Mitigation in Motion:
An Assessment of Natural Hazard Mitigation in Local Comprehensive Plans

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Abstract

Since the passage of the Disaster Mitigation Act (DMA) of 2000, thousands of local governments in the US have adopted hazard mitigation plans (HMPs) that address natural and manmade hazards, making them eligible for federal funding that can assist in pre and post-disaster hazard mitigation activities. However, the extent to which HMPs are being implemented is still unclear— both on the ground and through existing local planning mechanisms. This study assesses how HMPs are implemented through local comprehensive plans, and how this plan integration varies given different state and local factors. Using content analysis, it assesses this plan integration in 40 counties from three Western US states. The results reveal an overall low degree of integration between HMPs and comprehensive plans, yet with substantial variation by state, hazard type, and type of mitigation activity. These results lead to suggestions for improving the interconnections between HMPs and local comprehensive plans, and provide useful avenues for further research on the implementation of local natural hazard mitigation priorities in a post-DMA planning context.

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Chapter 1: Introduction

Background

Our vulnerability to natural hazards has been at the forefront of national discourse in recent years, provoked by a barrage of hurricanes in the US and devastating earthquakes and tsunamis in Chile, Indonesia and Japan. These natural phenomena become natural *disasters* when human and physical assets, like people, buildings, and critical infrastructure are exposed to them. Disaster risk is increasing worldwide due to both intensified hazards resulting from climate change, and *response*-oriented planning and resource allocation that allows the root causes of such disasters to persist and grow (Basher 2008). This problem is reflected in the rising costs of damage from natural hazards, which have increased exponentially in the last several decades; around the world and here at home. Globally, average annual losses from natural hazards (inflation adjusted) increased from less than $20 billion in the 1950s and 1960s to well over $70 billion in the 2000s (Smolka 2006). In the US the trend is similar, with average annual losses from natural hazards increasing from less than $5 billion in the 1960s to near $15 billion by the 2000s (Cutter and Emrich 2005). Such figures call into question the resilience of our built environment to natural hazards, and reinforce the importance of hazard mitigation.

Hazard mitigation, according to the Federal Emergency Management Agency (FEMA), is "any sustained action to reduce or eliminate the long-term risk to human life and property from hazards" ("Local Multi-Hazard Mitigation Planning Guidance" 2008, 3). As a milestone in hazard mitigation planning, and reaffirming the importance of mitigation, Congress passed the Disaster Mitigation Act (DMA) in 2000, establishing new requirements for coordination between local, state and tribal governments for mitigation planning, and creating a new source of pre-disaster mitigation funding for states and local governments ("Disaster Mitigation Act of 2000" 2000). The DMA made eligibility for this funding, as well as funding under the Hazard Mitigation Grant Program, Severe Repetitive Loss Program and Flood Mitigation Assistance Program, contingent on having a local hazard mitigation plan (hereafter referred to as HMPs) approved by FEMA ("Title 44…," CFR 201.6, 2002).

Local HMPs are meant to guide local decision making and resource allocation over mitigation projects, and they are required to include several key elements. They must provide risk assessments that profile the hazards communities face and the local assets vulnerable to them. They must also include mitigation strategies that describe goals for reducing local hazard vulnerability, and specific, implementable mitigation actions that achieve these goals. Lastly, they must prioritize these actions, describe how they will be implemented and administered, and explain how the HMP itself will be maintained and updated over time. HMPs must be formally adopted by the jurisdictions they plan for and approved by FEMA, and they must be updated and reapproved by FEMA every five years to maintain funding eligibility ("Title 44…" 2002).

The merit of mitigation funding sources HMPs make available to local governments is supported in a 2005 study by the National Institute of Building Science's Multi-hazard Mitigation Council. Their three year study on the impact of FEMA mitigation grants from 1993 to 2003 found that, on average, every dollar of grant money spent on hazard mitigation prevents four dollars in future disaster losses (Ganderton et Al., 2006). This is one reason why by 2009 – less than a decade after the DMA was passed— over 19,000 local governments in the US had FEMA-approved HMPs. However, this still leaves over 69,000 local governments ineligible for mitigation funding made available by HMPs— meaning many will be writing HMPs in the next few years, on top of thousands of HMPs that need to be updated (Schwab 2010).

Purpose

With thousands of local governments needing to update their HMPs and thousands more poised to write them, this is a critical time to understand whether HMPs have been acted upon since the DMA, and how the mitigation actions they put forward have been implemented. In short, we must determine whether HMPs have been kept off the shelf and put to work. In a 2007 report to Congress, the US Government Accountability Office (GAO) found that there is no shortage of local hazard mitigation activities that state and local governments have identified in HMPs, specifically mentioning building codes, protective barriers and land use controls. However, it found that many of these require local planning mechanisms, like comprehensive plans, to be implemented ("Natural Hazard Mitigation: Various…" 2007). Ten years after the DMA, it is unclear if this is taking place. A 2010 study published by the American Planning Association on the issue of HMP and local plan integration showed the results of a national survey of local governments that concurred with the GAO report. It showed that HMP quality, participation and mitigation identification is strong nationwide, but that implementation strategies for HMPs are lacking; particularly connections between HMPs and other local plans. It suggested further research on this issue for the next round of HMP updates (Schwab 2010). Therefore, the purpose of this study is to understand how natural hazard mitigation has been integrated into local planning mechanisms after the DMA, and how this integration varies in different planning contexts.

Project Overview

This study explores the many challenges that stand in the way of successful natural hazard mitigation at the local level. I then discuss literature on ways to overcome these challenges through local comprehensive planning, as well as literature that discusses variation by state and locality in the propensity to plan for natural hazards. I end with a discussion of uncertainties about natural hazard mitigation at the local level in a post-DMA planning context. This uncertainty leads to the following two research questions:

1) *How, and to what extent, have the desired outcomes of hazard mitigation plans been integrated with local comprehensive plans since the DMA, both overall and under different state mandates for natural hazards planning?*
2) *How does this integration vary at the local level with respect to hazard vulnerability?*

I answer these questions by sampling and analyzing HMPs and comprehensive plans from 40 medium-sized counties in California, Oregon and Washington. I then describe all three steps of my procedures, which included characterizing statewide planning systems in each state and their mandates for hazard mitigation planning, developing a method for filtering action items for further analysis, and then scoring the degree to which remaining HMP action items were integrated with comprehensive plans. I end with a description of my analysis.

My results section provides the scored results, both overall and by state, based on hazard type, degree of integration and types of mitigation actions, and shows how these results are influenced by local hazard vulnerability. I then discuss their implications as they related to each question. I also provide five suggestions for planning practitioners based on my findings, and present ideas for further research on this, and similar topics.

Chapter 2: Literature Review

The Challenge of Hazard Mitigation

The benefits of mitigation, by itself, are well established, and local governments clearly followed through on mitigation planning following the DMA. The challenge local governments face is in implementing these plans and using them to reduce their vulnerability to natural hazards. Local governments do not always implement HMPs simply because it is the right thing to do. Too many barriers stand in the way; an imbalance of funding toward disaster *response* instead of *mitigation*, poor recognition of successful mitigation efforts in the media (Sparks 2007), mistaken and paradoxical perceptions of hazard risks by property owners (Martin et Al. 2009; Zhang et Al. 2009), and federal funding that has historically incentivized development in hazardous areas (Burby 2006). There is also a general perception among planners in high risk communities that hazards are, to some extent, impossible to fully avoid, and that frequent, short-term concerns are worth more resources and focus than low probability, yet potentially devastating events (Berke 1998). For HMPs to overcome these barriers, they need planning mechanisms that lead to their implementation.

