monitoring map, but more than 30% replied that they were *not* aware of either. A high percentage (over 30%) of respondents were unsure how the US Drought Monitor process works. Additionally, a high percentage (over 50%) of respondents reported that they consider the USDM and NC maps only moderately accurate or that they are unsure about their accuracy. Despite questions and uncertainties about the maps' accuracy, some respondents indicated that they used the products for monitoring drought and water resource conditions and communications.

	Winter	Spring	Summer	Fall
Reservoir Management				
Water Conservation				
Communications				

Figure 5. Decision calendars - usefulness of **current conditions** and **short-range forecasts** for informing water management-related decisions

PHASE 1 WEBINAR RESULTS - AGRICULTURE AND FORESTRY

This section provides a summary of the webinar discussion with the agriculture and forestry representatives.

Communication Formats and Dissemination

In response to questions about what factors are considered important when using and passing information onto constituents or clients, a few key points emerged:

- Clarity of information was noted as being important. Participants indicated wanting straightforward, simple information. Confusing or unclear information leads to confusion

on the part of constituents about what to *do* with that information. Clear, straightforward information helps providers and ‘translators’ transfer and explain information to their constituents. One observation about scientific communications is the tendency to talk about uncertainties, probabilities, etc., so the takeaways are often difficult to understand or apply.

- Applicability of information: For providers, it’s important to know exactly what information the consumer needs and how that information will contribute or lead to a decision.
- Verified information: It matters that information be from a reputable or trusted source. Examples of trusted sources provided on the webinar were the NWS, NOAA, and SCONC. Having infographics that tie back to that trusted information source are seen as valuable.
- Processes that have worked for information translation and communication include incorporating products into everyday operations (whether drought is a concern or not) and having the ability to provide that information in multiple formats.

During the webinar, we mentioned a survey result which indicated that **social media**, and particularly Twitter, were *not* preferred/useful means of communicating or disseminating drought-related information. Some webinar participants indicated they used social media to share information and that having infographics were important for this. Others mentioned that many of their constituents used social media for personal, not work, correspondence.

Use of Specific Resources and Information

Some participants on the webinar focused on the use and access of technical information, and some mentioned specific data resources that they frequently use:

- **USGS stream gauge** information is helpful with questions about river flows for agricultural or recreational uses. No comments were made about difficulties accessing the data, though a desire for more gauging stations was expressed.
- Indices and maps available on the **SCONC’s Fire Weather Intelligence Portal (FWIP) and Integrated Water Portal (IWP)** were mentioned several times. Specific products include the Keetch-Byram Drought Index (KBDI), soil moisture data (station-based), Standardized Precipitation Evapotranspiration Index (SPEI), and GIS layers of CPC temperature and precipitation outlooks. Other indices and maps mentioned include the Evaporative Demand Drought Index (EDDI), gridded soil moisture data, and greenness maps. An NC Forest Service representative noted that constituents are most interested in having accurate forecasts of possible upcoming entry into drought. The NWS longer term precipitation and temperature forecast maps are now available on the FWIP for zooming in and can provide some of this information.
- **“Translated” products** that synthesize weather, climate, drought, or related information into easier-to-understand formats such as infographics received generally positive comments. It was suggested that we should try these types of graphics and assess users’ response. One example would be a graphic to show statewide reservoir levels.

Drought Awareness and Monitoring Processes

Discussion about drought awareness was mixed. Some participants mentioned that their constituents were generally well-informed and tuned in to current drought conditions. The information needed by this group are better forecasts of possible entries into drought conditions.

The project team presented some ideas about developing informational products about the NC DMAC, the USDM and NC Drought Map, and the NC DMAC process. Participants indicated that this would be valuable, particularly since their experience has been that their constituents are not aware of the multiple forms of information that are included in these, such as groundwater, reservoir levels, agricultural impacts, etc. One participant remarked that the NC DMAC has moved to focus more on impacts in its discussions and designations. This should be conveyed to users of any new products. Webinar participants supported these ideas, particularly as they might help with issues of transparency and awareness of the drought monitoring process in North Carolina.

