

The Mitigation Strategic Implementation Plan: Toward tsunami-resistant communities

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Abstract. The National Tsunami Hazard Mitigation Program is a federal/state partnership to reduce tsunami risk. The Mitigation Subcommittee constructed a Strategic Implementation Plan for Tsunami Mitigation Projects that has as its goal assisting coastal communities in becoming “tsunami resistant communities.” A tsunami resistant community is one that reduces the impact of tsunamis by:

1. understanding the nature of the tsunami hazard,
2. having the tools it needs to mitigate the tsunami risk,
3. disseminating information about the tsunami hazard,
4. exchanging information with other at-risk areas, and
5. institutionalizing planning for a tsunami disaster.

The Strategic Implementation Plan also provides a framework for the development of specific tools and policies that states and local communities can use that will help them become tsunami-resistant communities.

To measure performance, the key question becomes: have we actually succeeded in helping communities become more tsunami resistant than they were before we began to implement the Strategic Plan, and can we define this? To answer this question we will revisit a baseline 1994 survey of community needs that served as a catalyst in the formation of the program. We will compare “snapshots” of several West Coast communities in 1994 and in 2000 to see if and how the Strategic Implementation Plan has helped them become more tsunami resistant.

If the process has been successful in the United States, then it could serve as a model for other tsunami at-risk communities in the world. Then we have to ask, what have we learned and how do we transfer the model?

1. Introduction

The National Tsunami Hazard Mitigation Program (NTHMP) is a federal/state partnership to reduce tsunami risk. The NTHMP is made up of NOAA, FEMA, USGS, Alaska, California, Hawaii, Oregon, and Washington, and is chaired by NOAA. The Mitigation Subcommittee of the NTHMP is made up of emergency managers and geoscientists from the five states and two FEMA regions. FEMA chairs the Subcommittee and holds the leadership role in coordinating the states as they do with many other national hazard programs. The Mitigation Subcommittee has worked to bring local government into the partnership by creating a Strategic Implementation Plan for Tsunami Mitigation Projects that has as its goal assisting coastal communities in becoming “tsunami resistant communities” (Dengler, 1998).

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A tsunami resistant community is one that reduces the impact of tsunamis by:

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5. institutionalizing planning for a tsunami disaster.

The development of the Strategic Implementation Plan for Tsunami Mitigation Projects addresses three issues identified in the 1996 Implementation Plan developed by the Tsunami Hazard Mitigation Federal/State Working Group:

1. *Address Local Tsunami Mitigation and the Needs of Coastal Residents,*
2. *Improve Coordination and Exchange of Information to Better Utilize Existing Resources,*
3. *Sustain Support at State and Local Level for Long-Term Tsunami Hazard Mitigation* (Tsunami Hazard Mitigation Federal/State Working Group, later renamed the National Tsunami Hazard Mitigation Program or NTHMP Steering Group, 1996).

The Strategic Implementation Plan for Tsunami Mitigation Projects also provides a framework for the development of specific tools and policies that states and local communities can use that will help them become tsunami-resistant communities. A 1994 multi-state post-tsunami warning survey designed and run by the author pointed up the lack of consistency in community policies, plans, understanding, awareness, readiness, and availability of mitigation tools to build a basic level of tsunami resistance (Jonientz-Trisler, 1994). The survey recommended that a regional strategy be implemented to address these problems. The NTHMP meets this recommendation and has developed or identified many tools, activities and guides to help communities develop tsunami resistance.

2. What Was Promised?

The states and FEMA were charged with the umbrella goal of implementing a state and local tsunami mitigation program as they have experience doing with other hazard programs. The NTHMP provided \$1,682,019 or 98% of the funds requested in the Implementation Plan. However, the true cost was \$3,798,999 that includes the contributions of labor and materials from member agencies of the Mitigation Subcommittee (Table 1). Program goals for this work are detailed on page 13 of the Tsunami Hazard Mitigation Implementation Plan (Tsunami Hazard Mitigation Federal/State Working Group, 1996) and are as follows:

Table 1: Mitigation resources.

Fiscal Year	Requested	Available	States, Local, and FEMA Labor and Other Resources	
			non-NTHMP Match	TOTAL
1997	\$175,000	\$170,800		
1998	1,050,000	390,400		
1999	100,000	390,400		
2000	300,000	352,680		
2001	100,000	377,739		
Total	\$1,725,000	\$1,682,019	\$2,116,019	\$3,798,999

State and local tsunami mitigation program implementation—Costs: Year 1: \$275,000, Year 2: \$1,200,000, Year 3: \$125,000, Year 4: \$365,000, \$125,000/year thereafter.

Year 1

Task 1: Inventory and Needs Assessment of Existing Materials—Cost \$150,000

Conduct an inventory, needs assessment and gap analysis of existing educational programs, public information materials, warning and mitigation programs. This initial evaluation of capability will establish a baseline against which products resulting from this Plan can be assessed. This analysis is to include both domestic efforts on federal, state and local levels and foreign programs developed in other tsunami-prone regions. Develop a work program to develop needed materials and disseminate both existing and new programs and products.

Responsibility: FEMA and states

Products:

- Needs analysis
- Resource library
- Work program and network identification

Task 2: Strategic Implementation Plan—Cost \$125,000

Develop a Strategic Implementation and Utilization Plan for promoting, implementing and supporting tsunami mitigation utilizing existing federal, state and local networks and institutions.

Responsibility: FEMA and states

Product:

- Strategic Implementation Plan

Year 2

Task 1: Incorporation of Tsunami Mitigation Into All-Hazards Planning—Cost \$250,000

Integrate tsunami risk analysis into FEMA all-hazards mitigation planning for coastal states.

Responsibility: FEMA and states

Product:

- Integrated analysis by states

Task 2: Tsunami Mitigation Tools—Cost \$800,000

Develop tools to support local government risk reduction, including land use guidelines, construction guides and model codes, tsunami abatement techniques (barriers, vegetation, etc.), model awareness and preparedness programs, media materials, and education programs. Utilize existing products where available and crossover information from other hazard mitigation efforts.

Responsibility: FEMA and states

Products:

- Model land use guide
- Model building code provisions
- Model abatement projects
- Model construction guide
- Prototype education and training materials

Task 3: Training Workshops—Cost \$150,000

Convene five regional training workshops for land use planners, building officials, elected officials, private sector interests, educators, and emergency managers to promote utilization of risk-reduction approaches. Evaluation and modification of workshop content and format.

Responsibility: FEMA, NOAA, states

Product:

- Knowledge and risk communication

Year 3

Task 1: Continued Training Workshops and Technical Support—Cost \$125,000

Convene an additional five regional training workshops and provide continuing technical support to local governments and communities.

Responsibility: FEMA, NOAA, states

Products:

- Knowledge and risk communication
- Implementation of risk reduction

Year 4

***Task 1: Continued Training Workshops and Technical Support—
Cost \$125,000***

Convene an additional five regional training workshops and provide continuing technical support to local governments and communities.

Responsibility: FEMA, NOAA, states

Products:

- Knowledge and risk communication
- Implementation of risk reduction

Task 2: Evaluation and Assessment—Cost \$240,000

Develop and implement evaluation instruments to assess program effectiveness. Integrate results into program.

Responsibility: FEMA, NOAA, NSF, and states

Product:

- Program evaluation and adjustment

Year 5 and beyond

***Task 1: Continued Training Workshops and Technical Support—
Cost \$125,000***

Convene an additional five regional training workshops and provide continuing technical support to local governments and communities.

Responsibility: FEMA, NOAA, states

Products:

- Knowledge and risk communication
- Implementation of risk reduction

3. What Was Accomplished?

The state and local tsunami mitigation program has been and continues to be implemented. This paper is an overview of the Mitigation Subcommittee's work during the last 5 years. States have detailed their individual programs and products in papers they have submitted for the 5-Year Review.

Accomplishments for Year 1, Task 1: Inventory and Needs Assessment of Existing Materials

In order to accomplish Year 1, Task 1, states inventoried their existing tsunami materials and needs and then assigned product development priorities. These early needs assessments were published as appendices in the Strategic Implementation Plan for Tsunami Mitigation Projects, described under Task 2 next, and are used each year as a baseline to track progress and adjust priorities.

The inventory of existing tsunami materials has been shared among states to assist those without such products to acquire them. For example, Oregon had developed tsunami signage and brochure programs that, through the NTHMP, became adopted and modified by Alaska, California, and Washington. The popularity of model products led to funding of other educational product development and distribution by Oregon to other states in the NTHMP. Eventually other states began to develop their own educational products that they shared in turn. It is common for a state to take a template and modify it to more appropriately suit their local culture or to design improvements on the original product. For example, from state to state, target audiences may vary enough to require a modification in the original design. Trailhead signs and brochures at state parks in California are worded a little differently than they are when located in cities along the coast of Oregon or rural Alaska. Hawaii led the way in providing copies of tsunami warning materials and procedures to other states to assist them in development of their own products. Warning products were modified for West Coast states and Alaska because of differences in state warning policies and protocols.

A review of domestic and foreign efforts at federal, state, and local levels was done to guide development of a national program to address tsunami issues. This was done by selection and summary of some significant studies in tsunami mitigation. These summaries were included as appendices in the Strategic Implementation Plan. Studies include Planning for Risk: Comprehensive Planning for Tsunami Hazard Areas (Preuss, J., 1988), Earthquake and Tsunami Hazards in the United States: A Research Assessment (Ayre, R.S., Trainer, P.B., Mileti, D.S., 1975), and Earthquakes, Volcanoes, and Tsunamis: an Anatomy of Hazards (Steinbrugge, K.V., 1982). International bibliographies covering warning systems, mitigation, and education for tsunamis were also compiled with a selection of citations and included as appendices. Finally the Subcommittee funded a technical assessment of the International Tsunami Information Center Library in Honolulu, Hawaii that was also included in this document.

Accomplishments for Year 1, Task 2: Strategic Implementation Plan

The Mitigation Subcommittee accomplished Year 1, Task 2 by developing the Strategic Implementation Plan for Tsunami Mitigation Projects. The Plan is used to drive the Subcommittee's development of tsunami programs,

products and activities. The goal of the Plan is to build “tsunami resistant communities” as defined at the start of the paper. The Plan provides a framework to develop tools and policies that will build this tsunami resistance. The framework has five elements: 1) Education, 2) Tools for Emergency Managers, 3) Construction, Abatement and Land Use Guidance, 4) Information Exchange and Coordination, and 5) Long-Term Mitigation (including recovery planning) (Dengler, 1998).

The last 5 years have been spent developing many products under these elements, and in modification and exchange of a few that existed before the NTHMP. State activities, products, and tools are categorized under these elements within the Activities Matrix (Table 2). The Matrix is a dynamic document that concisely encapsulates the existence and gaps in development of these elements state by state. The Matrix serves to enhance and refine Year 1 Task 1 (Inventory/Needs Assessment) at the State level. The gaps in the Matrix serve to drive the succeeding years’ emphasis on activities. Prior to the NTHMP, this ability to logically and concisely identify existing and needed tsunami mitigation products did not exist.

Through the years, states have assessed local level inventories and needs too, especially through the mechanism of formal or informal State/Local Tsunami Work Groups and workshops. Work groups and workshops were held to include local input to product development. Alaska and Washington used this mechanism to ensure that communities received maps in a usable and understandable format. Oregon used local workshops to provide training in developing evacuation routes through use of inundation maps and other information. Hawaii’s work group concentrates on addressing the scientific and warning procedure issues related to tsunamis and often affects the other states.