Mitigation through Comprehensive Plans

The most important planning mechanism that can be used to implement hazard mitigation is the local comprehensive plan. The role of comprehensive plans varies widely from state to state, and it has also varied over time, ranging from mere visions to mandated blueprints, explicitly guiding local land use (Baer 1997). Regardless of its varying power and focus, Norton (2008) draws the broad conclusion that a comprehensive plan, in most contexts, is "a statement crafted deliberatively by the locality that articulates citizens' shared vision for the development of their landscapes over time" that it "identifies policies and regulations to be adopted," and that it "justifies both the reasoning behind the plan's goals and the reasonableness and efficacy of the means selected to achieve those goals." In short, a comprehensive plan acts as both "a repository of information and analysis" and "as guidance that is 'fact-based' and that reflects the 'real world'" (436-437). They are, unlike more narrowly-focused local planning mechanisms, *comprehensive.* In these ways, comprehensive plans can be a starting place for implementing HMPs, which are non-regulatory federal administrative requirements, with a more representative document that has the teeth to guide development in a local jurisdiction.

There is on-the-ground evidence that supports this conclusion. When comprehensive plans have incorporated hazard mitigation, disaster losses have been reduced (Nelson and French 2002; Iwan 1999; Burby 2006). Nelson and French (2002) scored the quality of seismic safety standards in local comprehensive plans, and then studied the extent of damage following the 1994 Northridge Earthquake. They found a significant positive correlation between high quality seismic safety elements in comprehensive plans and lowered earthquake damage in affected communities. Iwan (1999) cited a study showing a 25 percent reduction in floodplain development in cities that used their land use plans to restrict such development. This led to $11 million in reduced damage per year in those cities, compared to the $1.3 million cost of administering such policies (1945). Finally, Burby (2006) shows that per-capita flood insurance claims are three times lower in states that require code enforcement and comprehensive planning than in those that require neither, and this statistically significant relationship remains even when controlling for the number of severe weather events, population size, density and growth, and home value. He suggests that the DMA is a step forward in local hazard planning, yet states that

"the Disaster Mitigation Act of 2000 could be amended to require that regular mitigation plan updates mandated by the legislation be integrated into local comprehensive plans" (184).

HMPs and comprehensive plans actually *depend* on each other to be fully effective against natural hazards. Individually, HMPs have an advantage over comprehensive plans in their ability to incorporate greater technical detail about hazards. However, comprehensive plans help assure that HMPs do not lead to structural protections in hazard-prone areas that, according to Burby (1999), "inadvertently promote increased occupancy of those areas by making them safe for development" (249). In other words, comprehensive plans can focus on a scale that limits development in areas made safe merely through structural features; for example, levees and dams. Conversely, comprehensive planning can itself *increase* vulnerability to natural hazards when it *doesn't* explicitly incorporate hazard mitigation. This is due to the so-called "urban containment" strategies of comprehensive plans in many states, which artificially create land scarcity, leading to higher land prices and a greater incentive to develop in hazardous areas, like on floodplains, unstable slopes and fault lines (Burby et Al. 2001). In these ways, both mitigation planning without comprehensive planning and comprehensive planning without mitigation planning can increase a community's vulnerability to natural hazards.

The importance of hazard mitigation through comprehensive plans has not fallen on deaf ears. It widely accepted in the planning community, so much so that the American Planning Association (APA) has given it a name; "Safe Growth." Safe growth guides development and critical facilities away from high hazard areas, and involves audits of the comprehensive plans, zoning ordinances, subdivision regulations and capital improvement plans (CIPs) for key hazard mitigation attributes (Godschalk 2009). The APA also undertook a three year study on the issue of hazard mitigation in local planning, and compiled the results into a report titled "*Hazard Mitigation: Integrating Best Practices into Planning*," with an entire chapter on the integration of hazard mitigation into comprehensive plans. It provided many reasons that HMPs should not be stand-alone plans, among them being that HMPs, unlike comprehensive plans in many states, are not legally binding documents, as well as the avoidance of inconsistent or contradictory outcomes from HMPs and comprehensive plans (Schwab 2010, 21). This connection is most prominently mentioned in FEMA's HMP guide for "Bringing the Plan to Life," in which HMP implementation through comprehensive planning is listed as a required task of the mitigation planning process ("Bringing the Plan to Life…" 2003, 2-8). Given the importance of comprehensive plans to hazard mitigation, it would be worthwhile to understand how well comprehensive plans are *actually* incorporating mitigation at the plan-level.

State Planning Context and Mitigation through Comprehensive Plans

While its importance is well established, the prevalence of mitigation through comprehensive planning varies widely in the US, due to differences in state policies. An important factor in this variability is the existence of state policies that mandate the integration of hazard mitigation into local comprehensive plans (Burby et Al. 2001; Burby and Dalton 1994; Berke et Al. 1996). Historically, comprehensive plans in states that do not require them to address natural hazard mitigation have *not* included it (Burby et Al. 2001). This was confirmed through Burby and Dalton's (1994) study of five approaches that 176 local governments took for limiting development in areas prone to natural hazards. They explained that, while only half of the jurisdictions limited such development, those "in states with planning mandates were much more likely to have plans that recommend development limitations than governments in states without mandates" (231). These results were confirmed at a broader scale in a 2001 survey of

505 city and county planners nationwide by the Institute for Building and Home Safety (IBHS). It assessed the integration of natural hazards with local comprehensive plans, and found that planners in states with both hazard mandates and vertical integration with state planning requirements reported a 55 percent higher degree of hazard mitigation in comprehensive plans than states that did not ("Are We Planning…" 2002). Moreover, state mandates for local hazards planning have been shown to improve the overall quality of local comprehensive plans themselves (Berke et Al. 1996).

While state mandates can greatly influence whether local governments plan for hazards, the degree to which this occurs varies significantly (May 1994; May and Feeley 2000). May (1994) explores hazard mandate variability in a study of 19 hazard planning mandates in five states, showing that highly "prescriptive" (more clear and specific) mandates are more focused on specific hazards, especially floods and earthquakes, while mandates with more "controls" (or power to regulate) are geared more toward private rather than public activities, through the use of regulations rather than incentives. May and Feeley (2000) confirm this variability in a study of earthquake regulations in 258 local governments in nine Western US states. While they found that state regulations had a much greater influence than the local political and economic factors on the implementation and priority given to these regulations, they stated that major influences on the propensity to carry-out such mandates "include the requirements of state mandates, the extent of state assistance given to local governments to carry out mandates, and the degree of oversight and enforcement of intergovernmental requirements" (24). Burby et Al. 2001 found that even in states with mandates for local hazard mitigation in local plans, this integration, in some local governments, has been found to be "extremely weak" (486). This fact underscores the importance of understanding variability in state mandates for local hazard mitigation.

Local Variation on Mitigation through Comprehensive Plans

Even given the same mandates over hazard mitigation, local factors can also play a role in the propensity and ability to follow through on them (Beller-Simms 2004; Deyle and Smith 1998; Deyle et Al. 2008). In a study showing how local governments prepared for 1998's record breaking El Nino, places with higher economic vulnerability from El Nino's impacts were better prepared, as were those that faced frequent hazards, those that already highly prioritized mitigation activities, and those with more local resources (Beller-Simms 2004). Follow-through on mandates by local governments has been shown to be especially influenced by exposure to hazards. A study in Florida explored the influence of several factors— like local experience with hurricanes, development patterns and available revenue sources for planning— on the likelihood that local governments carried out state hazard planning mandates. Only hurricane experience was found to significantly affect compliance with such mandates (Deyle and Smith 1998). In fact, local vulnerability to hazards specifically, such as exposure to frequent hurricanes, can often outweigh the impacts of state mandates for local hazards planning (Deyle et Al. 2008). More mixed results on the importance of local hazard vulnerability in the propensity to plan for natural hazards were found in the national IBHS study. While planners reporting no experience with major natural disasters reported a far lower degree of hazard integration with comprehensive plans, this was not a major influence among planners with *some* of this experience. In fact, overall, this study did not find very large local variation among the propensity to plan for hazards outside the state-to-state differences (Institute for Business & Home Safety 2002).

