North Central Texas Council of Governments

# Integrating Transportation and Stormwater Infrastructure

# Standard Operating Procedure for Creating a Flood Early Warning System Master Plan

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integrating **Transportation** & **Stormwater Infrastructure**

# Standard Operating Procedure for Creating a Flood Early Warning System Master Plan

A **Flood Early Warning System (FEWS)** is designed to alert communities to developing flood emergencies with sufficient lead time to take protective actions that safeguard lives and property. To meet that objective, a FEWS must be organized to approach the effort holistically, integrating technical, operational, and community-based components.

The World Meteorological Organization (WMO) conceptualizes FEWS through an **"End-to-End" hydrological value chain**, which encompasses the full spectrum of flood forecasting and early warning activities (See Figure 1).


*Figure 1: Hydrological Value Chain in Flood Forecast and Early Warning (WMO, 2022[1])*

At the start of the hydrological value chain—commonly referred to as the **"First Mile"**—is the early identification of potential flood threats. This critical step often relies on data and forecasts from sources such as: National Weather Service (NWS) Forecast Offices, NWS River Forecast Centers, and local monitoring networks and data collection systems.

One of the most complex challenges in this phase is accurately predicting the amount and location of extreme rainfall from intense thunderstorms, which are especially frequent in Texas.

At the other end of the value chain—the **"Last Mile"**—is the community's response to flood warnings. The success of a FEWS ultimately hinges on its ability to deliver timely, actionable, and trusted alerts that lead to the right decisions at the right time, minimizing harm and maximizing public safety.

[1] World Meteorological Organization (WMO). Assessment Guidelines for End-to-End Flood Forecasting and Early Warning Systems (WMO-No. 1286). Geneva, 2022.

While every component of the hydrological value chain plays a vital role, the greatest challenges—and therefore the greatest opportunities for impact—lie in the First Mile and the Last Mile.

This guide presents a concise, step-by-step Standard Operating Procedure (SOP) for developing a Flood Early Warning System Master Plan. It outlines a transferable planning approach that can be adapted to different regions and institutional settings. The resulting Master Plan defines FEWS objectives, regional hydrology and watershed characteristics, flood risks, current system capacity, gaps, and strategic options for strengthening capability.

The SOP follows a holistic approach, viewing FEWS as an integrated system of interconnected components, where overall performance depends on how well these parts function together. While the SOP provides a general framework, each Master Plan should reflect the specific needs and conditions of the community it serves. In addition, Master Plans are intended to be living documents that are regularly reviewed and updated over time.

This SOP is not a rigid template but a practical guide to support communities through the FEWS planning process. It highlights key considerations across the full “End-to-End” hydrological value chain. Above all, it emphasizes continuous improvement as local experience with FEWS grows and flood risks change.

## Purpose and Outcome

The purpose of this SOP is to create a repeatable planning process that leads to a comprehensive FEWS Master Plan, while keeping detailed design, procurement, and implementation decisions in a later Implementation Plan. The SOP explicitly positions the Master Plan as the document that informs future work on system architecture, technology specifications, budget, schedule, coordination, compliance, procurement, installation, and long-term operations and maintenance.

The final Master Plan produced through this SOP should contain six core outputs:

1. FEWS objectives,
2. Regional hydrology and watershed characteristics,
3. Flood risk identification,
4. Existing FEWS capacity assessment,
5. System gap analysis, and
6. Strategic improvement options.

The NCTCOG FEWS Master Plan can be used as an illustrative example of one possible outcome and level of detail, not as a required template, fixed chapter sequence, or prescribed method for creating all FEWS Master Plans.

## Use Notes

This SOP governs the planning process, required analyses, and minimum outputs. The NCTCOG FEWS Master Plan is referenced to illustrate what a finished product can look like, but jurisdictions should adapt the final Master Plan structure, emphasis, data sources, and presentation style to local flood hazards, watershed conditions, governance arrangements, operational needs, and available resources.

Use the NCTCOG Master Plan to inform examples of deliverables such as objectives summaries, regional characterization, capacity inventories, gap summaries, and improvement frameworks. The example NCTCOG Master Plan is not a strict how-to model for the planning process itself, because the SOP is intended to be transferable across Texas and applicable to communities with different scales, capacities, and flood-warning needs.

## Operating Principles

Use an end-to-end FEWS perspective from detection through public action, with particular attention to first-mile detection and last-mile warning and response. Treat the Master Plan as a regional, multi-agency product that depends on stakeholder engagement, standardized terminology, and documented roles across jurisdictions and partner organizations.