By 1999, enough work had occurred to be described in a booklet intended to “document progress and disseminate information about tsunami hazard mitigation products and activities supported by the National Tsunami Hazard Mitigation Program (NTHMP). The States of Alaska, California, Hawaii, Oregon, and Washington have highlighted products and activities as models for other states and territories based upon their success or expected success in reducing tsunami hazards” (Jonientz-Trisler and Mullin, 1999). The report includes a 1999 version of the Activities Matrix that provides a broad look by state at Subcommittee products and some that existed prior to the NTHMP. Descriptions of multi-state projects are also included. These are projects that require a broader effort and resources than one state alone can provide. They are approved and developed in the best spirit of cooperation among the states. These are often products that by their very nature of joint development are perhaps best designed for use by a variety of tsunami-risk communities. Requests for this report have come from many nations around the Pacific and the Caribbean. An excellent booklet described in the report encapsulates personal tsunami survival lessons and was developed with interested parties in Japan and Chile (Atwater *et al.*, 1999). A Spanish version has been developed since in South America based on the one developed by NTHMP. This document and the TsuInfo Newsletter (Manson, C., Walkling, L., Eds.) serve as resources to disseminate information on tsunami

Table 2: Tsunami activities matrix (updated May 2001). O = Ongoing activity (NTHMP funding), M = Multi-state activity (NTHMP funding), C = Completed activity (NTHMP funding), and S = State activity (no NTHMP funding).

Planning Element	Alaska	California	Hawaii	Oregon	Washington
Education					
Evacuation and educational signage	C, O	C, O, S	S	C, O	C, O
Media materials	—	S	S, C	C	C
Public info products	S, C, O	S, C	S, C	M, C	C
Public service announcements	—	S, O	S	O	C
Cost/benefit of tsunami mitigation for businesses	—	—	S	—	—
State videos	—	S, O	C	C	C
Curriculum materials	O	O	S	C	C, O
Library-type materials inventory	O	—	O	—	C
Training materials	—	C	S	—	C
Tsunami info for tourists	O	C	S	M, C	C, S
Tsunami info for state and local officials	O	C	S	C	C
Public education	O	S, C	C, O	M, C	M, C
Tools for Emergency Managers					
Inundation maps	O	S, O, C	C, O	S, C, O	C
Evacuation routes	S, C, O	S, C	C	C, O	C
Evacuation brochure	O	—	C	S, C, O	C
Warning programs	S	S, C, O	C	S, C, O	C
Local warning system guidelines	—	C	C	M, O	O
Guides for unmapped communities	S	S, O	n/a	C, O	—
<i>Non-strategic plan activities</i>					
Community needs assessments	S, C	S, C	C	C	S, C
Surveys	S, C	S, C	C	S, C	S, O
Building and Land Use Guidance					
Codes and construction guides	—	M, O	S	—	—
Zoning regs and land use guides	—	M, O	S	S	—
Infrastructure guides	—	—	—	—	—
Vegetation guides	—	M, O	—	—	—
Vertical evacuation guides	—	—	S	—	—

Table 2: (continued)

Planning Element	Alaska	California	Hawaii	Oregon	Washington
Information Exchange and Coordination					
Coastal jurisdiction contact	S, C	S, C	S	C	C
Meetings between different disciplines	S, C	S, C	S	C	C
Resource center to catalog mitigation	—	—	—	—	C
Web page development	O	S	S, C	C	C
Working with non-program states, territories	—	—	S	C	C
Tsunami workshops	O	S, C	S	C	C
Access to tsunami technical advisor	S	—	S	C	C
Long-term tsunami mitigation					
State/local tsunami work groups	C	C	S	O	C
State tsunami mitigation planning	O	C	S	O	O
Incorporate tsunami into all-hazards planning	O	C	S	O	S
Post-tsunami recovery guide	—	—	O	—	—
<i>Non-strategic plan activities</i>					
Loss estimation	—	—	—	—	—
Local government tsunami planning guidance	—	C	S	—	—
Tsunami legislation	—	—	—	S	—

mitigation products and activities that others might adopt as promised in Year 1, Task 1. The survival lesson booklet and the TsuInfo Newsletter are examples of multi-state projects and were both led by Washington.

Accomplishments for Year 2, Task 1: Incorporation of Tsunami Mitigation Into All-Hazards Planning

The states and FEMA handle a number of specific hazard programs and have worked together to develop the concept of all-hazards planning for a number of years now. Basic tsunami planning continues to be integrated with other hazards planning at the state and local level currently in all 5 states and more remains to be done.

Accomplishments for Year 2, Task 2: Tsunami Mitigation Tools

The toughest gaps to address have been some of the Tsunami Mitigation Tools that serve to promote long-term local community behavioral change by permanently moving people out of harm's way or strengthening the performance of structures. These gaps include model land use guides, building code provisions, abatement projects (for example, vegetation and other barriers to dissipate tsunami wave energy), and construction guides. Political will and funds to explore these types of solutions are challenges to these needs. California took the lead on a multi-state funded project that began to develop local tsunami hazard mitigation guidance for buildings and land use. Washington will follow this up by bringing engineers from all the states together to discuss how to develop recommendations on building performance in a tsunami zone that is also at risk to strong ground shaking from subduction zone earthquakes. Oregon took the lead for another multi-state project developing tsunami warning systems and procedures guidance for local communities.

Some excellent prototype education and training materials have been developed in all states. Washington, Oregon, and Hawaii have developed successful curriculum materials. California has some curriculum as well and is currently adapting some from Washington.

Accomplishments for Years 3, 4, and 5, Task 1: Training Workshops and Technical Support

Training workshops and technical support have occurred annually for local communities including planners, building officials, elected officials, private sector interests, educators, and emergency managers to promote utilization of risk reduction approaches. Workshops have ranged from local, where a number of counties and communities participate, to regional, where counties and communities from several states participate and exchange information. Because travel to multi-state workshops in the lower 48 states is particularly burdensome for local officials in Alaska, the state of Alaska has funded their travel costs. This provides a wide variety of tsunami experience input for all local officials attending a workshop. Participants are asked to evaluate the workshops and suggest modification ideas for improvement to the sponsoring state or multi-state planning group. Evaluations have been overwhelmingly positive with requests for continued workshops from local participants appreciative of what the states and FEMA are providing to them to improve their readiness. The Subcommittee members have observed increased knowledge and risk communication and some implementation of risk reduction measures within participating communities as a result of these workshops. Perhaps the most obvious sign of this is the eagerness of communities to actively participate in tsunami hazard education and evacuation sign programs based on the technical support of state and federal agencies to assist them in developing community inundation maps and evacuation routes. Hawaii has had tsunami signage for decades. Signs appear along most of the Oregon and Washington coast now. Alaska has adapted and begun to install signs

and will continue. California has a few signs installed and is working with state DOT to install others. Prior to the NTHMP, “advertising” tsunami risk areas in communities this way was not popular politically because of the perceived negative effects on the tourism industry. Many communities, by adopting these programs, have since found that tourists are often interested in learning more about tsunamis and feel that the community is acting responsibly by planning for a tsunami event that might occur during their visit to the coast.

Training workshop subjects include warning, evacuation, awareness campaigns, planning, and other issues to assist local officials in preparing for dealing with tsunamis.

Accomplishments for Year 4, Task 2: Evaluation and Assessment

Both the Subcommittee and the Steering Committee have developed and implemented evaluation instruments to assess program effectiveness on several levels. The results are then integrated into the program to adjust it. Twice annually the Subcommittee revisits and updates the Activities Matrix to track progress of addressing gaps that exist within the program. Near the end of the 5-year program, the Subcommittee furnished to the Steering Committee an “Activities Report” to detail progress in the mitigation program. In 2001, the entire NTHMP is undergoing a 5-year review by external experts. Feedback from these experts will guide modification of the program. Also, a 2001 re-survey of several West Coast community and county emergency managers has provided some good information on how NTHMP has assisted them in improving their understanding, awareness, and readiness capabilities for tsunami events since a Pacific-wide tsunami warning in 1994. In 1994 the original preliminary survey suggested that community readiness and response to a tsunami warning varied greatly. Local emergency managers in these communities had requested state and federal assistance with many tools and activities that would improve their readiness and response capabilities. These requests helped guide development of NTHMP to best serve states and local communities. Like the 5-Year Review results, the re-survey results will also be used to address current needs of local communities as an integral target of NTHMP.

FEMA was asked to lead and coordinate the Mitigation Subcommittee’s strategy of program and product development based on its experience with other hazards programs. FEMA has passed its share of NTHMP funds to the states to fund the actual development of the products and has promoted the concept of team development of some multi-state projects that are beyond the scope of one state to develop. The Mitigation Subcommittee votes on how to apportion state programs and multi-state projects each year. The state programs in recent years have been funded at around \$50,000 each annually (or \$250,000 total for all five states in the program). Several multi-state projects have been funded in recent years that total around \$100,000 annually.

4. Indicators of Program Impact

As the program approached the end of its first 5 years, the Mitigation Subcommittee requested a formal assessment of the impacts of the program. It was decided that this assessment would be built upon the 1994 survey of emergency response personnel following a tsunami warning. The findings from this survey clearly indicated the need for more aggressive efforts to get a warning dissemination program in place that was highly useful to coastal emergency managers. Since there had been no tsunami warning on the northwest coast, subsequent to the one in 1994, the survey instrument to be used in May 2001 had to rely on hypothetical questions about the status of the tsunami warning system in the eyes of community and county emergency managers.² An effort was made to make the questions about the tsunami warning system parallel to those asked in 1994. The survey also included other question sets related to looking for indicators of the effectiveness of other aspects of the NTHMP for Washington, Oregon, and northern California coastal areas. Several weeks following the completion of the assessment survey in May 2001, a tsunami watch was initiated following a great earthquake off the coast of Peru. This provided the author further opportunity to examine the impact of the program activities by permitting the use of a quick telephone survey of the emergency managers interviewed in the May assessment survey, using the same questions from the post-warning survey done in 1994. This helped to further corroborate the responses given in May to the more hypothetical questions on the status of emergency managers' satisfaction with the tsunami warning system as it now stands.

4.1 1994 Warning Survey results and recommendations

West Coast reaction to the 1994 Pacific-wide tsunami warning was one catalyst for developing the particular tools and activities of the NTHMP. The negative emotional aftermath of the warning was obvious in communities when speaking with emergency decision makers. To measure performance of the NTHMP, the key question becomes: have we actually succeeded in helping communities become more tsunami resistant than they were before we began to implement the Strategic Plan, and can we define this? To answer these questions we revisit a baseline 1994 survey of community emergency management needs that served as a catalyst in the formation of the program. Within days of the 1994 tsunami warning, the author administered a survey of emergency managers in 14 coastal communities in the U.S. and Canada. Findings are for the 11 U.S. communities and pointed out a variation in community reactions to the warning even among similar communities. The 1994 questionnaire was originally designed to ask emergency managers how well they understood and were able to use the official warning message and what

²This survey instrument was designed by Patricia Bolton, Battelle Seattle Research Center. In-person interviews were conducted in coastal communities selected because of their inclusion in the 1994 warning survey. Dr. Bolton was accompanied during the interviews by Chris Jonientz-Trisler, as a representative of the Tsunami Mitigation Subcommittee, and these findings are reported here by Ms. Jonientz-Trisler.

actions they took based on it. The responses from U.S. emergency managers showed that only 36% (4 of 11) found the warning message “timely,” “updated regularly,” and “understood the risk to the community” based on the message. Only 45% (5 of 11) found the information “understandable” and “usable,” and distinguished between the terms of “watch” and “warning.” The 1994 survey pointed out some serious needs clearly expressed by the local emergency managers. The conclusions of the 1994 survey are as follows: 1) the warning information system needed improvement, 2) vulnerability and readiness levels varied among communities, and 3) responses to the warning varied greatly on 4 October (Jonientz-Trisler, 1994).