PHASE 1 WEBINAR RESULTS - WATER RESOURCES

This section provides a summary of the webinar discussion with representatives from the water resources sector.

Communication formats and dissemination

A common difficulty noted on the webinar regarding information was the challenge of format. Participants mentioned the perceived desire from their constituents -- and an observed trend in society and science communication -- for **short and visually appealing messages**. Participants also shared difficulties with translating and synthesizing complex information in a simple manner to non-technical audiences.

Participants mentioned relying on news releases and emails to share updates on conditions in the past, and that they are likely to rely more heavily on social media in the future. Though no specific strategies for how to make resources created in this project more visible and discoverable were discussed, a few ideas and insights did come to the surface during the webinar. Participants noted their reliance on information that was immediately available online, then adding additional details to this when conveying information to colleagues and constituents.

Web pages with lists of links were noted to *not* be useful, mainly because these could be overwhelming. It was recommended that as part of this project, we do not attempt to share new resources by simply adding a link to existing lists because this is unlikely to increase visibility. Traditional sources of communication, like print and local TV, were mentioned as avenues that shouldn't be overlooked for getting information to the public.

Webinar participants noted the relevance of **audience** when it comes to **what** information is shared, specifically the length and the content. During past drought events, different information might be sent to different audiences. Participants noted the importance of protocols and making sure that shared information did not disagree, or even seem to disagree, with an established protocol or areas of responsibility. For example, in the past NC DMAC members distributed via email an initial assessment of drought indicators, to facilitate review and discussion of conditions. However, this is intended for the DMAC and not necessarily for broader audiences.

There is a tension between information users who want simple, concise (but informative and meaningful) drought messages and information providers (i.e., DMAC members) who struggle to

convey very complex, technical, and nuanced concepts to the variety of audiences who are interested in or need drought information. The need to convey information in an understandable way was paramount, with webinar participants noting their experiences have suggested a lack of understanding has led to lack of trust and lack of perceived accuracy in drought products. Jargon and technical terms, such as percentiles, can be lost on people who don't often use them. A suggestion was to make an assumption that audience members have a limited technical background.

Use of Specific Resources and Information

*Weather and climate products **supplement** water-system specific data and information*

- Participants on the webinar relied on their own monitoring information (e.g., reservoir levels, groundwater wells) for their water supply and water conservation decisions. For more regional-scale and future information, SCONC's experimental products, NOAA and NWS were cited, particularly for longer-term outlooks. El Niño and La Niña were mentioned as useful climate patterns, and additional context for these supplied alongside drought communications materials could help provide usable information about anticipated drought impacts.

*Drought needs to be put into a **geographic and water management context***

- Webinar participants also described the need to be able to convey how conditions in a particular area relate to conditions upstream or downstream in a watershed. Having **the full watershed picture** -- not just river basins, but in watershed impoundments, water supply, and impacts downstream -- would help translate drought information and its relevance to customers. Coordination between different systems was mentioned as having been done in the past to facilitate a consistent message about water shortages, but no formal strategy was noted, just that coordination was attempted. One suggestion brought up on the webinar was the possibility of using HUC maps, perhaps a HUC8 layer, as a compromise between river basins and watersheds.
- The term "**mediashed**" was mentioned in contrast to "watershed," and it was noted that there have been difficulties finding the right way to coordinate messaging multiple water systems exist in a mediashed, or when an area's upstream water supply is outside the mediashed.
- The **need for localized information** was also cited in reference to existing communication methods, such as the SCONC's Climate Blog. While having a statewide perspective was valuable, localized, region-specific information was requested. In addition, having the ability to see evolving conditions was important for participants and they saw this as valuable to their constituents as well.

Feedback on producing a statewide reservoir map

The project team presented an idea about developing a statewide map to show reservoir levels, similar to products that are created in western states and regions. Participants on the webinar expressed agreement that this type of map could be useful, but cautioned on the difficulties with measuring and creating this type of graphic. A number of agencies and municipalities manage water systems across the state, and not all these systems use the same methods for monitoring their supplies. Additionally, operating procedures vary across systems, and it was noted that they've struggled in the past to convey this complexity without increasing confusion.