Use a planning horizon that is long enough to support phased investment and institutional development. Pay particular attention to sustainability, ongoing operations and maintenance, and equipment replacement planning. Build the Master Plan around practical decision needs not just technical inventories. Strive to consolidate fragmented tools and data streams that support coordinated actions. The steps below are intended to guide development of the six core outputs.

## Step 1: Initiate the planning process

### 1.1 Establish scope

Define the study area, participating jurisdictions, lead agency, key partners, and intended planning horizon. Begin by clearly defining geographic extent, counties, cities, and overlapping regional entities such as water districts, transportation agencies, and federal partners, which is essential for shared governance and data exchange.

### 1.2 Confirm deliverables

At project initiation, confirm that the primary deliverable is a FEWS Master Plan and that any implementation-level items will be documented separately for later action. Also confirm required appendices, maps, inventories, stakeholder records, and any chapter templates to keep products consistent across contributors.

### 1.3 Form the planning team

Create a core team with expertise in hydrology, floodplain management, emergency management, communications, geographic information system (GIS), operations, and information technology. Identify a broader advisory group that includes local jurisdictions, state and federal agencies, infrastructure owners, and community-facing representatives where relevant.

### 1.4 Develop the work plan

Prepare a work plan with milestones for kickoff, data collection, stakeholder engagement, technical analysis, draft review, revision, and approval. Include a document control process so that assumptions, source data, draft decisions, and review comments are traceable throughout development.

## Step 2: Define FEWS objectives

### 2.1 Gather user and stakeholder needs

Use surveys, interviews, workshops, and site visits to identify what agencies and communities need from the FEWS. The NCTCOG Master Plan used survey results, targeted follow-up, site visits, and workshop feedback to identify needs such as more monitoring, better forecasting, interoperable data, clearer alerts, and stronger public outreach.

### 2.2 Translate needs into objectives

Convert stakeholder input into concise planning objectives that describe what the FEWS must accomplish operationally and regionally. Objectives should address warning lead time, reliability, geographic coverage, support for emergency decision-making, public communication, equity for vulnerable populations, and coordination across jurisdictions.

### 2.3 Document planning assumptions

State assumptions about hazard types, service area, warning philosophy, existing institutional roles, and intended users of FEWS outputs. This chapter should explain whether the FEWS is expected to support flash flooding, riverine flooding, reservoir-influenced flooding, roadway flooding, or a combination of these conditions.

### 2.4 Deliverable

Prepare an Objectives chapter that synthesizes stakeholder input, identifies priority use cases, and states the planning goals that guide all later analysis.

## Step 3: Characterize the region

### 3.1 Describe geographic and jurisdictional context

Summarize the study area’s counties, cities, watersheds, political boundaries, and the institutional landscape that affects warning operations. Include cross-boundary issues that affect upstream monitoring, downstream warning value, and mutual dependence among jurisdictions.

### 3.2 Describe climate and meteorology

Document the storm types, seasonality, rainfall intensity patterns, and atmospheric influences that drive flooding in the region. Note whether the area is driven by hurricanes,

convective storms, or other dominant event types. Include climate context and the potential role of increasingly intense rainfall in flood risk.

### 3.3 Describe watershed and hydrologic response

Summarize watershed boundaries, topography, soils, land use, drainage density, runoff potential, response times, and the distinction between flashy tributaries and longer-lead mainstem flooding. The SOP suggests using both narrative and analytical methods, including indices such as drainage density, lag time, time-to-peak, topographic wetness, and related watershed metrics where data and effort justify them.

### 3.4 Describe built environment and flood infrastructure

Identify reservoirs, levees, dams, low water crossings, stormwater systems, transportation corridors, critical facilities, and other infrastructure relevant to flood consequences and warning decisions. The NCTCOG example shows why this matters by linking critical facilities, low water crossings, impervious growth, and reservoir operations to FEWS siting and warning priorities.

### 3.5 Describe population and vulnerability context

Summarize demographics, vulnerable populations, access and functional needs, language needs, and communities that may require tailored warning strategies. Include how these characteristics affect both flood consequences and the design of communication and preparedness measures.

### 3.6 Deliverable

Prepare a Regional Hydrology and Watershed Characteristics chapter with maps, concise narrative, and supporting tables that describe the physical, institutional, and social setting of the FEWS.