The recommendations flowing from these conclusions were as follows: 1) make information more timely and usable, 2) during the development, communication must go both ways between scientists and responders so that responder needs are understood by scientists and limitations of scientific tools are understood by responders, 3) meet community needs for tools such as local risk identification and expertise, training and warning equipment, 4) develop a regional strategy to provide more consistency of message and response in communities, 5) use 4 October as a learning exercise for both distant and near source tsunamis. The May pre-watch and June post-watch surveys in 2001 seem to indicate that these recommendations have been met.

In 2001, it was necessary to redesign the 1994 questionnaire to pursue relevant but not the same information exactly due to lack of the same conditions (i.e., a tsunami warning event). For example, because we could not ask if information on a specific event since the 1994 event was understandable, usable, etc., we instead asked respondents if they thought “official notification message contains all the information needed to take the first step in responding to the notification.” We received an 81% (13/16) “yes” response from combined community and county emergency managers. We also asked if they distinguished between “watch” and “warning” terms and 94% (15/16) answered that they would take more action for a “warning” than they do for a “watch.” One person confused the terms by reversing their meanings but he is not involved in any operations or decision-making role and has not experienced a watch or warning since moving to the area recently.

4.2 June 2001 Post-Watch Survey

The redesigned survey was run in May 2001 and findings were being incorporated into this paper when a great earthquake off the coast of Peru triggered a tsunami watch on 23 June 2001. During the following week, the author surveyed most of the same emergency managers surveyed weeks earlier, but was now able to ask the exact questions asked in 1994. The findings for the June 2001 watch survey are in striking contrast to those in 1994 and verify what the May hypothetical warning questions suggested. In June 2001, 86% (12 of 14) and 79% (11 of 14) respectively found the watch message “timely” and “updated regularly.” Eighty-two percent (11.5 of 14) “understood the risk to the community” based on the message. (One person qualified their answer with “yes and no” and explanations). Seventy-nine percent (11 of 14) and 93% (13 of 14) respectively found the watch message

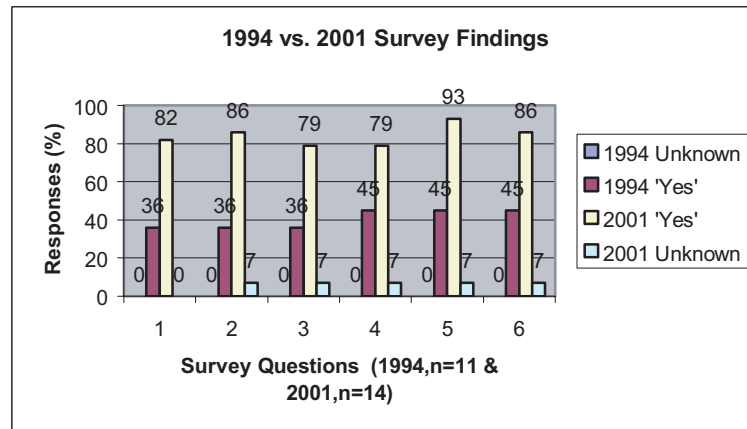


Figure 1: Emergency managers' ability to use warning messages doubled between 1994 and 2001. The survey questions were as follows: (1) Was local community risk clear (based on message)? (2) Was message timely? (3) Was message updated regularly? (4) Was message understandable? (5) Was message information usable? (6) Was "watch" vs. "warning" terminology clear?

to be "understandable" and "usable." Eighty-six percent (12 of 14) distinguished between "watch" and "warning" during the message series (Fig. 1). This fact was particularly interesting because the warning center issued an "Advisory," changed it to a "Watch," then downgraded it to "Advisory," and then upgraded to "Watch" again before finally issuing a cancellation. Another factor that complicated the process was that the geographic boundary for the extent of the "Watch" versus "Advisory" and "Information" bulletins fell within the states being surveyed putting neighboring states and communities at different levels. Not only that, the boundary also changed during the series of messages from Cape Mendocino, California to Cascade Head, Oregon. These complicating factors provided a potential for great confusion among community emergency managers. In spite of that, their positive responses regarding understanding the message content and their positive assessment in discussions of the event differed greatly from the responses and assessment following the 1994 event.

4.3 1994 to 2001 changes

Since 1994, there has been a substantial change in the emergency managers' distinction between "watch" and "warning" and their perceptions of the watch/warning message as timely, updated, understandable, usable, and indicating risk to the local community. Since the 1994 findings and recommendations from those findings helped drive formation and goals of the NTHMP, it seems reasonable to ascribe at least a significant portion of that change to the work of the NTHMP to address those 1994 concerns. NOAA Warning Centers (WCs) in Hawaii and Alaska responded quickly to work with states and communities to change and enhance procedures to facilitate communication of hazard information while NOAA Pacific Marine Environ-

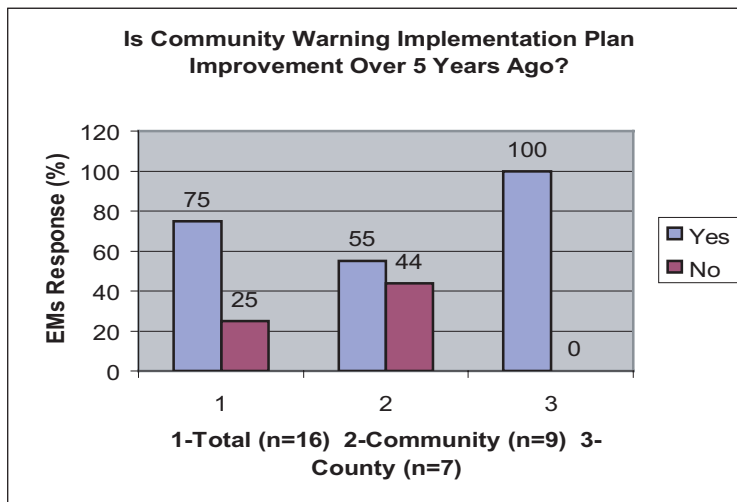


Figure 2: One-hundred percent of the County Emergency Managers, and 55% of the Community Emergency Managers feel that their community warning implementation plan is improved since 1994. **Note:** EMs = Emergency Managers.

mental Laboratory (PMEL) hosted meetings to draft a plan to address the broader range of issues raised by the 1994 event. By 1995 NOAA led development of a 5-year work plan and the formation of the NTHMP to implement the plan. States serve as the link for local information needs to the Warning Centers. State program managers have worked with the WCs to improve the format and content of warning messages. They have also hosted workshops and projects to improve the warning system and the understanding of it by locals. They have reviewed and nominated communities for NOAA's TsunamiReady Program with Ocean Shores, Washington becoming the first community in the nation to be named a TsunamiReady Community on 29 June 2001 after it met the required criteria. All states have enhanced or built warning programs since 1995. The State of Hawaii with its unique make-up of tsunami scientists serves as a hub to focus on warning issues that touch all states.

4.4 May 2001 redesigned survey (Pre-Watch)

The re-designed survey that was run in May 2001, prior to the Peru generated "watch" and June post-watch survey, would also appear to support the view that NTHMP has been a significant factor in greatly improving the warning implementation plan. Emergency managers (EMs) were asked if the community warning implementation plan was an improvement over 5 years ago. Over half (55%) of the community emergency managers answered "yes." All of the county emergency managers answered yes, giving a total combination of 75% "yes" (Fig. 2). When asked which factors listed were critical for any improvement, both community and county EMs listed "Better Planning and Coordination" as number one, followed by "Better Information," and then "Public Education About What To Do" (Fig. 3). When asked which

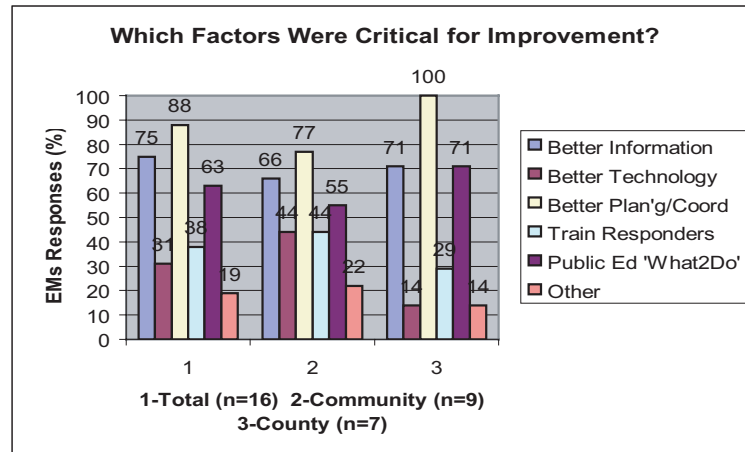


Figure 3: Better planning and coordination was rated the top factor for plan improvement. The factors evaluated were as follows: (1) Better planning and coordination. (2) Better information. (3) Public education about what to do.

factor they needed to go to the next level, they indicated that “Better Technology” was of first importance, “Public Education on What To Do” next, then “Better Information” for county EMS and “Training of Responders” for community EMS (Fig. 4).

4.4.1 Local risk knowledge improved

An understanding of “local risk” entails a background understanding of what in the community is in the inundation zone, how many people are in the zone, whether safe evacuation routes exist, what the hazard sources are, etc. In 1994 few of the people interviewed had access to any kind of inundation map or projection to help them determine this.

NTHMP has worked hard with communities to develop tools that they can use to improve their knowledge of the tsunami hazard and better define their local risk during distant and near source tsunamis events. This fulfills NTHMP goal #1 to assess tsunami hazards and goal #5 to support mitigation efforts for at-risk communities. The Mitigation Subcommittee implemented several strategic planning elements. States built State and Local Tsunami Work Groups that prioritize mapping and other projects, give input to modelers and geologists making the maps, work on evacuation brochures, etc. New information and technology has enabled emergency managers to understand more about tsunami hazard sources and the local areas and facilities that are in the inundation zone. Because of this, it was possible to install tsunami hazard zone signs in many heavily used areas to let the public know that they are in a tsunami hazard zone (Photo 1). Evacuation route signs are also installed in many communities to indicate evacuation routes during tsunami events. Another educational tool installed in many places is the interpretive sign that shows the implications of the

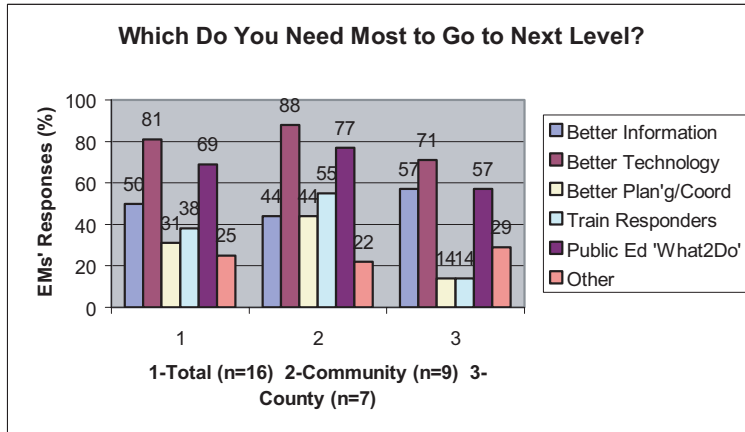


Figure 4: Things most needed next to go the next level of preparedness for managing a tsunami warning include better technology and public education on what to do. **Note:** “What to do” refers to what the public should do during the next tsunami warning or event.