Uncertainty in Hazard Mitigation through Local Planning

Altogether, this literature provides a piecemeal, historical understanding of variation in the propensity to plan for natural hazards. However, while many of these studies were conducted after communities began planning under the DMA, most of them do not *acknowledge* the different planning contexts for hazard mitigation under the DMA. Instead, they explore either general hazard content in comprehensive plans, on-the-ground implementation of hazard mitigation identified in comprehensive plans, or simply the content of state mandates influencing this implementation. No studies have put all of these factors together.

Furthermore, uncertainties were raised by the APA and IBHS reports. The APA report leaves this issue of implementation through HMP integration open as an important area of research. It states that while "mandates do make a difference, there is considerable opportunity to improve our understanding of just how much difference they make— and whether specifically requiring that hazards be addressed in comprehensive plans makes a bigger difference" (Schwab 2010, 30). It also states that "no systematic statistical research evaluating DMA outcomes has been undertaken nationwide" (Schwab 2010, 18). Moreover, both the APA and IBHS reports used self-reported surveys to report on the integration of hazard mitigation with local comprehensive plans, leaving uncertainty around how this integration *actually* occurs at the plan-level.

Research Questions

If hazard mitigation integration with comprehensive plans is so critical, as suggested by Nelson and French (2002), Burby (2006), Godschalk (2009), Schwab (2010) and the APA and IBHS reports, it would be useful to understand whether such integration has actually taken place through hazard mitigation plans post-DMA. If the literature is correct in framing the importance of HMP integration with comprehensive plans, integration can be considered an important step toward the implementation of the HMPs.

I have identified two major gaps in the literature on this issue. One is in understanding, at the plan-level, the extent and ways in which hazard mitigation is integrated with comprehensive plans post-DMA. Another gap is in understanding how two scales of influences— state mandates and local conditions— affect and relate to DMA implementation through comprehensive plans.

Given these unknowns, this study explores the following questions:

1) *How, and to what extent have the desired outcomes of hazard mitigation plans been integrated with local comprehensive plans since the DMA, both overall and under different state mandates for natural hazards planning?*
2) *How does this integration vary at the local level with respect to hazard vulnerability?*

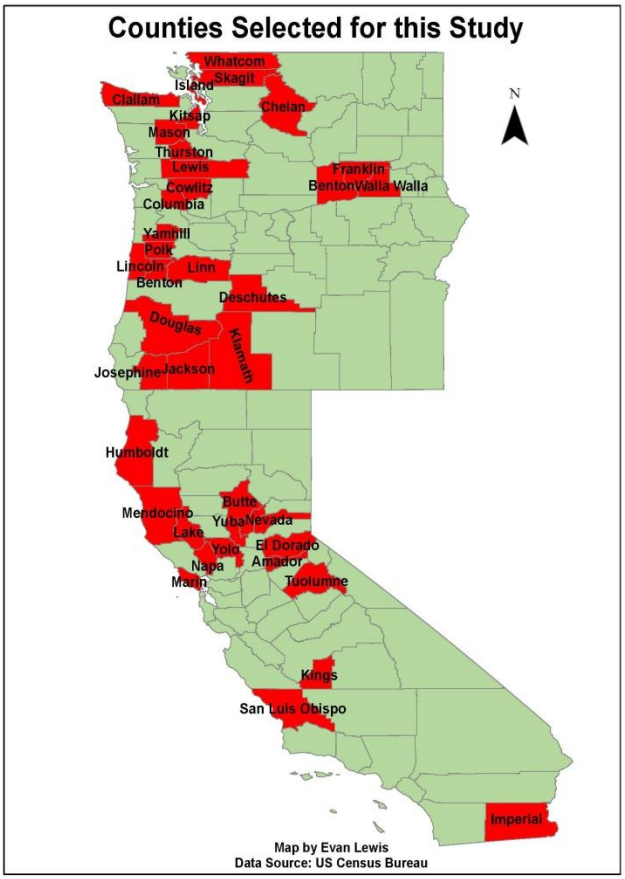
The answer to the first part of the first question will provide the most detailed picture yet of ways that HMPs are being integrated into local planning— much more detailed than surveys that were conducted on this issue. Regarding the second part of the first question, if mandates for hazard mitigation are so important, as shown by Burby and Dalton (1994), Berke et al. (1996), Burby et al. (2001) and May (1994), I would expect that a mandate like the DMA would lead to widespread implementation of HMPs in states with strong mandates, and lesser implementation in states with weak or no mandates. Finally, the answer to the last question should provide some indication as to whether a local condition, specifically hazard vulnerability, bears a relationship to the variability of hazard mitigation through local planning.

Chapter 3: Methodology

Overview

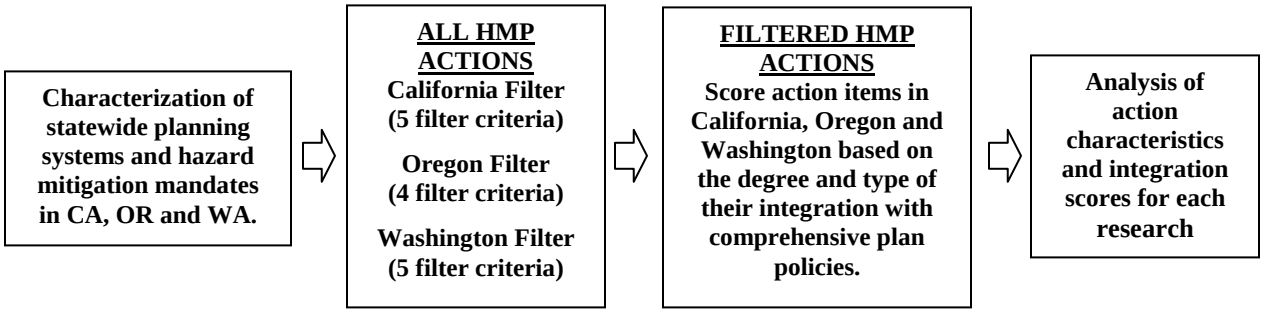
To answer my research questions, I conducted content analysis of local comprehensive plans to show how they incorporated desired outcomes of HMPs. These plans came from counties in California, Oregon and Washington, all of which share similar natural hazards and have large variation in the type and strength of their mandates for local hazard mitigation through comprehensive planning. In addition, land use planning laws in these three states share many attributes. All three states require local governments to adopt comprehensive plans, require consistency between local zoning codes and comprehensive plans, and specify required elements to be included in comprehensive plans. Furthermore, all have strong state control over local planning, relative to the rest of the US ("General State Planning Legislation…" 2009). Finally, these states provide a regional opportunity to assess the extent and ways in which HMPs have been integrated with comprehensive plans. Each selected county is shown in Figure 3.1.

Figure 3.1



This analysis was carried out in four steps; 1) a characterization and comparison of statewide planning systems and hazard mitigation mandates in California, Oregon and Washington, 2) the development of filters to relate HMPs to comprehensive plans, 3) the creation of a scoring scheme from which I could show the integration of HMPs with comprehensive plans, and 4) the actual implementation and analysis of the content analysis. From this analysis, I derived scores for each county and state that represent the integration of these two planning documents to understand the overall extent of integration between HMPs and comprehensive plans. I used a range of these scores to show how integration varies under different mandates for hazard mitigation, and by hazard vulnerability. Figure 3.2 provides a schematic of this process.

Figure 3.2: Overview of Methodology



Data

For the content analysis, my data consisted of hazard mitigation action items from county-level HMPs in California, Oregon and Washington, as well as comprehensive plans (or, in the case of California, "general" plans) for these same counties. To allow for the maximum amount of time in which HMPs could have been implemented, the HMPs I chose were the first approved plans in those counties— not updated plans. These plans were found on county websites, state emergency management websites, received through email from county staff, and in one case received via mail. They were all in searchable, portable document formats (PDFs). For the vulnerability analysis, I used hazard vulnerability designations for each county found in the most recent versions of each state's statewide HMP, as well as data on federal disaster declarations provided by the Office of Management and Budget ("FEMA Disaster Declarations Summary" 2011).