## Step 4: Identify flood risks

### 4.1 Compile hazard information

Assemble available hazard maps, historical flood records, modeled flood extents, known problem locations, and future-condition information where available. Document flood extent, magnitude, intensity, historical information, future risks, and watershed response times at key impact locations.

### 4.2 Identify exposure and vulnerability

Map critical facilities, vulnerable populations, transportation chokepoints, evacuation constraints, and infrastructure whose failure or closure could worsen consequences. Ensure the analysis covers both direct flood impacts and indirect impacts such as isolated neighborhoods, blocked access routes, and reduced emergency access.

### 4.3 Identify stakeholder roles in risk information

Document which organizations create, own, update, interpret, and communicate risk information. Include how local knowledge, technical expertise, and community input are used to validate and update flood-risk understanding.

### 4.4 Consolidate risk information

Create a centralized structure for risk information, ideally GIS-based, that can support ongoing review and future FEWS operations. The NCTCOG improvement framework reinforces this by recommending a living regional flood risk atlas with merged mapping layers, critical facilities, vulnerable populations, and flash-flood hot spots.

### 4.5 Deliverable

Prepare a flood risk chapter or section that identifies priority flood hazards, vulnerable areas, important impact locations, and the implications for FEWS planning and warning needs.

## Step 5: Assess existing FEWS capacity

### 5.1 Inventory current assets and systems

Inventory monitoring hardware, telemetry, software platforms, dashboards, communication systems, modeling tools, staffing arrangements, data sources, and operational procedures. The NCTCOG Capacity Analysis organizes this work through hardware assets, observational capacity, temporal resolution, data management, operations, forecasts, mapping resources, and other data sources.

### 5.2 Assess capacity across the end-to-end value chain

Evaluate current capability in at least five areas: flood risk identification, detection and monitoring, analysis and forecasting, warning dissemination and communication, and preparedness and response. A structured checklist around these same broad elements is

included in Appendix A. The checklist emphasizes that they collectively cover the flood warning value chain.

### 5.3 Evaluate operational expertise

Assess whether the FEWS has defined roles, interoperable data exchange, routine maintenance, quality control, cybersecurity, redundancy, archiving, staffing coverage, and clear warning procedures. The checklist in Appendix A also stresses evaluating institutional mechanisms such as standard operating procedures, memoranda of understanding, and data-sharing protocols.

### 5.4 Document strengths and constraints

Summarize what works well and what limits performance, including fragmented systems, insufficient staffing, uneven local expertise, weak forecasting integration, limited public-facing capability, and inadequate sustainment planning. Present both technical findings and organizational findings. The example Master Plan treats both as core parts of current-state assessment.

### 5.5 Deliverable

Prepare an Existing FEWS Capacity chapter with inventories, maps, summary tables, and a narrative explaining how current capability performs against regional needs.

## Step 6: Conduct the gap analysis

### 6.1 Establish evaluation criteria

Use a standardized checklist to compare required capability with current capability across each FEWS function. The NCTCOG Master Plan utilized structured gap-analysis questions on risk information, monitoring, forecasting, warning dissemination, public education, and preparedness then synthesized resulting strengths and gaps by topic area.

### 6.2 Identify gaps by function

Document gaps separately for flood-risk information, monitoring networks, temporal and spatial resolution, forecasting tools, communication channels, operational coordination, preparedness, and public education. Make each gap explicit enough to support a later improvement strategy, not just a descriptive observation.

### 6.3 Identify cross-cutting constraints

In addition to functional gaps, identify constraints related to governance, funding, staffing, interoperability, maintenance, local technical capacity, and uneven participation among jurisdictions. Fragmented tools, data streams, inconsistent local capability, and weak feedback loops limit the value of otherwise strong data sources.

### 6.4 Prioritize gaps

Rank gaps by consequence, urgency, feasibility, and regional relevance. Highlight issues that most directly affect life safety, decision speed, warning reach, and the ability to operate a regional system consistently.

### 6.5 Deliverable

Prepare a Gap Analysis chapter that presents key strengths, key gaps, and the consequences of leaving those gaps unresolved.

## Step 7: Develop strategic options for capacity enhancement

### 7.1 Create improvement themes

Develop improvement strategies that respond directly to the prioritized gaps and cover the full FEWS value chain. The NCTCOG Master Plan organizes improvements around risk identification, detection and forecasting, warning dissemination, decision support, preparedness and response, and public awareness.