Photo 1: A tsunami hazard zone sign educates the public about what to do after a felt earthquake—run uphill or inland. Many signs and decals were installed in the Pacific Northwest and now Alaska.

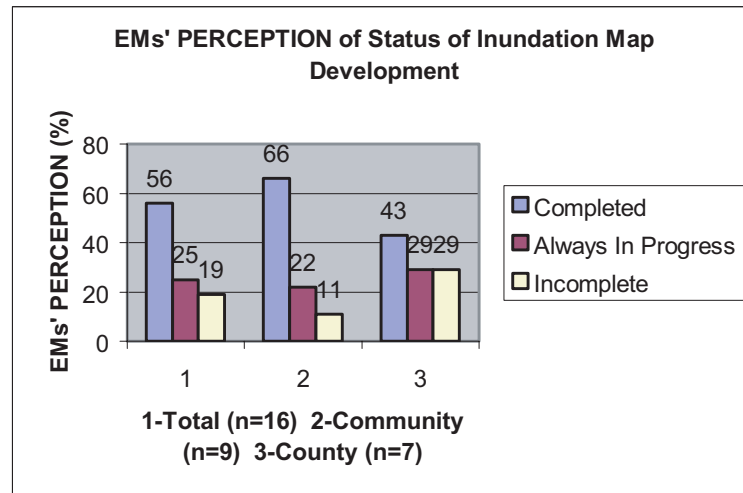


Figure 5: The majority of community EMs are satisfied with current maps. **Note:** “Always in Progress” means that new technology and information may require more work in the future. “Incomplete” means that the EM still wants more information on the current map. This is not unusual where safe evacuation areas are very distant from a peninsula community and choices of safe areas are hard.

subduction zone off the coast for a local tsunami hazard and the need for quick response in case of a strong earthquake.

During the 1994 warning survey, only 36% of EMs said the local risk was clear to them. During the June 2001 watch survey, 82% said the risk was clear. Since 1994, inundation and evacuation maps have been developed for all communities and are in final or draft form. During the May 2001 redesigned survey, 66% (6 of 9) of community EMs believe they have a completed inundation map (Fig. 5). Twenty-two percent (2 of 9) view the map as “always in progress” as new information and technology emerge. One of nine views the map as “incomplete” indicating they want more information currently. Forty-three percent (3 of 7) of county EMs view the map as “completed.” The remaining 4 of 7 split evenly on whether they believe their maps are “always in progress” or “incomplete” now. Overall the majority of community EMs perceive their maps as “completed,” whereas less than half of county EMs feel they are “completed.” However the remainder feel comfortable with the maps but see them as in transition based on coming technology and information. Only two view the maps as “incomplete,” these being where people have to travel farther to exit the inundation zone.

All EMs have or are planning evacuation routes. The routes are or will be marked by special signs (Photo 2). Special geological interpretive signs are also installed in many popular sites to educate the public as to the reason for the hazard and evacuation signage (Photo 3). The majority of EMs perceives their evacuation route specifications as completed. Seventy-eight percent (7 of 9) of community EMs view their evacuation route specification (Fig. 6) as “completed” compared to 71% (5 of 7) county EMs. The remainders in both groups are in the “planning stage” for evacuation routes.



Photo 2: An evacuation sign directs traffic along the evacuation route in Ocean Shores, WA. Many signs are installed in Oregon and Washington with a few in California and Alaska now.

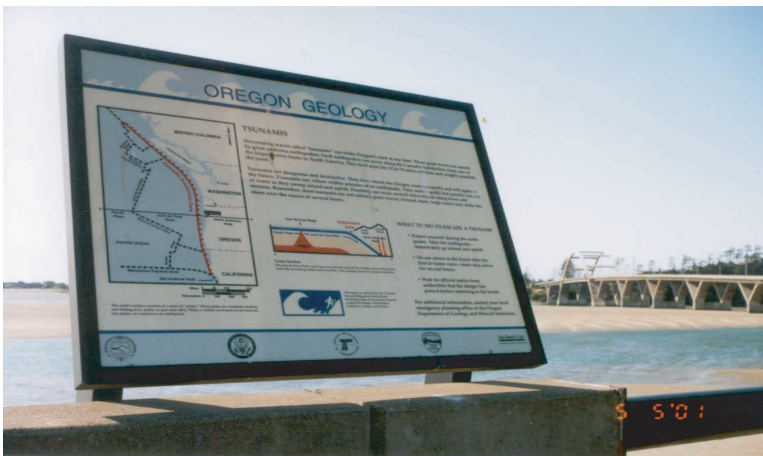


Photo 3: These geologic interpretation signs have been installed at several popular sites in Washington and Oregon. California has installed some that look a little different.

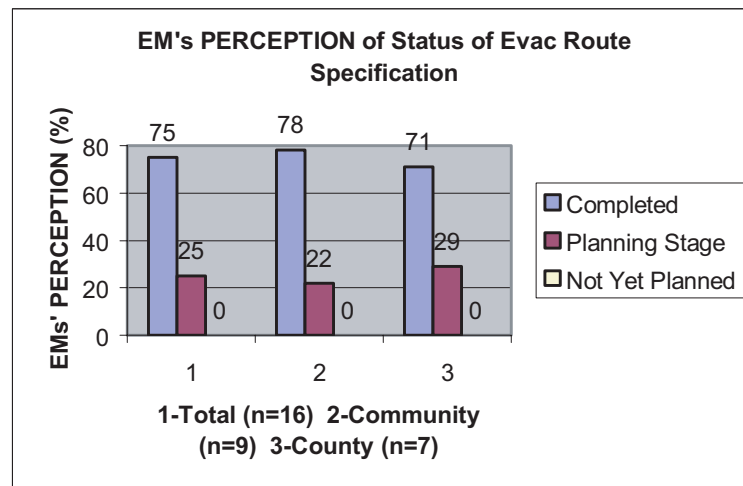


Figure 6: Three-quarters of EMs view their evacuation routes as completed, the remainder are in planning stage. **Note:** EMs = Emergency Managers.

The majority of EMs has disseminated evacuation route maps to the public (Fig. 7). Respondents were questioned about the status of dissemination of evacuation maps to the public. 67% (6 of 9) community EMs and 57% (4 of 7) have disseminated evacuation maps to the public primarily via brochures, media, and in some cases posting at public buildings like City Hall. During site visits we documented brochures in several Chamber of Commerce Visitors Centers (Photo 4), some of which included evacuation maps as well as tsunami information.

First responder installations and Emergency Operating Centers (EOCs) are generally not located at a safe elevation with regard to tsunamis along the northern California, Oregon, and Washington coast (Fig. 8). Seventy-seven percent (7 of 9) community EM respondents and 57% (4 of 7) county respondents say they are not at a safe elevation. This finding suggests it is in the interests of individual citizens to know ahead of time what they should do immediately to respond to a felt earthquake (near source tsunami potential). First responders, in the event of a near source, short time arrival of tsunami waves event, will be reacting to move themselves and equipment out of danger in order to be able to effectively respond to the event. Meanwhile, the ground shaking IS the local tsunami “siren” for residents. During the May survey, we asked EMs what their policy is for what they want residents to do if they feel a strong earthquake (Fig. 9). Seventy-seven percent (7 of 9) of community EMs and 100% (7 of 7) of county EMs said their policy for residents feeling an earthquake is to “move to high ground.” Two of the nine community EMs advise “move up, listen to the radio,” another advises “don’t go to the beach,” and one advises “move inland” (where they translate “inland” as to a certain elevation). None advise residents to “stay put, listen for information.”

The information above is especially important when we look at how well residents understand it. Respondents were asked to characterize residents’

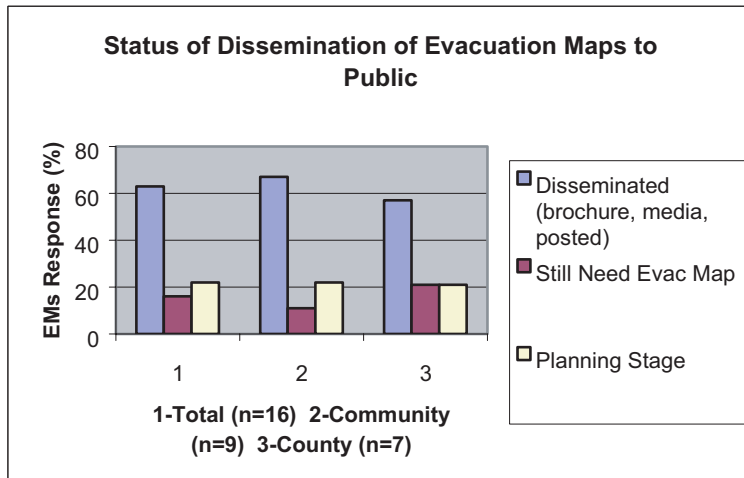


Figure 7: The majority of community and county EMs has disseminated evacuation maps to people in their jurisdictions.



Photo 4: Tsunami brochure in middle of display case at Florence, OR. Brochures were found in many Chamber of Commerce Visitors Centers in Oregon and Washington.

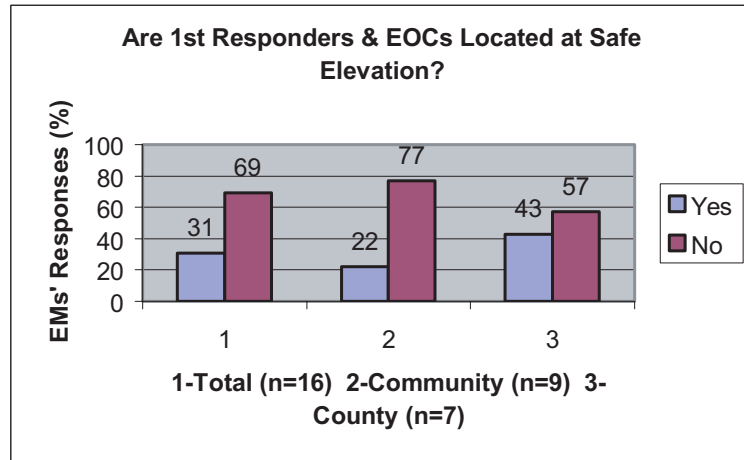


Figure 8: The majority of community and county first responders and EOCs are not at safe elevations. **Note:** EMs = Emergency Managers.