Sample

Counties were purposively sampled from California, Oregon and Washington. My sample consisted of 40 counties; 16 in California, 13 in Washington and 11 in Oregon. This distribution is roughly proportionate to each state's share of the combined total of counties in these three states, and represents roughly thirty percent of counties within each state. For a county to be included, it had to meet several conditions. To control for vastly different planning contexts between large and small counties, only medium-sized counties were selected. Selected counties had populations ranging from roughly 38,000 to 262,000 people, due to a natural break in county populations on the high end of that range, and data limitations on the low end. Population data for each county came from the 2005-2009 American Community Survey. Counties also had to have FEMA-approved HMPs, and those HMPs had to have enough action items to be given a score after going through an action item filter (described in the procedures sections). Finally, the counties had to have comprehensive plans that were electronically searchable by keyword in order to carry out the content analysis in a consistent way. Exceptions to these rules and relevant statistics for each of these counties are found in Appendix I. Ultimately, these conditions led to the exclusion of 17 out of the 57 counties in the population range I set; eight out of 24 in California, seven out of 20 in Washington, and two out of 13 in Oregon.

Procedures: Synopsis and Guidance

Content analysis of county comprehensive plans was the main methodology used for this study. According to Krippendorff (2004), there are four characteristics of research questions for which content analysis is suited; they are answerable "by examinations of body of texts," they "delineate a set of possible…answers among which analysts select," "they concern currently inaccessible phenomena" and they "allow for (in)validation…by acknowledging another way to observe or substantiate the occurrence of the inferred phenomena" (32-33). My research meets all of these criteria, as its questions are dependent on a body of two types of text, anticipate possible answers, are most easily and reliably answered through the analysis of written text, yet could still be answered through other, more indirect methods— like surveys. In these ways, content analysis can be justified as a methodology for this study.

To carry out my content analysis I relied on the steps for creating a content analysis coding scheme described by Weber (1985), an analysis of plan quality studies by Berke and Godschalk (2009), and a content analysis strategy specific to local master plans outlined by

Norton (2008). This guidance was useful in framing my work within all possible uses of this methodology, yet also in providing a reference point to know how my use of content analysis deviated from more traditional uses of this methodology. Ultimately, my methodology resembled a hybrid comparative plan quality analysis (Berke and Godschalk 2009) — one that I adapted for my interest in the integration of HMPs and comprehensive plans.

In this study, HMPs in all states are generally expected to follow a similarly structured format and fulfill similar purposes. The structure and purposes of comprehensive plans, on the other hand, vary from state to state. While comprehensive plans carry more teeth in-terms of implementation, they do not necessarily contain the full scope of planning intentions of local governments (Norton 2008). This is nicely framed by Norton (2008) who, on one hand, describes the local comprehensive plan as a type of "communicative policy act" with content that "reflect[s] the policy intentions of local officials." On the other hand, while arguing that comprehensive plans are well suited for content analysis, he emphasizes that, to draw meaning from such analysis, "it is necessary to first have a clear conception of what role the plan plays and how it relates to development management program elements" (437).

In this study, understanding these roles was critical to determining how the desired outputs of HMPs are integrated into comprehensive plans for each state, and what the results mean. In HMPs, such outputs are defined by goals, objectives and mitigation action items (sometimes called "mitigation strategies"). Action items represent the outputs of HMPs. Everything else in the HMP (the community profile, risk assessment, etc.) leads up to the development of mitigation action items that can be implemented ("Developing the Mitigation Plan…" 2003, 2-1). For this reason, action items were the chosen recording unit with which to carry out this analysis.

Procedures Part I: Characterizing State Land Use Planning and Hazard Mandates

To filter out action items from this study which could not possibly be addressed through comprehensive plans, and to understand the significance of my content analysis results, I characterized the land use planning requirements and mandates for hazards planning in all three states. Table 3.1 shows the required comprehensive plan elements in each state. Highlighted elements are those required among all three states.

Table 3.1: Required Comprehensive/General Plan Elements by State

California ("General Plan Guidelines 2003)	**Oregon** ("Oregon's Statewide Planning Goals…" 2010)	**Washington** ("Chapter 36.70A RCW 2010)
• **Land Use** • **Circulation** • **Housing** • Conservation • **Open Space** • Noise • Safety	• Citizen Involvement • **Land Use Planning** • Agricultural lands • Forest lands • **Natural Resources, scenic and historic areas, open space** • Air, water and land resources quality • Areas subject to natural hazards • Recreational needs • Economic development • **Housing** • Public facilities and services • **Transportation** • Energy conservation • Urbanization • Willamette river greenway • Estuarine resources • Coastal shorelands • Beaches and dunes • Ocean resources	• **Land use** • **Housing** • Capital facilities • Utilities • Rural areas • **Transportation** • Economic development • **Parks and Recreation**

It is the differences in the planning systems of these states that are of interest to this study. Oregon and Washington require both cross-jurisdictional coordination in comprehensive planning (horizontal consistency) and compliance with state mandates (vertical consistency). California requires neither. While California and Oregon both require local plans to be formally adopted, Washington does not. Most important, while California and Oregon require hazard elements in comprehensive plans, Washington does not ("General State Planning Legislation…" 2009). I have provided a more detailed state-by-state analysis below to explore and compare these differences further.

<u>California</u>

Compared to Oregon and Washington, California has strong mandates for hazards planning and moderately strong land use planning laws. It requires all cities and counties to adopt general plans (hereafter referred to as comprehensive plans— to be consistent with Oregon and Washington) that include seven required elements (listed in Table 3.1). The requirements for each element are rigidly defined by state law, which must include goals, objectives, policies and implementation measures of increasing specificity ("General Plan Guidelines…" 2003).

California explicitly states the purpose of comprehensive plans as being for the "physical development of the county or city, and of any land outside its boundaries which in the planning agency's judgment bears relation to its planning" (Cal. Gov. Code 65300…" 2011). Importantly, however, while certain general plan elements are required by the state, its statewide land use planning system does not involve compliance integration with state growth management goals in the same way as the other states in this study (Schwab 2010).

California's core mandate for hazard mitigation in local comprehensive planning is the required Safety Element in comprehensive plans. This element is required in comprehensive plans of all local governments, and it must address seismic, flood, fire and landslide hazards and ways to mitigate them ("General Plan Guidelines…" 2003). This safety element is composed of several state laws addressing hazard mitigation, yet there are still several separate state laws mandating hazard mitigation beyond this element; mainly addressing earthquake and wildfire hazards (Schwab 2010). Furthermore, taking the incentive rather than regulatory approach, Assembly Bill 2140 was passed in California in 2006. This bill provides post-disaster assistance to local governments that have integrated their HMPs with the safety element of their comprehensive plans. However, few communities have reportedly followed through on this incentive (Schwab 2010).

Oregon

Compared to California and Washington, Oregon has both a strong mandate for hazards planning and a strong land use planning system. All cities and counties in Oregon are required to adopt comprehensive plans, along with zoning ordinances to implement them. These plans must address a local government's future land use and associated issues, and comply with each of the state's 19 planning goals. They generally contain two parts; one providing background information and data, and the other laying out policies and implementing measures that are put into effect to achieve the plan's objectives ("Oregon's Statewide…" 2010). It is fair to conclude that Oregon has the strongest, most top-down land use planning system of these three states.

Oregon's Statewide Planning Goal 7 addresses natural hazards, and is among the strongest hazard planning mandates in the country (Schwab 2010). Goal 7 requires comprehensive plans to provide inventories, policies and measures to reduce the risk of hazards. Hazards addressed must include floods, landslides, earthquakes, wildfires and, where applicable, tsunamis and coastal erosion. Oregon's Goal 7 guidelines suggest several implementation considerations to be included in comprehensive plans, including emergency access, stormwater management and compliance with the National Flood Insurance Program. It is important to mention, however, that unlike California's Safety Element, Goal 7 does not explicitly mandate a hazards *element*; only compliance with a state goal ("Goal 7: Areas Subject to Natural Hazards…" 2002). Comparing Oregon to other states, Schwab (2010) states that, "Oregon focuses considerably greater attention on the problem of natural hazards," thanks in large part to strong guidance provided by its Department of Land Conservation and Development on how to address hazard mitigation in comprehensive plans (29-30).