### 7.2 Define candidate options

For each theme, identify practical options such as expanding rain and stream gage networks, improving radar-rainfall integration, adding forecasting tiers, building interoperable dashboards, standardizing warning templates, strengthening exercises, and improving outreach to vulnerable groups. The example NCTCOG Master Plan also emphasizes a shared decision layer that turns multiple data tools into coordinated, role-specific actions.

### 7.3 Screen options

Compare options based on expected benefit, cost, complexity, maintainability, staffing burden, interoperability, and value across multiple jurisdictions. Where appropriate,

distinguish near-term foundational improvements from more advanced future enhancements.

### 7.4 Organize options into a strategic framework

Present preferred options as a coherent framework for improvement rather than as an unstructured list. Each strategic option should identify the problem it solves, why it matters, who would lead it, and what enabling conditions are needed.

### 7.5 Deliverable

Prepare a Strategic Options or Framework for Improvement chapter that translates gaps into practical, scalable actions for regional FEWS enhancement.

## Step 8: Assemble the Master Plan

### 8.1 Standard chapter structure

Assemble the final Master Plan in a consistent structure, such as:

1. Introduction and purpose.
2. Objectives.
3. Regional hydrology and watershed characteristics.
4. Flood risk identification.
5. Existing FEWS capacity assessment.
6. Gap analysis.
7. Strategic options for capacity enhancement.
8. Supporting appendices and technical references.

### 8.2 Quality review

Perform technical review, editorial review, and stakeholder review before finalizing the Master Plan. Confirm that all recommendations trace back to documented conditions, identified gaps, and stated objectives.

### 8.3 Approval and handoff

Submit the Master Plan for agency review and approval using the project's established governance process. On approval, document how the Master Plan will transition into a more detailed Implementation Plan and future updates.

## Minimum contents checklist

Use the checklist below before closing the SOP process:

| Required element | Minimum content |
|---|---|
| FEWS objectives | Stakeholder-informed planning objectives, service goals, and intended operational outcomes. |
| Regional characteristics | Geography, jurisdictions, climate, hydrology, watershed response, infrastructure, demographics, and vulnerabilities. |
| Flood risks | Hazard extent, flood mechanisms, exposed assets, vulnerable populations, and priority impact locations. |
| Existing capacity | Monitoring, forecasting, communication, governance, operations, data systems, staffing, and current procedures. |
| System gaps | Functional and cross-cutting deficiencies, prioritized by consequence and need. |
| Strategic options | Practical improvement strategies tied directly to gaps and framed for future implementation planning. |

# Appendix A

The following Gap Analysis checklist was adapted from WMO (2018). This checklist is not definitive but represents the kinds of questions to ask during the Gap Analysis.

## Identify flood risk.

1. **Are key flood hazards and related threats identified?**
    - ☐ Summarize what's known about geographical extent, magnitude, intensity, historical data, future risks.
    - ☐ What are the watershed response times at key locations of significant flood impact?
    - ☐ What flood hazard maps are available?
2. **Are flood risks and vulnerabilities identified?**
    - ☐ Critical facilities mapped (e.g., hospitals, water treatment, fire/police stations, etc.).
    - ☐ Impacts to critical infrastructure evaluated.
3. **Are roles and responsibilities of stakeholders identified?**
    - ☐ Who are the key agencies. (e.g. Host agency, NWS, NWSRFC, USGS, USACE, etc.)? Describe roles.
    - ☐ Hazard identification and risk information coordination. Who is responsible?
    - ☐ Available experts to assess quality of risk data and information (e.g., PW Engineer, Consultant, etc.).
    - ☐ Process in place to engage rural and urban communities in risk assessment.
4. **Is risk information consolidated?**
    - ☐ Is there a centralized database of events, disasters, and risk information, including GIS. Where? Who is responsible?
    - ☐ Is process in place for systematic collection, sharing, and assessment of risk data?
    - ☐ Process in place for regular review and updating of risk information, including new or emerging vulnerabilities.
5. **Is risk information properly incorporated into the FEWS?**
    - ☐ Mapping to show flood extents, safe zones, and evacuation routes.
    - ☐ Risk information on vulnerable groups.
    - ☐ Process in place for regular review and updating of risk information, including new or emerging vulnerabilities.