Assimilating this information into a graphic, and a usable one at that, presents a challenge. NC

DWR has tried to develop a water supply reservoir index in the past, but it was very difficult to do.

Drought Awareness and Monitoring Processes

The weekly drought maps were simultaneously lauded for their ability to show different intensities in a visually pleasing format, and critiqued for the *difficulty in putting these intensities in context* for different audiences: What does this mean? How serious is this? What does the forecast look like and what does it imply about conditions getting worse or better?

The need for better **forecast** information was cited by multiple webinar participants, particularly as it relates to anticipated or possible drought conditions. The USDM and NC Drought Maps are based on retrospective data. In other words, each map is based on conditions up to the moment that the map was made and forecast data are not included. While webinar participants recognized this, they shared that they often need to know or be able to communicate to their constituents or the media about where we think we’re going.

PHASE 1 POST-WEBINAR SURVEY

Based on survey results and webinar discussion, the project team created a list of potential resources to develop. Webinar participants were asked to rank them from 1 to 5, with 1 being the highest priority, in a post-webinar survey. Table 3 shows the ranking results from survey participants (7 total; 2 agriculture-forestry; 5 water resources). Table 4 shows comments provided to the open-ended questions included in the survey.

Table 3. Post-webinar survey results

Product or Resource	Average Rank
Resources that describe the NC Drought Management Advisory Council, its purpose, its weekly drought monitoring process, and how this relates to the US Drought Monitor	3.4
Information in narrative form to accompany the NC Drought Map that synthesizes the weekly drought status in North Carolina, any recent changes in drought status or outlooks, and the data and information was used in determining the drought status	1.7
Resources that relate anticipated short- and long-range conditions, such as those provided by national-scale forecasts and outlooks, to drought conditions and local- and sector-specific effects in North Carolina	2.1
AF: Information that explains how to access, interpret, and apply more technical types of information, such as newly developed drought indices and tools. WR: Resources aggregating statewide or basin-wide conditions including reservoir levels and precipitation totals	2.4
I think you should prioritize a different product or resource	4.4
Comments <ul style="list-style-type: none"> • A description of the NC DMAC process would probably be a "one-time" effort but could be used in a variety of communications. I understand the interest in providing a weekly narrative but without hard rules on decisions, it could add more questions and uncertainty. • Climate factors that cause NC drought 	

Table 4. Comments from the post-webinar survey

<p>“Please provide any comments regarding other communications preferences or specific formats or strategies that have worked well for you in the past when communicating about drought to your customers or constituents.”</p> <ul style="list-style-type: none">• Infographics and other brief content that we could then tailor and relay through our own social media would be useful to us.• A less text heavy NCCO website with more graphics depicting current conditions and forecasts would be more useful.• Email works great. I either forward what you send, post it to the web, or "grab" to include in presentations.• Keep it simple...add depth as requested or through links that will take advanced users deeper into the content, approach, limitations, etc.• It seems at one or several points in the past that we attempted to provide a summary of the decision process for the weekly recommendations. My recollection is this summary was provided during a particular dry period in which the USGS drought monitor did not coincide with NC recommendations or perhaps when information from several different indicators conflicted. However, I don't recall this practice last long after the drought conditions subsided.• A description of the NC DMAC process would probably be a "one-time" effort but could be used in a variety of communications. I understand the interest in providing a weekly narrative but without hard rules on decisions, it could add more questions and uncertainty.
<p>“Please provide any other comments about suggested modifications to specific, existing resources that would help them better meet your or your constituents’ needs or other recommendations for the project team to consider.”</p> <ul style="list-style-type: none">• When communicating reservoir levels, I think translating the lake level to available water supply is important, especially for multi purpose reservoirs such as Jordan Lake and Falls Lake. Another useful metric for communication is translating a lake level to days of water supply, based on a the current level of demand and assuming the storage volume doesn't change.• I think having a resource describing climate factors that cause NC drought would be very helpful, so constituents will know what to look for and thus can be better prepared. A brief explanation of what the drought severity levels actually mean would also be most helpful.• Water table data. The state has a network of wells; however, I've had a hard time figuring out what is going on with some of them, or with how it may or may not relate to soil moisture, stream flow, or irrigation concerns.• Build it and we will come. Also provide a balance of pushed and web-based content. I am often inspired to hit links when I get your blog versus remembering to go to your website and scope fire info or detailed resources. I like the climate forecasts but usually get them pushed to me versus remembering to go find them, so a balance makes great sense.