Washington

Compared to California and Oregon, Washington has a fairly weak hazard planning mandate and a moderately-strong statewide planning system. The statewide planning system in Washington allows for greater power among local governments over local land use decisions. The 1990 Growth Management Act (GMA) requires counties with populations over fifty

thousand people, or that had more than a seventeen percent rise in population growth in the previous 10 years, to adopt comprehensive plans ("Chapter 36.70A RCS," 2010). Counties required to plan under the GMA must develop county-wide planning policies, adopt urban growth boundaries, and adopt the implementation measures to carry out their plans ("Chapter 36.70A RCS," 2010).

While not an explicit mandate for hazard mitigation, local governments in Washington are required to designate "critical areas" ("Growth Management"). The Washington State Department of Community, Trade and Economic Development (CTED) identifies five types of critical areas that must be identified in comprehensive plans, including wetlands, aquifer recharge areas, frequently flooded areas, geologically hazardous areas, and wildlife conservation areas. Counties are required to develop conservation policies in their comprehensive plans to protect these areas, and adopt development regulations to carry out these policies. As long as adverse impacts to critical areas are mitigated, the basic functions of critical areas are preserved and destruction of critical areas justifies with so-called "best available science," counties are given plenty of leeway in the ways and extent to which critical areas are regulated and protected ("Critical Areas Assistance Handbook: Protecting Critical Areas…," 2003). There is some disagreement over whether Washington State's critical area planning requirement is or is not a "mandate" for hazards planning. Schwab (2010) clearly shows that it is not (25-26), while Godschalk et al. (2003) explicitly states that it is (735). Regardless, the mandate for hazard mitigation in Washington is not as comprehensive or well-defined as the mandates in California and Oregon.

Procedures Part II: Filtering Action Items

The results of the state planning and hazard mandate assessment helped guide the second part of my study. There were 1512 mitigation action items among the 40 HMPs in this study. These action items addressed 32 hazards, and addressed a wide range of issues related to hazard mitigation. To show how they were integrated with comprehensive plans, I developed similar yet slightly modified filters for determining which action items could conceivably be addressed through comprehensive plans in California, Oregon and Washington. Influenced by the state-by-state assessment above, I considered five important action item attributes in determining whether the action was appropriate to be scored.

- **Whether the action was hazard mitigation**
  This was based on the important distinction, as described by Basher (2008) and Sparks (2007), that needs to be drawn between hazard *mitigation* and disaster *response*.
- **Whether the action related to the state land use planning system's central purpose**
  This was based on the purpose of local comprehensive planning as stated in the state comprehensive planning guidelines.
- **Whether an action was related to at least one of the required elements of comprehensive plans in a state**
  This was intended to remove action items that had no relationship to the purpose of land use planning in the state.
- **Whether the action addressed floods, earthquakes, wildfires, wind and/or winter storms, droughts, or multiple hazards**
  This was intended to remove action items that addressed hazards I chose not to include in this study. For example, avalanches are only hazards in mountainous counties, tsunamis and coastal erosion are only hazards in coastal counties, and volcanic eruptions are

hazards confined to counties with, near or downwind from volcanoes. Also, despite the prevalence of landslides in the western half of these three states, I excluded actions related to landslides due to their low prevalence in the eastern halves of these states ("Natural Hazard Mitigation: Various…" 2007, 23).

- **Whether the action could be addressed through a policy or implementation action of a comprehensive plan**
  This was intended to remove action items that could not be included in a comprehensive plan based on the scale of its focus. It was based on the characterization of comprehensive planning in each state. All three states require policies or implementation actions that are addressed at a scale similar to mitigation actions in HMPs.

If an action item failed to meet all five criteria, it was not included as part of the content analysis, and was not scored for the degree to which it was integrated with local comprehensive plans.

Procedures Part III: Scoring Scheme for Item Integration with Comprehensive Plans

My scoring scheme was influenced by a strategy for adopting content analysis to the review of local plans developed by Norton (2008). In reviewing other plan content analysis schemes, Norton (2008) found that a common practice used in identifying whether plans addressed certain themes was to score plan policies as "0," "1," or "2" based on whether a theme was not mentioned, partially mentioned or mentioned in detail. The intensity of this integration was determined was by assessing whether a policy used "exhortatory" statements or "prescriptive" statements (Norton 2008, 433-434). In my study, for example, following Norton (2008) I distinguished between policies that used "should" instead of "will" in describing a intended activity (Norton 2008, 449). A complete list of these prescriptive versus exhortatory distinctions I made for all plans is shown in Appendix IV.

In practicality, carrying out my content analysis required some deviation from suggestions in existing content analysis literature. Among literature by Weber (1985), Berke and Godshchalk (2009) and Norton (2008), content analysis was always used to search for a small set of themes or ideas among various kinds of texts. For example, Berke and Godschalk described a method for conducting a comparative plan study, yet only described comparing one concept between them, such as "sustainable development" (Berke and Godschalk 2009, 237). In my study, each action item could be considered its own "concept" or "theme." This required a different approach. To reflect the large variety of action items and the different ways they could be addressed in comprehensive plan policies, I used the following scoring scheme for this study.

0: If the object of an action, in context, was not mentioned in a comprehensive plan policy or implementation measure

1: If the object of an action, in context, was partially or indirectly mentioned in an exhortatory way in a comprehensive plan policy or implementation measure

2: If the object of an action, in context, was partially or indirectly mentioned in a prescriptive way in a comprehensive plan policy or implementation measure

3: If the object of an action, in context, was fully and directly mentioned in an exhortatory way in a comprehensive plan policy or implementation measure

4: If the object of an action, in context, was fully and directly mentioned in a prescriptive way in a comprehensive plan policy or implementation measure

Following Weber's (1985) steps, I first defined my recording units as "sentences" within comprehensive plans— or, in this case, policies. This required taking the objects or other representative words, parts of words and variations of words from each action item (such as "levee," "insurance," "wind" or "stormwater" and "storm water"), and using these to search for policies addressing action items. I then scored each action item by its representation of different levels of integration between HMP action items and comprehensive plan policies or actions. Next, taking me halfway through Weber's steps, I tested this scheme on a sample of plans not used in my study and then began carrying out my content analysis on plans in my study—making a few revisions after scoring the first few plans (Weber 1985, 23-24).

Analysis

My analysis involved three broad steps, including the development of HMP and comprehensive plan integration scores for each state and county, an assessment of these scores overall and by state, and an assessment of how they relate to local vulnerability. After filtering the action items, and after fully developing my scoring strategy, I scored all remaining action items from 0 to 4 based on how well they were integrated with comprehensive plans. This involved using key search terms that represented the objects of mitigation actions to find comprehensive plan policies that included those terms. To determine county-by-county scores from this analysis, I followed the strategy suggested by Norton (2008) and Berke and Godschalk (2009); I added up the scores for each action item in the county and divided them by the total possible score. To determine the state scores, I added up the total scores from each county in the state and divided them by the sum of total possible scores from each county.

In assessing the results, I provided a hazard-by-hazard breakdown of all action items assessed in this study, as well as those that were used for the content analysis. Related to my first research question I looked at a score-by-score breakdown of action items by state and hazard type. I also showed how these results varied by the category of action items they fell under. FEMA suggests that action items can be grouped into six possible categories, which include, prevention, property protection, public education and awareness, natural resource protection, emergency services and structural projects ("Developing the Mitigation Plan…" 2003). I provided an interpretation of these action item categories that was adapted to this study, shown in Appendix III. To answer my question about the extent of integration, I looked at the overall integration scores, as well as integration scores by state.