## Detection, monitoring, analysis and forecasting of flooding and possible consequences.

1. **Are monitoring systems in place?**
    - ☐ Describe network to monitor rainfall, stream levels and other relevant data (e.g., wind, tide, etc.).
        - ▫ Provide network map. GIS or KML files of gage locations.
        - ▫ What is the rain gage density (mi2/gage)?
        - ▫ What is the stream gage network?
        - ▫ Other hydrometeorological sensors? (Describe)

- ☐ Measurement parameters and specifications documented. Rain/stream reporting resolution and frequency? Web site?
- ☐ Data reporting protocol
  - Self-reporting
    - ▫ ALERT
    - ▫ ALERT2
    - ▫ GOES
    - ▫ Other (Describe)
  - Interrogated
    - ▫ SCADA
    - ▫ Microwave network
    - ▫ Cell phone
    - ▫ Other (Describe)
  - Communications medium
    - ▫ VHF/UHF radio
    - ▫ Microwave
    - ▫ Cell phone
    - ▫ Satellite other than GOES
    - ▫ Other (Describe)
- ☐ Web camera network. Describe.
- ☐ Are data available via a publicly accessible website?
- ☐ Personnel trained to operate and maintain equipment.
- ☐ Monitoring data received, processed, available in an interoperable format in real time or near real time. Describe data sharing/transfer. SHEF, DSS, FTP (Push/Pull), others?
- ☐ Monitoring data and metadata routinely managed with quality controls, archived, accessible for verification, research purposes, and other applications.
- ☐ Monitoring hardware and software maintenance conducted routinely. Describe.
- ☐ Operations and maintenance costs and resources budgeted to ensure long-term operation.
- ☐ Are power supplies at field sites and at the data operations center sufficient for continued operations if main power fails?
- ☐ Are there potential single points of failure (e.g., a single radio repeater, single radio receiver/modem, single computer at data collection site, single point internet access, etc.)?

**2. Are there forecasting and warning services in place?**

- ☐ Describe data analysis and processing, modelling, prediction, and warning products generated (e.g., high water alerts, streamflow forecasts etc. Are flood forecasts generated internally or by an outside agency such as the NWS.).
- ☐ Describe information dissemination to key stakeholders and public (e.g., high water alert displays on a website, text, emails, etc.).
- ☐ Can new data analysis and processing, modelling, prediction, and warning products be integrated easily in the system as science and technology evolves?
- ☐ Warning centers are operational at all times (24 hours/day, seven days/week) and staffed by trained personnel following appropriate national and international standards.

- ☐ Warning messages are clear, consistent, and include risk and impact information, and are designed with consideration for linking threat levels to emergency preparedness and response actions.
- ☐ Software and data analysis for the received data updated periodically and to appropriate cyber security standards.
- ☐ The state of the monitoring and data analysis systems continuously monitored for any data gaps, connection issues, or processing issues
- ☐ Flood warnings generated and disseminated in an efficient and timely manner.
- ☐ Warning system subjected to regular system-wide tests and exercises.
- ☐ Process established to verify that warnings have reached the principal stakeholders and people at risk.
- ☐ Mechanisms in place to inform people when the threat and its impacts have ended.
- ☐ Operational processes, including data quality and warning performance, are routinely monitored and evaluated.
- ☐ Fail-safe systems in place, such as power backup, equipment redundancy, and on-call personnel systems.
- ☐ Strategies developed to build credibility and trust in warnings (e.g. understanding difference between forecasts and warnings).
- ☐ False alarms minimized and improvements communicated to maintain trust in the warning system.
- ☐ Warning and forecast archival processes and systems in place.

3. **Are there institutional mechanisms in place?**
   - ☐ Plans and documents for monitoring networks available and agreed upon with experts and relevant authorities.
   - ☐ Standardized process, and roles and responsibilities of organizations generating and issuing messaging established and mandated by legislation or other authoritative instruments (e.g. memorandum of understanding (MOU), standard operating procedures).
   - ☐ Agreements and interagency protocols established for exchange of monitoring systems data (e.g., Standard Hydrologic Exchange Format, ALERT, ALERT2, DSS, etc.).
   - ☐ Agreements and interagency protocols established to ensure consistency of warning language and communication responsibilities.
   - ☐ Warning system partners, including local authorities and the media, are aware of and respect which organizations are responsible for generation and issuance of warnings.
   - ☐ Cross-border exchange of warnings and observation data realized through bilateral/ multilateral agreements (e.g., IWBC).

## Warning dissemination and communication

1. **Are organizational and decision-making processes in place and operational?**
   - ☐ Functions, roles, and responsibilities of each partner in the warning dissemination process included in the standard operating procedures.