Table 5. Summary of Phase 1 key findings and takeaways by sector and participant group.

		Agriculture and Forestry		Water Resources	
who	NC DMAC	Extension agents	Constituents: farmers, agricultural producers, land managers	Water system managers	Constituents: Water customers, local and municipal staff, boards, elected officials
why	Determine drought status (D0-D4)	Provide guidance regarding drought and other weather-climate conditions for agricultural and land management decisions	Make planting, harvesting, irrigation, and planning decisions	Make operational decisions Communicate to customers, staff, and officials about drought conditions and conservation actions	Make water use and conservation decisions Communicate to citizens
when	Weekly (past conditions/ preceding 7 days)	Daily to seasonally (current to anticipated conditions)	Daily to seasonally (current to anticipated conditions)	Weekly to seasonally (current to anticipated conditions)	Daily to seasonally (current to anticipated conditions)
where	State, county, basin	Region, county	Parcel	River basin, water system area (county-municipal level)	Individual homeowners and businesses Municipalities
what	Technical information, from a variety of federal and state agencies	Technical information, from a variety of federal and state agencies, primarily precipitation and temperature data	Not addressed in Phase 1	Water system-specific information Technical information, from a variety of federal and state agencies, primarily water level data	Not addressed in Phase 1
how	ncdrought.org website, NC drought map, links to individual agencies	Preferences for concise maps, graphs, narratives	n/a	Preferences for concise maps, graphs, narratives Communicated through news media, emails, social media, websites	n/a

PRIORITIES AND RECOMMENDATIONS FOR PROJECT NIGHTHAWK PRODUCTS

The priorities described below were identified during Phase 1 of the project. During Phase 2, the prototypes and products developed to address each priority will be elaborated upon. During Phase 4, strategic dissemination plans and mechanisms will be developed.

Priority 1: Narratives to accompany NC Drought Map

- These may take the format of a blog-style write-ups with shorter (1-2 sentence or bullet point) summaries and visuals to convey recent changes to drought maps.
- For example, SCONC has write-ups from previous maps and discussions that can be used to develop prototype narratives and formats.

Priority 2: Resources that relate anticipated short- and long-range conditions, such as those provided by national-scale forecasts and outlooks, to drought conditions and local- and sector-specific effects in North Carolina

- An example is a 1-2 page fact sheet that describes ENSO current conditions, model forecasts, and a timeline of expected evolution and sector-specific impacts (if ENSO is a seasonally relevant pattern). Additional information that may be included are the amount of skill (or lack thereof) for the given season and important caveats about the outlooks, such as that these are forecasting average seasonal conditions (i.e., a forecast for above-normal temperatures doesn't mean there won't be some cooler periods).

Priority 3: For the agriculture and forestry sectors- information that explains how to access, interpret, and apply more technical types of information, such as newly developed drought indices and tools

- Developed products would describe technical information, drought indices, and/or existing data-access tools with examples of instances these would be used and how. Products may take the form of 1-2 page factsheets, infographics, blog-posts, or a combination.

Priority 4: For the water resource sector- resources that aggregate statewide or basin-wide conditions

- One example is an infographic integrating basin-wide reservoir levels and precipitation totals. Another example is a product that describes how water resources across the state (or within example basins) are managed, and the influence that weather, climate, and drought have on water management decisions.

Priority 5: Resources that describe the NC Drought Management Advisory Council, its purpose, its weekly drought monitoring process, and how this relates to the US Drought Monitor

- For example, this could be a "one-time" resource that can be made available on the DMAC and/or SCONC websites
- A more in-depth description could take the form of a story map, whereas a more shareable version could take the form of one or a series of factsheets with infographics.