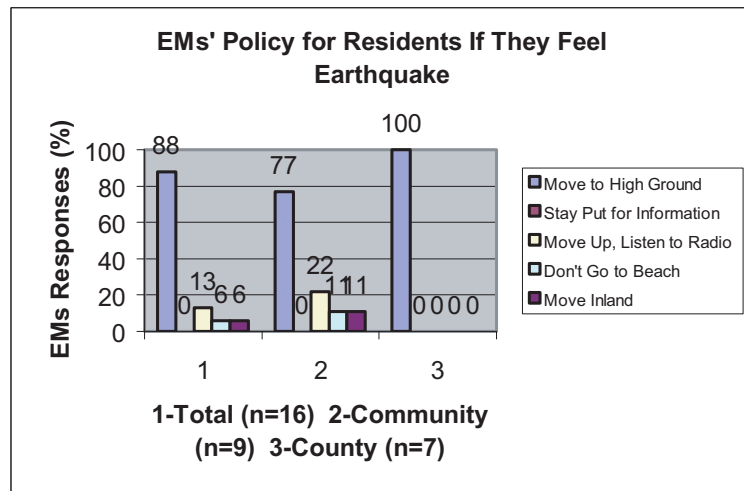


Figure 9: EMs want residents to move to high ground if they feel an earthquake.

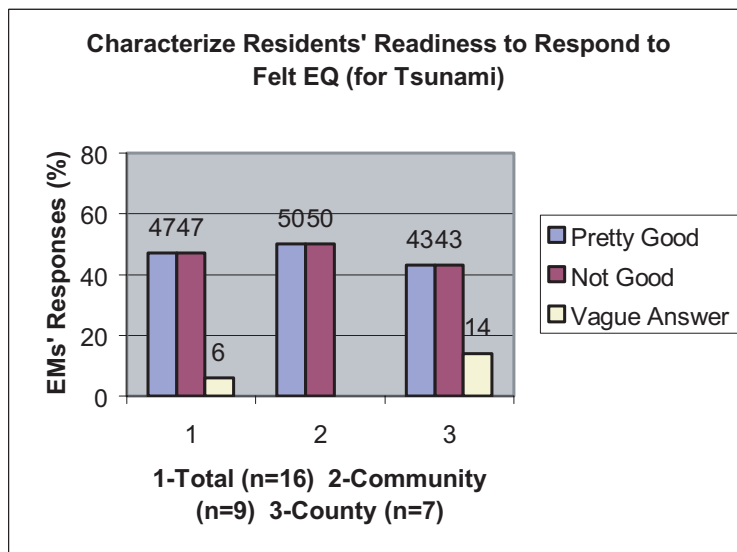


Figure 10: One-half of EMS rate residents ready to respond to a felt earthquake, another one-half rate them not.

readiness to respond to a felt earthquake for tsunami risk by indicating whether they felt the readiness was “pretty good” or “not good” (Fig. 10). Fifty percent (4.5 of 9, one rated “half and half”) of community and 43% (3 of 7) of county EMS rated their jurisdictions as “pretty good,” and the remainder rated “not good.” This suggests that more public education on what to do in the event of a felt earthquake on the coast is needed. The NTHMP has been working hard to raise awareness.

One of the earliest successes of the Subcommittee was its tsunami signage program. The goal was to provide a consistent message to residents and visitors regardless of which state they were in. To obtain signs, local communities had to commit to planning an evacuation route. In Oregon, communities were assisted by state-hosted workshops and meetings where they learned how to plan a safe route. They were also assisted with evacuation route brochure planning, design, and often printing.

The large majority of respondents characterized their residents’ readiness to respond to an official tsunami warning and evacuation for a distant tsunami as “pretty good” (Fig. 11). Sixty-seven percent (6 of 9) of community EMS and 69% (5 of 7) of county EMS characterized residents’ readiness to respond as “pretty good” while one each community and county EM rated “not good.” The remaining three were vague answers. Emergency managers typically can only speculate about citizen readiness levels as accurate data on this is difficult to obtain.

There has been an increase in the number of tsunami plans for cities and schools since 1994. In 1994 between 18 and 36% of emergency managers thought that schools in their jurisdictions had tsunami plans. Although five EMS reported that their schools were out of the inundation zone, they had problems with schools releasing students to buses and homes in the

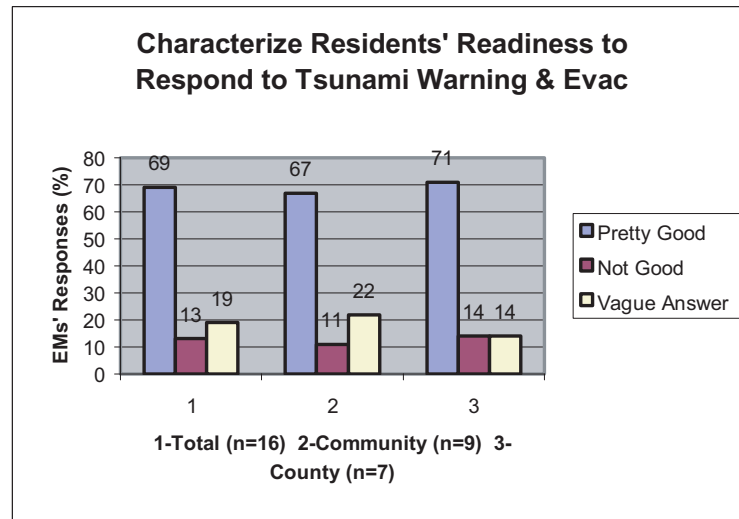


Figure 11: Over half of EMs rate residents ready to respond to a tsunami warning and evacuation. **Note:** EMs = Emergency Managers.

inundation zone. In 2001, 100% of surveyed EMs say that at least some or most schools in their jurisdictions have evacuation plans if they are in the inundation zone. States have worked to make schools aware of tsunami hazards. Oregon provided evacuation signs to schools that went through a program designed to teach them how to develop a tsunami plan. Washington recently completed K–12 tsunami curriculum. NTHMP may want to work with schools out of the inundation zone that may inadvertently send children back into the zone.

In 1994, 64% (7 of 11) of community EMs say their city had a tsunami plan. In 2001, 89% (8 of 9) of community EMs say their city has a tsunami plan or set of procedures specific to tsunami. In 1994, 55% (6 of 11) of community EMs said there were critical facilities at risk to tsunami in their jurisdiction (three were unknown). In 2001, all EMs said they have at least some critical facility or major industry in the inundation zone. The north end of the Cascadia Subduction Zone reported higher numbers of critical facilities in the zone. Several of these towns at the north end of the zone are located entirely or nearly entirely in the zone, for example, Seaside, Oregon, and Long Beach, West Port, and Ocean Shores, Washington. Half of the EMs report schools and retirement centers within their jurisdictions are in the inundation zone. One reported a hospital in the zone. A majority of city EMs report port facilities, major businesses, and industry or “other” in the zone. Over half report a local or county EOC in the zone.

4.4.2 *Tsunami resistant community ratings*

Respondents were also asked to rate their community or county in regards to several characteristics of a Tsunami Resistant Community taken from the Strategic Implementation Plan for Tsunami Mitigation Projects and

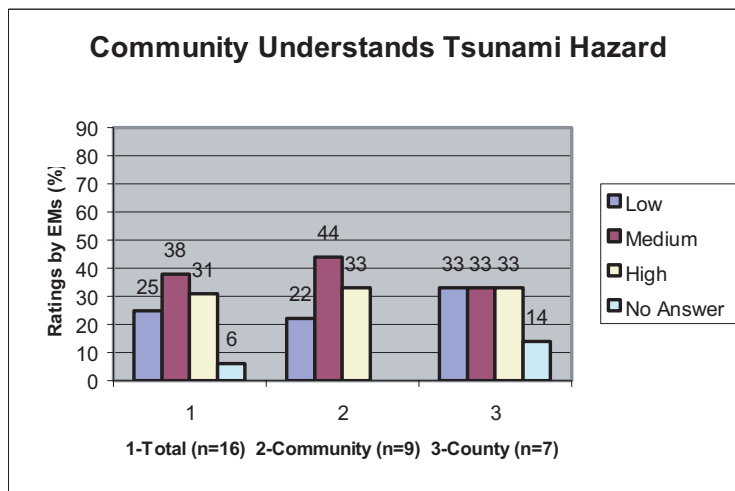


Figure 12: Community EMs rated their residents a little higher in understanding tsunami hazard than did the county EMs, which were evenly split between “low,” “medium,” and “high.” **A tsunami resistant community characteristic:** Community understands the nature of the tsunami hazard.

expanded a bit (Fig. 12). Seventy-seven percent of community and 66% of county EMs rated their jurisdictions medium to high for the characteristic **“Community Understands the Nature of the Tsunami Hazard.”** The scale was 0 to 10 and converted to sections called “low,” “medium,” or “high” for graphic depiction. Two of 9 community EMs and 2 of 7 county EMs rated their jurisdictions “low.” Forty-four percent (4 of 9) community and 33% (2 of 7) of county EMs rated “medium.” Thirty-three percent (3 of 9) community and 33% of county EMs rated “high.” More education can and should be done in this area.

We can see a difference in how communities and counties rate their jurisdictions for **“Agencies Have the Tools They Need To Mitigate the Tsunami Risk”** (Fig. 13). Fifty-six percent (5 of 9) community EMs and zero county EMs gave ratings of “high.” In fact 57% (4 of 7) county EMs gave ratings of “low.” The reasons for this might be explored to better determine how to raise county ratings. The kind of tools they require or the resources to obtain them may be factors that differ for communities and counties.

We can see differences within communities and within counties in how they rated **“Have Technology for Timely Warning to Public”** (Fig. 14). Equal portions of community EMs rated “low” and “high” at 44% (4 of 9), and rated only 1 of 9 for “medium.” County EMs gave equal ratings for all three levels at 29% (2 of 7) each with one person giving no answer. This spread indicates that both types of jurisdictions believe they are at varying levels of technology for timely warning. This issue could be explored and lower rated jurisdictions be assisted to feel more comfortable with or update their warning systems.

Both community and county EMs give solid “medium” to “high” ratings

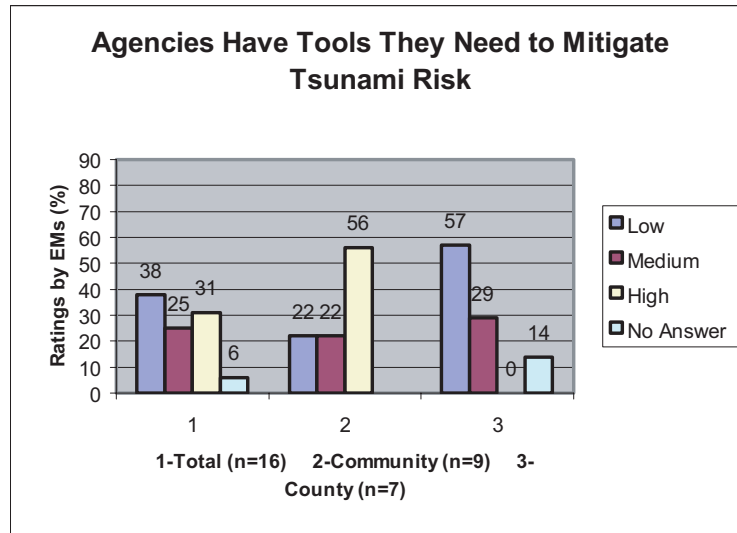


Figure 13: Community EMs say they generally have needed tools, county EMs feel they mostly do not. **A tsunami resistant community characteristic:** Agencies have tools they need to mitigate tsunami risk.