- ☐ Warning communication strategies at the national, state, regional, and local levels in place that ensure coordination across warning issuers and dissemination channels.
- ☐ Regular coordination, planning, and review meetings between the warning issuers, the media, and other stakeholders.
- ☐ Professional and volunteer networks established to receive and disseminate warnings widely.
- ☐ Feedback mechanisms in place to verify that warnings have been received and to correct potential failures in dissemination and communication.
- ☐ Mechanisms to update the information are in place and are resilient to the event.

**2. Are communication systems and equipment in place and operational?**

- ☐ Trust between stakeholders established.
- ☐ Communication and dissemination systems tailored to the different needs of specific groups (urban and rural populations, women and men, older people and youth, people with disabilities, etc.).
- ☐ Understanding of last-mile connectivity to know which population groups can be reached by different services, including mobile-cellular, satellite, and radio services.
- ☐ Warning communication and dissemination systems reach the entire population, including seasonal populations and those in remote locations, through multiple communication channels (e.g. satellite and mobile-cellular networks, social media, flags, sirens, bells, public address systems, door-to-door visits, community meetings).
- ☐ Communication strategies evaluated to ensure messages are reaching the population.
- ☐ Agreements developed to utilize private sector resources where appropriate (e.g., mobile-cellular, satellite, television, radio broadcasting, amateur radio, social media) to disseminate warnings.
- ☐ Equipment maintained and upgraded to utilize new technologies (when appropriate) to ensure interoperability.
- ☐ Backup systems and processes in place in the event of failure.
- ☐ Resilience of communication channels and early warning system hardware evaluated in advance to reduce the impact of events on the infrastructure.
- ☐ Coverage of communication channels and multiple-channel systems assessed to identify gaps and possible points of failure that may increase vulnerability.

**3. Are impact-based early warnings communicated effectively to prompt action by target groups?**

- ☐ Warning messages provide clear guidance to trigger reactions (e.g., evacuation).
- ☐ Early warnings should take into account the different risks and needs of subpopulations, including differential vulnerabilities (urban and rural, women and men, older people and youth, people with disabilities, etc.).
- ☐ Public and other stakeholders are aware of which authorities issue the warnings and trust their message.

## Preparedness and response capabilities

1. **Are disaster preparedness measures, including response plans, developed and operational?**
    - ☐ Flood preparedness, including plans or standard operating procedures, developed in a participatory manner, disseminated to the community, practiced, and underpinned by legislation where appropriate.
    - ☐ Flood preparedness measures, including plans and standard operating procedures, account for the needs of people with different degrees of vulnerability.
    - ☐ Flood risk assessments utilized to develop and design evacuation strategies (evacuation routes, safe areas and location of temporary shelters, use of vertical evacuation if needed).
    - ☐ Community's ability to communicate in response to early warnings assessed.
    - ☐ Contingency planning developed in a scenario-based manner following forecasts or likely scenarios across different timescales.
    - ☐ Early action and response options across time and on geographical scales are linked to the provision of funding to support them.
    - ☐ Strategies implemented to maintain preparedness for longer return-periods and cascading hazard events.
    - ☐ Protocols incorporated in the plans or standard operating procedures to reach emergency and health services that need to be ready to respond to events promptly.
    - ☐ Protocols established to activate and mobilize last-mile operators (e.g. local police, firefighters, volunteers, health services) who disseminate warnings to the public and decide public measures, including issuing orders for evacuation or sheltering in place.
    - ☐ Regular exercises undertaken to test and optimize the effectiveness of early warning dissemination processes, preparedness and response to warnings.
2. **Are public awareness and education campaigns conducted?**
    - ☐ Ongoing public awareness and education programs.
    - ☐ Public education provided to recognize hydrometeorological and flood hazard triggers.
    - ☐ People educated on how warnings will be disseminated, which sources are reliable, and how to respond.
    - ☐ Utilization of the most effective media (e.g. established broadcasting media, social networks, alternative media) to improve public awareness.
    - ☐ Public awareness and education campaigns tailored to the specific needs of vulnerable groups (e.g. women, children, older people, people with disabilities).
3. **Are public awareness and response tested and evaluated?**
    - ☐ Previous emergency and disaster events and responses analyzed, and lessons learned incorporated into preparedness and response plans and into capacity-building strategies.
    - ☐ Public awareness strategies and programs evaluated regularly and updated as required.