To answer my question about the impact of local hazard vulnerability on local HMP implementation, I conducted a statistical analysis, using SPSS software, to determine whether a statistically significant correlation exists between the county integration scores and the hazard vulnerability of each county. For the integration scores, I used the standardized scores from the content analysis based on all action items in all counties, as well as standardized scores for counties of only the action items that received a score of at least 1 (so I excluded actions that received a score of zero). I conducted a bivariate analysis of both kinds of scores with three measures of local hazard vulnerability in each county. One was county-identified vulnerability for each county as shown in each state's hazard mitigation plan ("2010 State of California…" 2010; "State of Oregon Natural Hazards…" 2009; "Washington State Enhanced…" 2010). For each state, this self-identified vulnerability was shown merely as "high," "medium" or "low"—either aggregated for all hazards or for each hazard individually. I made high= 3, medium= 2 and low= 1. If these designations were given to each hazard individually, I averaged the scores for each hazard that was relevant to this study. For the other two measures of vulnerability, I used

the number of federally declared disasters in each county since 1953 (when this data was available) and since 2000, to show how more recent hazard experience might affect this relationship ("FEMA Disaster Declarations Summary" 2011). I analyzed these two variables in the search of statistically significant relationships between them.

Limitations

Several aspects of this study limit its ability to be more than exploratory, or more than a source of general guidance to planners, or simply a starting place for further research. The biggest limitation is that comprehensive plans do not reflect the only way HMP mitigation actions can be implemented. While addressed with the use of action item filters, and even though comprehensive plans tend to be at the top of the local planning hierarchy, some mitigation actions could have been integrated into other local plans, like subdivision ordinances and capital improvement plans. Another major limitation is that the large difference in the number of mitigation actions per state and per plan could be greatly influencing their integration scores. When a mitigation activity less-suited for comprehensive plan integration is broken into many actions, the forces leading to a lower integration score are compounded many times. Furthermore, I only considered two aspects of local hazard vulnerability; both vulnerability that was self-identified by counties, and federally declared disasters as a proxy for local vulnerability. There are certainly more measures of hazard vulnerability, as well as many more local influences that could affect state-to-state implementation of HMPs. Finally, I was the only person who carried out this content analysis. Weber (1985) and Norton (2008) suggest using multiple scorers when carrying out content analysis to assess how replicable the method is. This option was not available to me in carrying out this project. Ideally, future studies using or adapting my methodology will carry out this scoring with two or more scorers.

Chapter 4: Results

Action Item Filter Results

There were 1512 mitigation actions among the 40 counties for which I scored the integration of HMPs and comprehensive plans. They addressed 32 different hazards; both natural and manmade. Full results for all counties are found in Appendix II. Table 4.1 provides a breakdown of all of these action items. The rows of hazards that were included in this study, as explained and justified in the procedures part II section of the methodology chapter, are highlighted.

Table 4.1: Total Mitigation Actions by State and Hazard

Hazards Addressed	CA	OR	WA	Total	% of Total
Multi-Hazard*	71	112	128	311	20.6%
Flood	110	81	87	278	18.4%
Wildfire	117	70	27	214	14.2%
Earthquake	62	76	49	187	12.4%
Winter Storm/Windstorm	31	94	23	148	9.8%
Drought	20	13	7	40	2.6%
Landslide	29	46	6	81	5.4%
Tsunami	23	10	17	50	3.3%
Terrorism	34	4	6	44	2.9%
Dam Failure	21	7	0	28	1.9%
Volcanic Eruption	1	16	9	26	1.7%
Utility Loss	14	6	0	20	1.3%
Biological Threat	13	0	0	13	0.9%
HazMat	1	7	0	8	0.5%
Insect	8	0	0	8	0.5%
Fish Loss	7	0	0	7	0.5%
Avalanche	4	0	2	6	0.4%
Expansive Soil	0	6	0	6	0.4%
Area Wide	5	0	0	5	0.3%
Agricultural Disruption	4	0	0	4	0.3%
Levee Failure	4	0	0	4	0.3%
Water Disruption	4	0	0	4	0.3%
Technological	3	0	0	3	0.2%
Special Events	3	0	0	3	0.2%
Transp/Pipeline Accident	3	0	0	3	0.2%
Coastal Erosion	0	3	0	3	0.2%
Erosion	3	0	0	3	0.2%
Economic Disruption	1	0	0	1	0.1%
Heat	1	0	0	1	0.1%
Fog	1	0	0	1	0.1%
Pest	1	0	0	1	0.1%
Soil Settlement	0	0	1	1	0.1%
Total	599	551	362	1512	100.0%
% of Total	39.6%	36.4%	23.9%	1	

*Note: Multi-hazard action items address two or more hazards.

Table 4.1 reveals that the six hazards addressed by action items in this study make up the vast majority of hazards addressed by all actions in this study; about 78 percent of all actions. This supports the appropriateness of choosing these six hazards for inclusion in this study.

As described in Chapter 3, this filter determined which action items could conceivably be integrated into comprehensive plans, and therefore which were appropriate for scoring in this project. The filter was based on five criteria for California and Washington, and four criteria for Oregon; also listed in Chapter 3. Of the 1512 mitigation action items among the forty counties, 812 met all of the filter criteria; 54 percent of all action items. Table 4.2 provides a breakdown of these action items.

Table 4.2: Scored Action Items (those that passed the filter)

Hazards Addressed	CA	OR	WA	Total	% of all Action Items for Hazard	% of all Action Items
Flood	78	74	64	216	78%	26.6%
Multi-Hazard	43	63	61	167	54%	20.6%
Wildfire	76	51	18	145	68%	17.9%
Earthquake	41	66	37	144	77%	17.7%
Winter Storm/Windstorm	19	80	16	115	78%	14.2%
Drought	11	11	3	25	63%	3.1%
Total	268	345	199	812		100.0%
% of Total	33.0%	42.5%	24.5%	100.0%		

Of action items that passed the filter and were analyzed for their integration with comprehensive plans, roughly one-quarter addressed floods, one-fifth addressed multiple hazards and half addressed either earthquakes, winter storms or wildfires. Filtered action items for all hazards accounted for between two-thirds and four-fifths of all action items for that hazard. Furthermore, 33 percent of filtered actions were in California, 42 percent in Oregon and 25 percent in Washington.

A more meaningful way to show these totals is presented in Table 4.3 which shows the average number of total actions verses filtered actions per HMP by state.

Table 4.3: Average Action Items per HMP, and the % lost through the filter, per state

	Average # of Total Actions per plan	Average # of Filtered Actions per plan	% of action items lost through filter
CA	37.4	16.8	55.3%
OR	50.1	31.4	37.4%
WA	27.8	15.3	45.0%

Table 4.3 reveals that HMPs in Oregon had, by far, the most action items per plan among the three states, as well as the lowest share of total action items filtered out. This combination of factors led to Oregon having twice as many action items passing the filter and receiving a score as both California and Washington.

Action Item Filter Discussion

There are two important reasons why Oregon had twice as many action items passing the filter and receiving a score than both California and Washington, and that California lost the most through the filter. One is that Oregon had four filter categories, while California and Washington had an additional category that addressed whether an action was explicitly related to land use planning or a county's physical development. These characteristics— both explicitly

stated in the comprehensive planning guidelines for California and Washington, yet not for Oregon— as well as the much narrower range of plan elements in California and Washington compared to Oregon, reflect a narrower focus of comprehensive plans in those two states. This narrower focus led me to exclude more actions in California and Washington from the scoring step of my study.

Another reason is that California had far more actions addressing hazards outside the scope of this study than Oregon or Washington; accounting for 30 percent of all actions in California, 19 percent in Oregon and 10 percent in Washington. This led to more actions being excluded for this reason in California. This is reflected in the broader range of actions items in California. Of the 32 types of hazards addressed by actions in all three states, 29 were addressed in California, 15 in Oregon, and 12 in Washington.

Overall, the filter results might suggest that HMP actions in Oregon counties have more ways to be addressed through comprehensive plans than those in California and Washington. However, a large share of actions in all states was lost by simply not meeting the criteria I set for this project. This makes it difficult to discern much meaning from how many actions were excluded per state, and makes the biggest reasons for the drastically larger difference between action items excluded in California verses Oregon hard to determine.