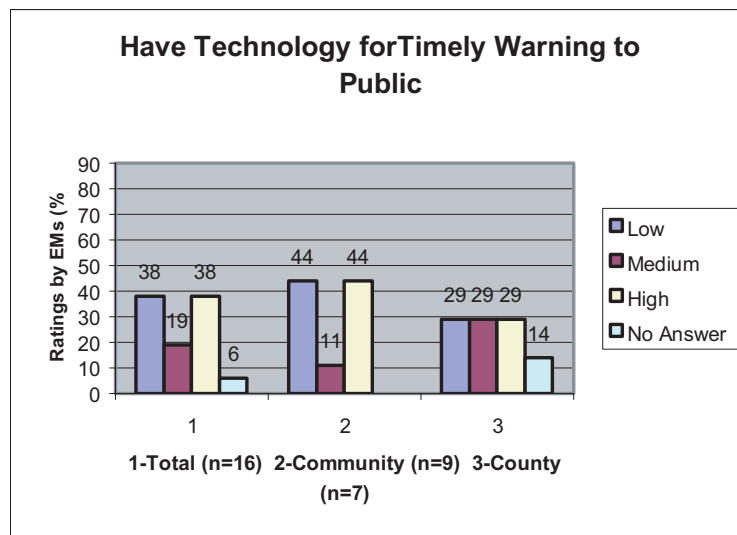


Figure 14: EMs say they are at different levels of technology for timely warning to the public. **A tsunami resistant community characteristic:** Community has appropriate technology for warning public.

for **“Hazard Information Disseminated More than Once a Year”** (Fig. 15). Forty-four percent (4 of 9) of community EMs rated “high” and another 33% (3 of 9) as “medium.” County EMs rated “high” at 71% (5 of 7) and another 1 of 7 at “medium” (1 was no answer).

Eighty-eight percent (8 of 9) community EMs rate “medium” to “high” for **“Information Well-Targeted to Specific Audiences”** while county EMs rate equally at 29% for “low,” “medium,” and “high” with one person giving no answer (Fig. 16).

Community and county EMs rate themselves “high” at 66% (6 of 9) and 86% (6 of 7) respectively for **“Local Authorities Exchange Information with Other At Risk Areas”** (Fig. 17).

Over half of both community and county EMs rate their jurisdictions “low” for **“Annual Budget Provided for Tsunami Response Readiness”** at 56% (5 of 9) and 71% (5 of 7), respectively (Fig. 18). However, over half of them also rate their jurisdictions “high” for **“Program Change Identification is Job Duty of At Least 1 Official”** at 55% (5 of 9) and 57% (4 of 7) (Fig. 19).

4.4.3 Strong program constraints rating

We also asked respondents to rank constraints to achieving and maintaining a strong program. Both community and county EMs said that **“Agency Man Power”** was a “high” constraint with 56% (5 of 9) of community and 71% (5 of 9) of county, respectively (Fig. 20).

Community EMs were more split (22 to 33%) on whether **“Necessary Expertise Locally”** was a “high,” “medium,” or “low” constraint (Fig. 21). County EMs felt more strongly that it was a “low” (57%) to “medium” (29%) constraint.

Both community and county EMs were very spread across all level ratings on whether **“Low Public Concern About the Hazard”** was a constraint (Fig. 22).

Almost three-quarters of both types of EMs rated **“Lack Support by Current Local Government”** as a “medium” to “low” constraint (Fig. 23). The ratings were 77% (7 of 9) “medium” to “low” for community EMs and 69% (5 of 7) “low” for county EMs.

A similar “medium” to “low” majority rating occurred for **“Political or Jurisdictional Issues”** (Fig. 24).

Ratings for **“Protection of the Tourism Industry”** as a constraint showed some difference between community and county EMs (Fig. 25). Fifty-five percent (5 of 9) of community EMs rated this as “high” to “medium,” while only 43% (3 of 7) of county EMs rated it “high” to “medium.” In fact 43% (3 of 7) of county EMs rated this as “low.” During site visits we were able to find at least two hotels willing to take responsibility for having plans for their guests. In each hotel room is an evacuation route and instructions to the guest. Recently the author was in a third hotel that puts out evacuation maps for their guests (Photo 5).

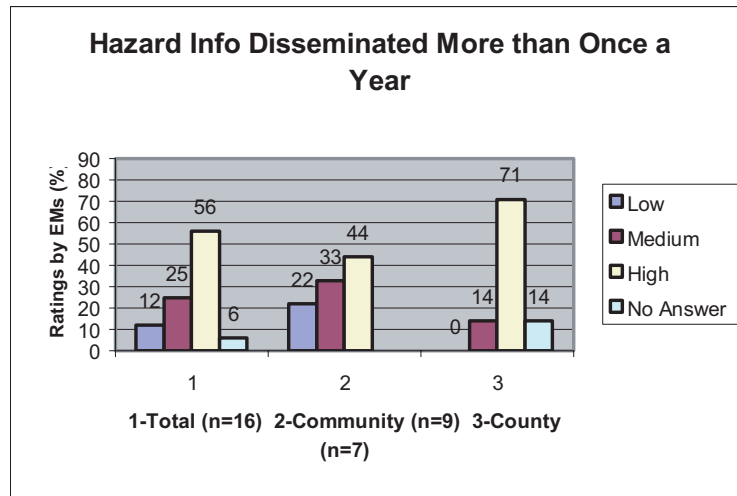


Figure 15: Most EMs say they disseminate hazard information more than annually. **A tsunami resistant community characteristic:** Tsunami hazard information is disseminated frequently.

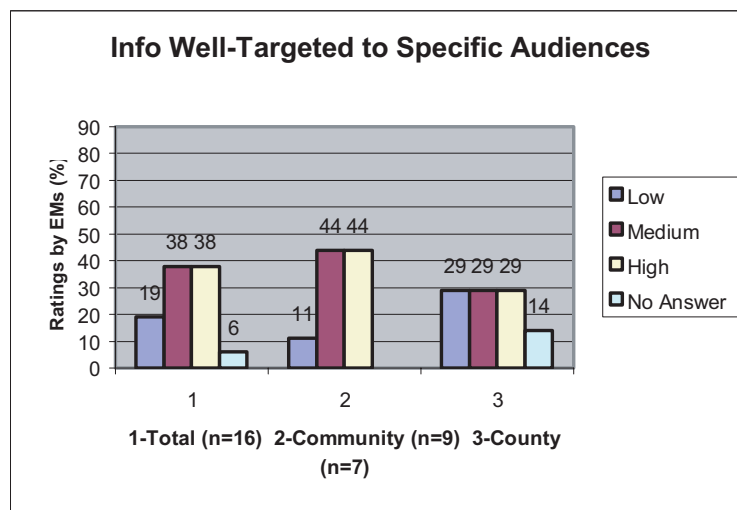


Figure 16: Community EMs say they target specific audiences while county EMs spread across all levels. **A tsunami resistant community characteristic:** Tsunami hazard information is well-targeted to specific audiences. **Note:** EMs = Emergency Managers.

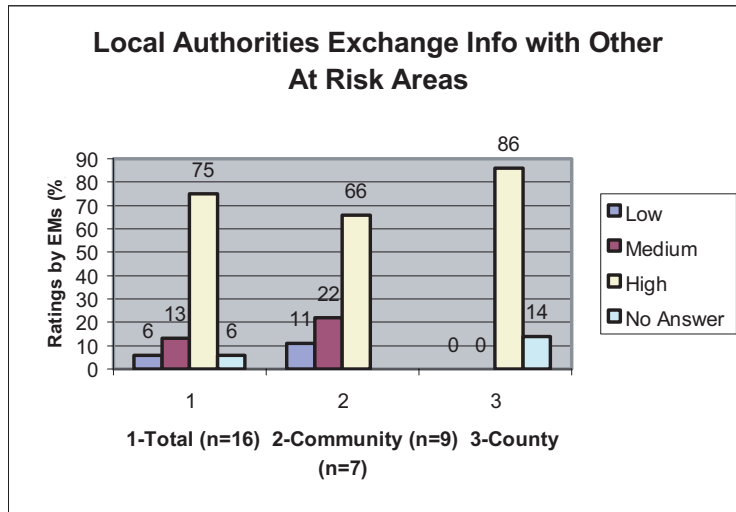


Figure 17: EMs feel they exchange a lot of information with other at-risk areas. **A tsunami resistant community characteristic:** Local authorities exchange information with other at-risk areas.

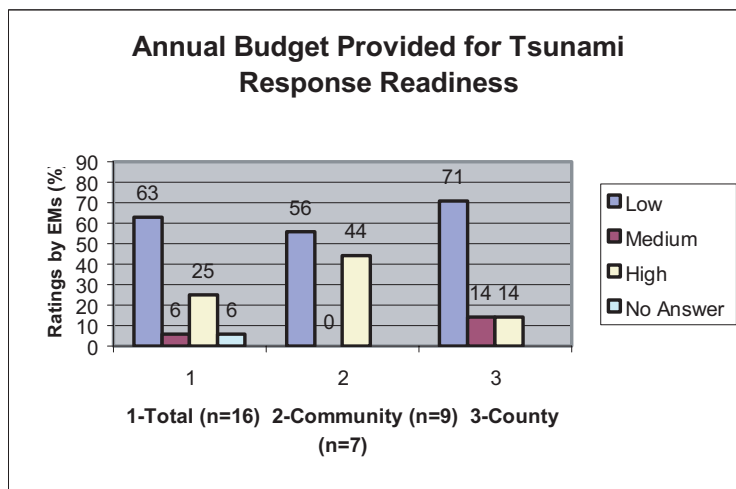


Figure 18: Most EMs say the annual budget provides sparse resources for tsunami readiness, especially at the county level. **A tsunami resistant community characteristic:** Annual budget provides resources for tsunami response readiness.

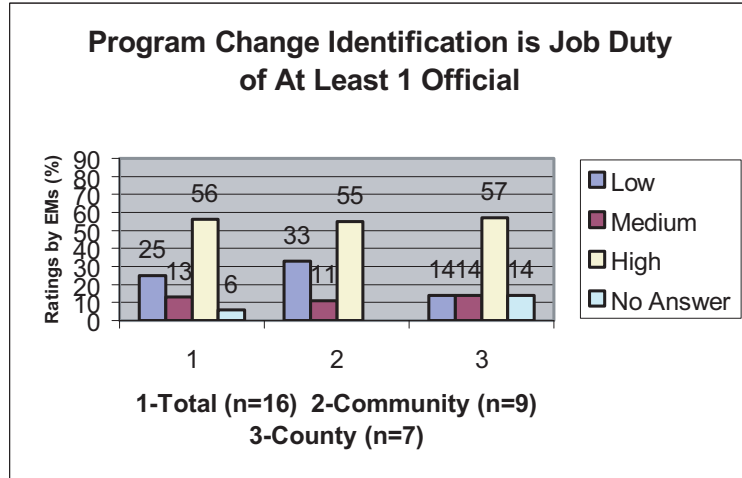


Figure 19: Despite lack of budget resources, most EMs say that identifying needed changes or enhancements to the tsunami program is part of their official job duties. **A tsunami resistant community characteristic:** Tsunami program change and enhancement is an official job duty. **Note:** EMs = Emergency Managers.