Research Question 1 Results

How, and to what extent have the desired outcomes of hazard mitigation plans been integrated with local comprehensive plans since the DMA, both overall and under different state mandates for natural hazards planning?

To understand the action item scoring results as they relate to the first research question, it is important to conceptualize what each score represents. Table 4.4 provides examples from my study of action items that received five different scores, giving a snapshot of the types of reasoning that went into deriving integration scores for over 800 HMP actions.

Table 4.4: Examples of Scoring System and Reasoning for each Score

Score	HMP Action Item	Comprehensive Plan Policy	Explanation
4	"Create comprehensive geological mapping of the County to identify earthquake faults, liquefaction and landslides."	"Maintain and add to the GIS database prepared for this element with the purpose of improving the quality of the geologic and fault mapping within jurisdictional boundaries to incorporate new and updated information…"	This policy addresses the updating of a GIS database for geologic mapping in the county, which fully encompasses the object of this action. It is written as a command, which makes the integration of the action and policy prescriptive.
3	"Protect utility lifelines (water, power, communications, etc.) by concealing, burying, or encasing."	"Under grounding of all utilities should be encouraged where feasible, particularly in newly developed areas"	The burying of utilities is directly addressed by this policy, yet the terms "should" and "encourage" make the integration of the action and policy exhortatory, rather than prescriptive.
2	"Review recognized flood-prone areas and match to exposures of personnel, facilities and equipment."	"The County shall identify and delineate flood prone study areas discovered during the completion of the master drainage studies or plans." / "No new critical or high occupancy structures (e.g., schools, hospitals) shall be located in the 100-year floodplain of any river, stream, or other body of water."	These policies recognize flood prone areas and match them to the exposure of specific development types (critical or high occupancy), yet not in a way that addresses each part of this action (personnel, facilities and equipment). The use of "shall" makes the integration of the action and policy prescriptive.
1	"Adoption of construction codes for the use of more fire resistant building materials"	"Review and consider the adoption of the International Fire Code Council Urban Interface Model Code for new development projects in wildland urban interface areas."	This policy addresses a fire code for new developments, but this may or may not encompass fire resistant materials- so this relationship is indirect. Also, the use of "consider" makes the integration of the action and policy exhortatory, rather than prescriptive.
0	"Participate in National Flood Insurance Program"	NA	There was no mention of the NFIP or flood insurance in this comprehensive plan.

Table 4.5 reveals the results of this scoring system for all 40 counties in this study.

Table 4.5: Summary of Integration Scoring Results by County

State	County	Filtered Actions	Total Possible Score	Total Score	Integration Score	Integration Scores for Actions with some level of integration
CA	Amador	9	36	14	0.39	0.58
CA	Butte	13	52	17	0.33	0.71
CA	El Dorado	7	28	10	0.36	0.63
CA	Humboldt	49	196	70	0.36	0.73
CA	Imperial	6	24	2	0.08	0.50
CA	Kings	20	80	32	0.40	0.80
CA	Lake	25	100	39	0.39	0.70
CA	Marin	7	28	20	0.71	0.83
CA	Mendocino	24	96	27	0.28	0.61
CA	Napa	20	80	17	0.21	0.61
CA	Nevada	14	56	27	0.48	0.68
CA	San Luis Obispo	9	36	14	0.39	0.88
CA	Sutter	8	32	2	0.06	0.50
CA	Tuolumne	15	60	32	0.53	0.89
CA	Yolo	12	48	19	0.40	0.59
CA	Yuba	30	120	55	0.46	0.76
OR	Benton	25	100	16	0.16	0.57
OR	Columbia	27	108	8	0.07	0.50
OR	Deschutes	7	28	6	0.21	0.50
OR	Douglass	33	132	22	0.17	0.61
OR	Jackson	26	104	24	0.23	0.60
OR	Josephine	17	68	8	0.12	0.67
OR	Klamath	42	168	16	0.10	0.57
OR	Lincoln	15	60	10	0.17	0.50
OR	Linn	25	100	10	0.10	0.63
OR	Polk	57	228	24	0.11	0.55
OR	Yamhill	71	284	18	0.06	0.64
WA	Benton	4	16	9	0.56	0.56
WA	Chelan	17	68	10	0.15	0.50
WA	Clallam	13	52	2	0.04	0.50
WA	Cowlitz	8	32	0	0.00	0.00
WA	Franklin	10	40	7	0.18	0.88
WA	Island	6	24	2	0.08	0.50
WA	Kitsap	29	116	20	0.17	0.56
WA	Lewis	15	60	5	0.08	0.63
WA	Mason	24	96	19	0.20	0.59
WA	Skagit	6	24	7	0.29	0.44
WA	Thurston	7	28	15	0.54	0.75
WA	Walla Walla	34	136	16	0.12	0.57
WA	Whatcom	26	104	13	0.13	0.46

Table 4.5 makes clear that there were a wide range of filtered and scored action items per county, as well as a wide range of integration scores. However, the last column shows that these scores by county were quite different when only scoring action items that had *some* level of integration with comprehensive plans.

The integration of HMPs and comprehensive plans can be broken down in many ways. Table 4.6 provides overall results showing the intensity with which mitigation action items were integrated with comprehensive plans.

Table 4.6: Level of HMP Integration with Comprehensive Plans, by State

Types of Action Item Integration with Comprehensive Plans	% of CA Actions	% of OR Actions	% of WA Actions	% of All Actions
Fully, Directly and Prescriptively Integrated (score = 4)	20.9%	3.8%	3.5%	9.4%
Fully, Directly and Exhortatively Integrated (score = 3)	5.2%	0.6%	4.5%	3.1%
Partially/Indirectly and Prescriptively Integrated (score = 2)	22.8%	14.2%	15.6%	17.4%
Partially/Indirectly and Exhortatively Integrated (score = 1)	3.4%	1.7%	4.0%	2.8%
Not Integrated at all (score = 0)	47.8%	79.7%	72.4%	67.4%

These results reveal that among all three states, two-thirds of mitigation actions were not integrated with county comprehensive plans. Of those that were, most were addressed partially or indirectly, yet prescriptively. Regardless of whether action items were fully or partially integrated, the vast majority were integrated in a prescriptive rather than exhortatory way. At the state level, only half of action items were integrated with comprehensive plans in California, yet this is far more than in Oregon or Washington, where roughly one-quarter were integrated. For action items that were integrated, the results showing how the intensity of this integration varies closely match the overall results. One exception is in California, where a much higher percentage of action items were fully integrated than in Washington and Oregon.

These same integration intensity results are shown by hazard in Table 4.7.

Table 4.7: Level of HMP Integration with Comprehensive Plans, by Hazard

Types of Action Item Integration with Comprehensive Plans	% of Drought Actions (n=25)	% of Earthquake Actions (n=144)	% of Flood Actions (n=216)
Fully, Directly and Prescriptively Integrated	20.0%	6.3%	11.1%
Fully, Directly and Exhortatively Integrated	4.0%	4.2%	2.8%
Partially/Indirectly and Prescriptively Integrated	20.0%	18.8%	19.0%
Partially/Indirectly and Exhortatively Integrated	4.0%	1.4%	2.8%
Not Integrated at all	52.0%	69.4%	64.4%

Types of Action Item Integration with Comprehensive Plans	% of Winter Storm Actions (n=115)	% of Wildfire Actions (n=145)	% of Multi-Hazard Actions (n=167)
Fully, Directly and Prescriptively Integrated	3.5%	12.4%	9.6%
Fully, Directly and Exhortatively Integrated	0.9%	6.2%	1.2%
Partially/Indirectly and Prescriptively Integrated	8.7%	20.0%	17.4%
Partially/Indirectly and Exhortatively Integrated	0.0%	6.2%	3.0%
Not Integrated at all	87.0%	55.2%	68.9%

Table 4.7 reveals that, out of the six hazard types, the action items addressing drought and wildfire had the highest percentage of integrated action items, at roughly one-half. Action items addressing winter storms had the lowest percentage of integrated action items, at only 13 percent. The pattern of integration intensity among these hazards was roughly the same as the pattern for all hazards overall, as the vast majority of HMP actions addressing all hazards were integrated prescriptively, with more partially or indirectly integrated than fully and directly integrated.