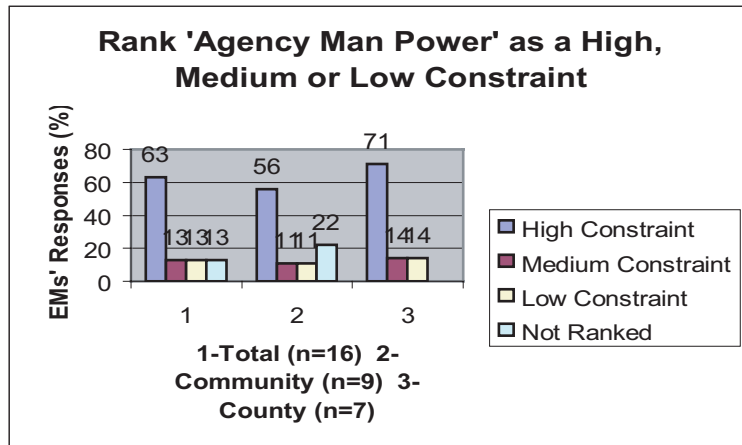


Figure 20: EMs said that lack of manpower was the strongest constraint for achieving and maintaining a strong program. **Constraints to achieving and maintaining a strong program:** Top-ranked constraint—Agency manpower.

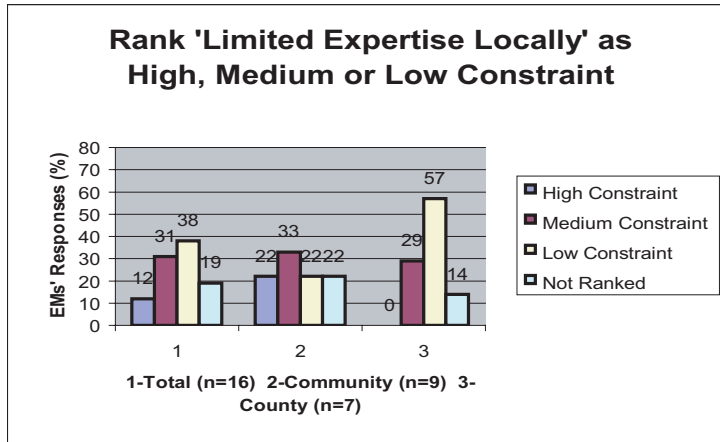


Figure 21: EMs said that limited expertise locally was not a strong constraint. **Constraints to achieving and maintaining a strong program:** Limited expertise locally.

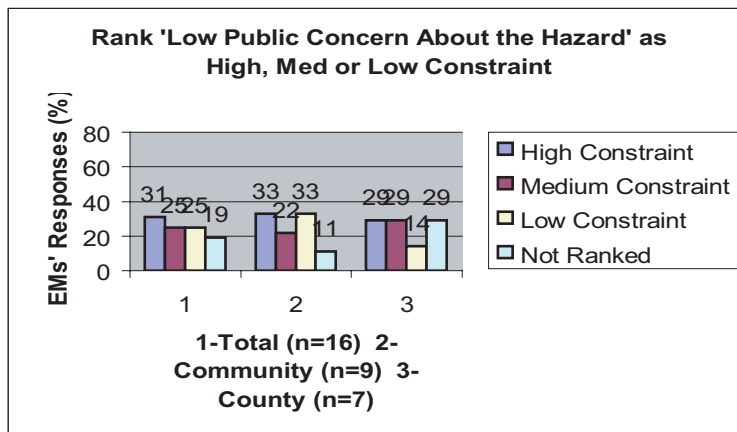


Figure 22: EMs report a variety of rankings about whether low public concern about the hazard is a constraint or not. **Constraints to achieving and maintaining a strong program:** Low public concern. **Note:** EMs = Emergency Managers.

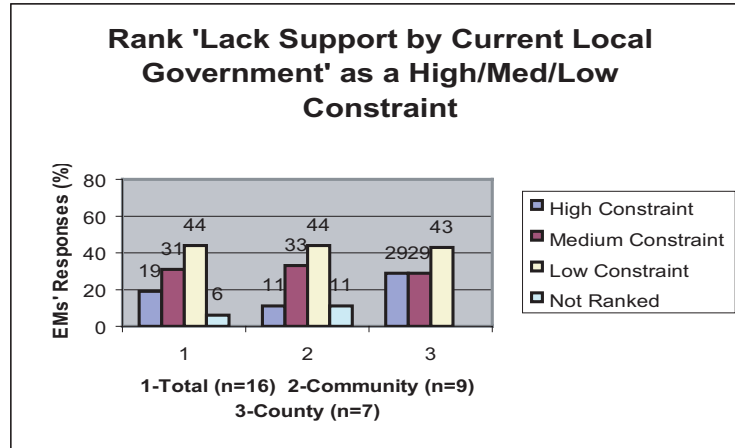


Figure 23: EMs rank lack of support by local government on the low side. **Constraints to achieving and maintaining a strong program:** Lack of support by current local government.

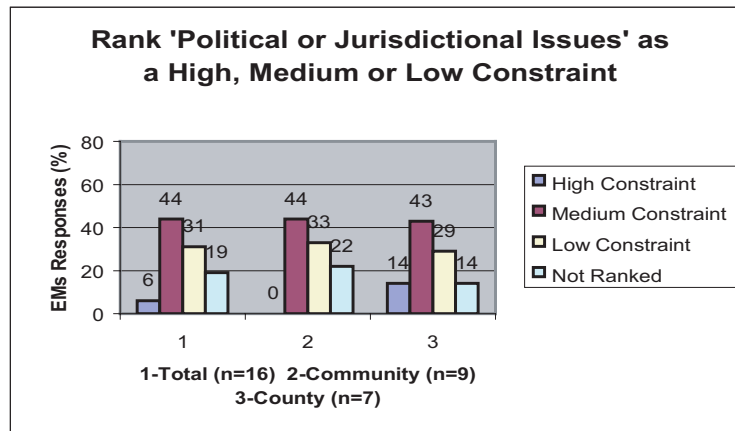


Figure 24: The majority of EMs rated political or jurisdictional issues on the “medium” to “low” side for maintaining a strong program. **Constraints to achieving and maintaining a strong program:** Political or jurisdictional issues.

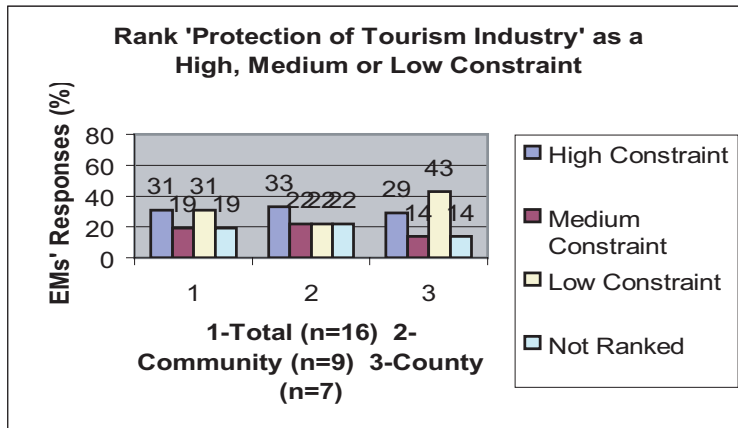


Figure 25: Only a third of community EMs says that protection of the tourism industry is “high.” A higher percentage of county EMs say that this is a low constraint. **Constraints to achieving and maintaining a strong program:** Protection of the tourism industry. **Note:** EMs = Emergency Managers.



Photo 5: Evacuation map in Ocean Shores, Washington hotel room. Such maps for guests and hotel plans were also found in Cannon Beach, Oregon.

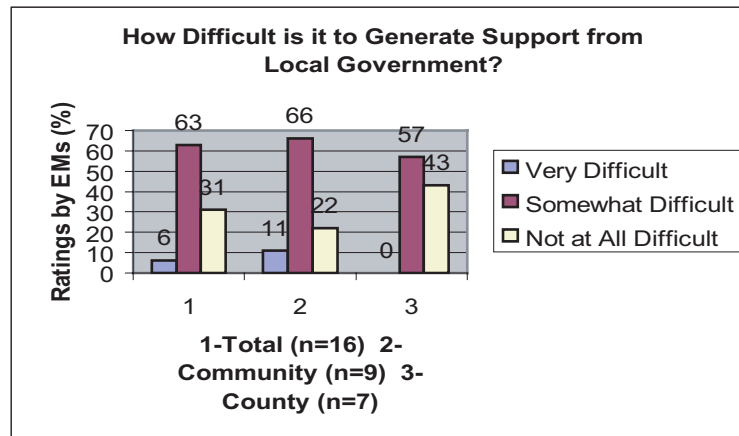


Figure 26: The majority of EMs say that it is “somewhat difficult” to generate support from local government. **Note:** EMs = Emergency Managers.

4.4.4 Local government, tourism industry, and resident program support ratings

Emergency managers were asked how difficult it was to generate support from local government, the tourism industry, and residents on a scale of “very difficult,” “somewhat difficult,” and “not at all difficult.” It appears that support from residents is at about the same “somewhat difficult” to “not at all difficult” level in both communities and counties. County EMs rate the support from the tourism industry higher in the “very difficult” level than do community EMs. Sixty-six percent (6 of 9) of community EMs chose “somewhat difficult” when rating local government support compared to 57% (4 of 7) of county EMs (Fig. 26). When rating the tourism industry support, 66% of community EMs again chose “somewhat difficult,” and county EMs weighed in slightly heavier at 43% (3 of 7) choosing “very difficult” (Fig. 27). Community and county EMs were in agreement when rating support from residents at 43% to 44% for “somewhat difficult” and the same percentages again for “not at all difficult” (Fig. 28).

4.4.5 Tsunami hazard vs. other community problems and concerns

EMs were also asked to rate the level of attention to tsunami versus other problems and concerns in the community (Fig. 29). The majority felt even with so many other concerns, that the attention paid to the tsunami hazard was “too low.” Sixty-seven percent (6 of 9) community EMs and 43% (3 of 7) chose “too low.” Only one person in the community pool and one in the county pool felt the level of attention being given was more than the community could afford, this being related to the cost of maintaining siren systems.

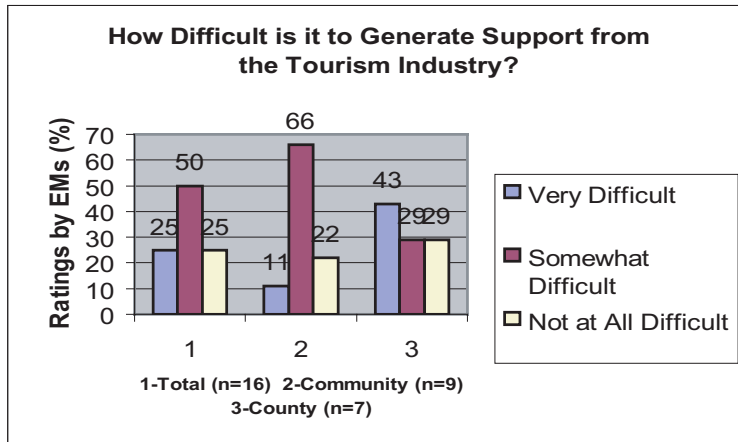


Figure 27: Community EMs say that getting support from the tourism industry is “somewhat difficult” compared to nearly half of the county EMs who say it is “very difficult.”

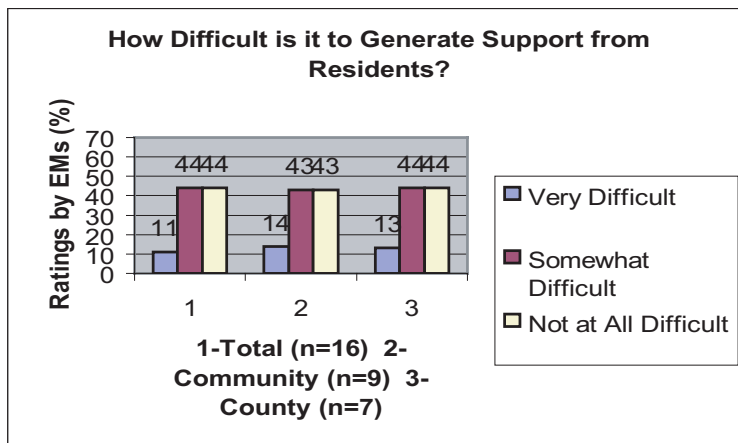


Figure 28: Most EMs at the community and county levels say that getting support from residents is “somewhat” to “not at all difficult.”

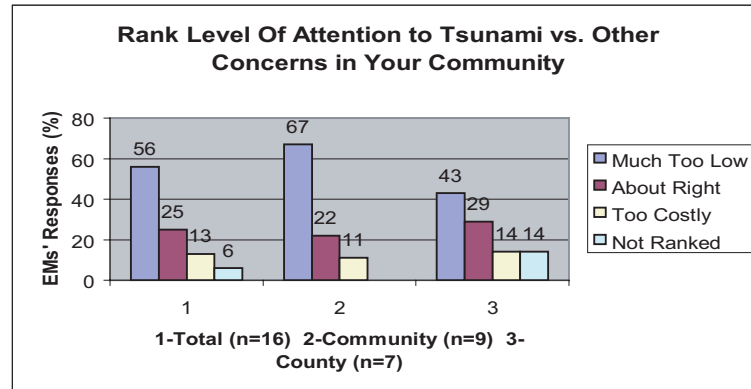


Figure 29: Most EMs feel that level of attention to tsunami hazard vs. other concerns is “much too low.” A few say it is “too costly” with high annual maintenance on a deteriorating siren system.

4.4.6 Information needs during felt earthquake

Responders were also asked to name the type of information that they need the most following a strong felt earthquake. Over half the EMs in both communities and counties answered “epicenter” (Fig. 30). A few answered “magnitude” and the rest of the list was a variety of items including: Mercalli intensity, tsunami potential, actual tsunami generation, hypocenter, if located offshore, if structures had collapsed. Forty-four percent (4 of 9) community EMs and 29% (2 of 7) county EMs answered that they “don’t get felt earthquakes.”

4.5 Conclusions about program impact

The 1994 recommendations were presented to the agencies that later formed the NTHMP and those agencies rose to the challenge presented to them by the communities. Have we succeeded with the tools we have developed together? Emergency managers are more satisfied with the improved warning procedures and regular interaction with the state and federal agencies in NTHMP. They are pleased with the increased number of meetings and workshops to help them learn to use the tools and to get their input to develop others. In 2001 they have an improved warning system, a better understanding of what the procedures are, a better understanding of their local risk based on outreach and tsunami inundation maps, more realistic evacuation plans based on the maps and their exchanges with the experts, better tools designed for and with them based on their priority needs, a better and larger and more diverse network of information contacts, and the beginnings of institutionalizing their plans for the next tsunami event. The measure of whether the NTHMP has helped communities meet their needs identified in 1994 was demonstrated in the words of one of the county emergency managers in 1997. She stated that “We are light-years ahead of where we were in 1994” in becoming more tsunami resistant. The measure

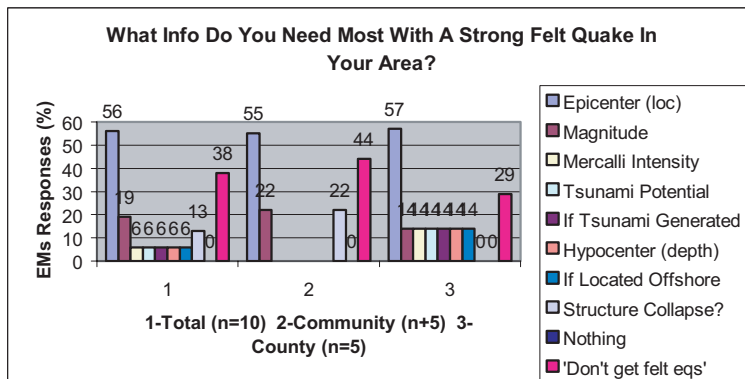


Figure 30: Over half of the EMs say that the information they need most after a felt quake is about the “epicenter.” **Note:** EMs = Emergency Managers.

in 2001 lies not just in words, but in the many NTHMP products we saw in City Halls, Visitor Centers, EOCs, hotels, and along highways as we traveled from Northern California north through Oregon and Washington during the May 2001 survey.

5. The Future: Next 5 Years

Where are we starting from now?

The Activities Matrix will continue to serve as a framework to track progress of the Strategic Implementation Plan. States are to be commended on meeting many of the Plan’s goals over the past 5 years by concentrating on developing, and assisting each other on developing, good basic state and local tsunami programs with an emphasis on preparedness and education. The next 5 years will be spent addressing the Plan’s goal, “Sustain support at state and local level for long-term tsunami hazard mitigation.” At the state level, Alaska will expand the inundation mapping and tsunami evacuation signage program to other communities and is planning a follow-up warning guidance workshop for local officials. California will focus on expanding its mapping program. Hawaii will continue public awareness campaigns and emergency operating center enhancement. Oregon will concentrate on completing more evacuation maps and signage installation and improving local warning using NOAA weather radios. Washington will continue to develop local warning systems and land use planning and lifeline issues.

Some of the existing gaps are of a more complex, harder to address, but long-lasting mitigation nature. Large gaps have existed for the Building and Land Use Guidance Element, including guidance for building code provisions and construction in areas subject to both severe ground shaking and tsunami forces, land use, and abatement projects. Some of these begin to be addressed in “Designing for Tsunamis—Seven Principles for Planning and Designing for Tsunami Hazards” (NTHMP, 2001) and the accompanying publication “Designing for Tsunamis—Background Papers”

(NTHMP, 2001), a multi-state project led by Richard Eisner in consultation with Mintier and Associates and others. Infrastructure Guides remain important but sparse. There are three gaps in products for the Education Element: tsunami mitigation cost/benefit information, library-type materials inventory, and training materials. All other items under this element have been addressed by all or most states. Most or all of the states have addressed Tools for Emergency Managers. However, Guides for Unmapped Communities has not been addressed by all and is important as the demand for maps increases with inadequate funds. Information Exchange and Coordination items are well addressed by states; however, we know that a resource catalog of the many state products and activities is sorely needed. The Long-Term Tsunami Mitigation Element shows some items well addressed by most or all states with the exception of a post-tsunami recovery guide, loss estimation, and tsunami legislation. The Subcommittee should also work more closely with non-Program entities to share products that might be used as models in other tsunami at-risk regions and learn what products have worked successfully elsewhere that might be adopted into the NTHMP, etc.

Where do we want to be at the end of the next 5 years?

Using reduction of loss of life and property as an overall mitigation goal, the Mitigation Subcommittee's desired impact at the end of the next 5 years is to:

- have improved a **local** capability to save the maximum number of lives and property,
- have the capability to use NTHMP expertise to assist tsunami response,
- have the products to play a major advisory role in recovery and rebuilding of communities during the next tsunami event.

The next tsunami event will be a unique window of opportunity to put real, hard-core mitigation into place in addition to all the education, awareness and improved warning system activities that NTHMP has been involved in.

To be at this place in 5 years we need to spend those 5 years accomplishing the following:

1. Maintain State Programs at \$50,000 per year per state
2. Maintain ongoing multi-state activities at \$50,000 per year (TsuInfo Alert and reprints of selected publications as needed)
3. Re-evaluate and adjust the Strategic Plan by:
 - (a) Using 2001 Survey including 2001 needs of local survey communities
 - (b) Revisiting existing gaps
 - (c) Using new information from lessons learned with various activities (i.e. worth continuing or not, tweaking, etc).

Recommendations

The activities that need to be funded in order to accomplish this include:

- Maintain state programs and include a new emphasis on response and recovery activities, which is a natural follow-on to the basic program
- Maintain multi-state projects and activities
- Hold two workshops similar to the recent warning workshop for locals
- Develop a reconstruction manual using case studies (e.g., Hilo), and information gained by participating in the 2003 EERI U.S.-Japan Earthquake Workshop in Hawaii
- Develop pre-disaster mitigation tools to reduce hazards and vulnerability (e.g., work with the Applied Technology Council to ultimately put useful information into the Coastal Construction Manual) to address tsunami forces in areas also vulnerable to strong ground motion (this will be at least a 3-year project)
- Re-evaluate projects and activities, i.e., new and value-added projects

Cost over 5 years for Mitigation Subcommittee activities to continue:

• State Program maintenance	\$1,250,000
• Multi-state maintenance	\$250,000
• Two workshops	\$130,000
• Reconstruction Manual	\$70,000
• ATC project	\$230,000
• New/adjusted projects	\$70,000
Total over 5 Years	\$2,000,000

The Mitigation allocation is essential in that it allows engagement of communities. \$2,000,000 over 5 years is seed money compared to the need. Seed money is the incentive for states and locals to do things they would not be able to do alone. The funds give leverage to obtain state and local matches and develop partnerships. In the last 5 years, the total state, local, and FEMA match is approximately \$2,116,980. Seed money provided by NTHMP for mitigation during that time was \$1,682,019.

Tsunami expert, Dr. Eddie Bernard, acknowledges, “communities must be committed to a continuous, long-term education program as tsunamis are infrequent events and succeeding generations may forget tsunami safety lessons” (Ingleton, 1999). Not only must the education program be long term, but also issues of building performance and land use guidance address the real mitigation solution to community sustainability in the face of tsunami risk.

A basic preparedness and education program and a variety of mitigation tools have been developed during the previous 5 years performance of the NTHMP. A new emphasis on development of tsunami response and recovery tools over the next 5 years will complement the warning and preparedness

activities that now exist. Recovery tools will provide opportunities to emplace longer-term mitigation measures following the next tsunami disasters. Future tsunamis will, by their very destructive nature, provide a chance to rebuild communities to an improved level of sustainability in the face of repetitive tsunami risk. The alternative is that they will simply cost lives and dollars in a predictable and repetitive manner for our future generations. (Cost-recovery and response tools can be developed within the recommended funding levels for state programs and using the recommended hard-core mitigation tools, such as the guidance and loss estimation tools. Lessons learned from other disasters and model Memorandums of Agreement between federal and state agencies can be used to develop and put in place a plan on how to work most efficiently together to address the immediate and longer-term response and recovery issues that will be raised by the next tsunami. Recovery and response activities are one area that is fairly easy for federal and state agencies in NTHMP to contribute labor and other resources toward).

The Subcommittee will continue to develop guidance to sustain a community's longevity in the face of repetitive disaster risk by addressing the more difficult, more expensive gaps in guidance for building performance for a combination of earthquake and tsunami forces, land use guides, and tsunami mitigation legislation models.

The Subcommittee will work more closely with non-Program entities in tsunami regions around the world in order to gather successful products from elsewhere into the NTHMP for the benefit of our communities, and in order to enhance other tsunami programs.

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