Integration scores were also assessed based on different categories of action items recommended by FEMA. These results for all three states are shown in Table 4.8.

Table 4.8: HMP Integration Scores by Action Item Category, by State and Total

	CA		OR		WA		All States	
Action Type	**% of Action Items**	**Int. Score**	**% of Action Items**	**Int. Score**	**% of Action Items**	**Int. Score**	**% of Action Items**	**Int. Score**
Emergency Services	5%	0.46	3%	0.05	6%	0.06	4%	0.21
Natural Resources	6%	0.34	4%	0.21	6%	0.40	5%	0.32
Prevention	29%	0.42	36%	0.13	25%	0.25	31%	0.24
Public Edu./Awareness	3%	0.46	3%	0.04	1%	0.50	2%	0.21
Property Protection	33%	0.34	46%	0.10	38%	0.09	40%	0.16
Structural Protection	25%	0.32	7%	0.15	24%	0.13	17%	0.23
Total	100%	0.37	100%	0.12	100%	0.16		

Table 4.8 first reveals that most action items scored addressed preventative measures, property protection or structural protection. Most interestingly, it reveals very little variation among integration scores of different types of action items. This suggests that the extent to which counties integrate action items with comprehensive plans is not dependent on the category which that action item falls into.

Table 4.8 also reveals that the results by action item category show more variation when assessed by state. The proportion of action items in each category for each state closely followed the proportions among all three states. In-terms of the integration scores, there was hardly any variation by category in California and Oregon, while there was dramatic variation in scores by category in Washington.

Finally, state integration scores were calculated by dividing the total integration score for each state (a sum of total integration scores for each county) by the total possible integration score for each state (a product of the number of action items in the state and an integration score of four). Integration scores by state are shown in Table 4.9.

Table 4.9: HMP Integration Scores by State

State Results for HMP Integration with Comprehensive Plans			
	Total Possible Score	**Actual Total Score**	**State Integration Score**
CA	1072	397	0.37
OR	1380	162	0.12
WA	796	125	0.16

Table 4.9 reveals that California has the highest state integration score of .37, which is 136 percent higher than Washington's integration score and 215 percent higher than Oregon's integration score. It is important to highlight that Oregon had the highest number of scored action items (345) despite having the fewest counties, as well as the highest number of action items per county (31). Washington had the fewest number of action items (199) and the fewest action items per county (15).

These results suggest that a large majority of the desired outcomes of HMPs— HMP mitigation actions— are not being integrated at all with county comprehensive plans. When they are integrated, they are usually integrated into comprehensive plans only partially or indirectly, however most often in a prescriptive way. In other words, while overall HMP integration is low, those that are integrated may carry some weight.

Research Question 1 Discussion

I identified four meaningful findings related to my first research question. The first is that, overall, HMP actions that were integrated with comprehensive plans were almost always integrated prescriptively; with wording that suggests strong intent to be acted upon. However, as demonstrated in Tables 4.6 and 4.7, this prescriptive integration was most often for partial or indirect relationships between the two plans. This is evidence that this integration might not be intentional; that counties are not necessarily addressing HMP actions through comprehensive plans *because* of their HMPs. In other words, evidence of HMP actions in comprehensive plans might be due to several reasons other than having been identified in an HMP.

A second finding is that there were large differences in the levels of action item integration by hazard, especially between actions addressing wildfires and droughts (with the highest degree of integration) and winter storms (with the lowest degree of integration). This is opposite of what I expected. Many of the winter storm action items are related to snow and ice removal on roads, or roadside trees and utilities. Here are two examples of such actions from Humboldt County, California: "*Designate snow routes and strengthen critical road sections and bridges*" and "*trim trees back from power lines*." It stands to reason that these action items are more likely to be addressed in the transportation or utility elements of comprehensive plans, as well as hazard elements. While I can't fully explain why this result occurred, it may provide some support to the power of state mandates that centralize hazard policies in one place in the comprehensive plan. In California, wildfire actions were usually concentrated in the safety elements, since they were one of the hazards that these elements had to address. Such a mandate does not exist in any of these states for winter storm hazards to be addressed in other plan elements, such as in the utility or transportation elements of comprehensive plans. In addition, it could be that the specific nature of winter storm action items are less likely to be integrated into comprehensive plans. Instead, they might be better integrated into a local emergency operations plan, or implemented right away (since tree trimming and de-icing is presumably already well engrained in the ongoing operations of counties).

A third finding is that, while HMP integration scores showed little variation based on the six FEMA-suggested categories that action items fell into, the number of scored action items varied greatly by category— with most addressing either hazard *prevention* through development regulations, or *property protection* to reduce hazard vulnerability. An example of an action item addressing prevention is as follows: "*Review and revise, as needed, existing wildland fire related codes and ordinances to address the recognized hazards of building and living in the wildland urban interface*." It is preventative because it aims to limit the vulnerability of structures to wildfires. An example of an action addressing non-structural property measures is as follows: "*analyze the feasibility of a mandatory versus voluntary seismic retrofit program for un-reinforced masonry buildings*." It relates to property protection because, while seismic retrofits don't avoid the overlap of structures and hazards, they do protect existing structures from the effects of seismic events. These results suggest that action items which can be addressed through comprehensive plans are strongly geared toward directly mitigating losses through prevention

and property protection, rather than indirectly through actions that address public education, natural resource protection or natural disaster *response* in the form of emergency services.

The most interesting finding is that, overall, most HMP action items are not being integrated into existing local planning mechanisms. This is shown in Tables 4.5 and 4.9. Until this is addressed, it will limit the power of HMPs to affect change on the ground. However, addressing the "extent" aspect of the first question, California counties showed the highest level of integration between HMPs and comprehensive plans— more than twice as much as for Washington counties, and over three times as much as for Oregon counties. These results show surprising differences among these states. With both a strong, top-down statewide planning system and a strong mandate for hazard mitigation in comprehensive plans, one would expect Oregon counties to demonstrate the highest degree of HMP integration among these states.

In examining this last result, it may be that characteristics of action items scored in Oregon are better geared toward implementation through other planning mechanisms, even if they could conceivably be addressed through local comprehensive plans. In other words, low integration does not *necessarily* mean that the HMP mitigation actions were not implemented. The more likely reason for lower scores in Oregon, however, is that the large number of actions in Oregon, compared to the other states, was a result of similar mitigation activities being broken into more actions than they would have been in other states. Having scored eleven Oregon counties, it is clear that this splitting of actions was more prominent in Oregon than California or Washington. Here are two examples of such action items from Klamath County, Oregon: "*Seek funding for the installation and operation of additional precipitation gages*" and "*seek funding for the installation and operation of additional stream gages*." While some counties might have combined the need for monitoring gages into one action, this county broke it into two. This splitting of action items causes mitigation activities less geared toward comprehensive plan integration to count against the integration scores in Oregon more than they would have in California or Washington. For instance, since no gages of any kind were mentioned in the Klamath County Comprehensive plan, this score of zero was counted against the county twice, instead of once as it might have been in another county. In other words, the affect of HMP actions not being integrated was amplified by them being split into multiple actions. There is also the possibility that another factor is at play, leading to results that are almost opposite of what one would expect.

Research Question 2 Results

How does this integration vary at the local level with respect to hazard vulnerability?

Figures 4.1 and 4.2 show how the variables of comprehensive plan-HMP integration and hazard vulnerability relate spatially. In answering this second question, I considered the integration scores for all action items, as well as those for just the action items with *some* level of comprehensive plan integration. Figure 4.1 shows a fairly similar pattern between both measures of integration scores. Beyond the higher integration scores in California, there does not appear to be a strong geographic pattern in the degree of integration scores within states.

Figure 4.2, meanwhile, does not suggest any clear geographic relationship between local hazard vulnerability and the integration scores shown in Figure 4.1.

Figure 4.1

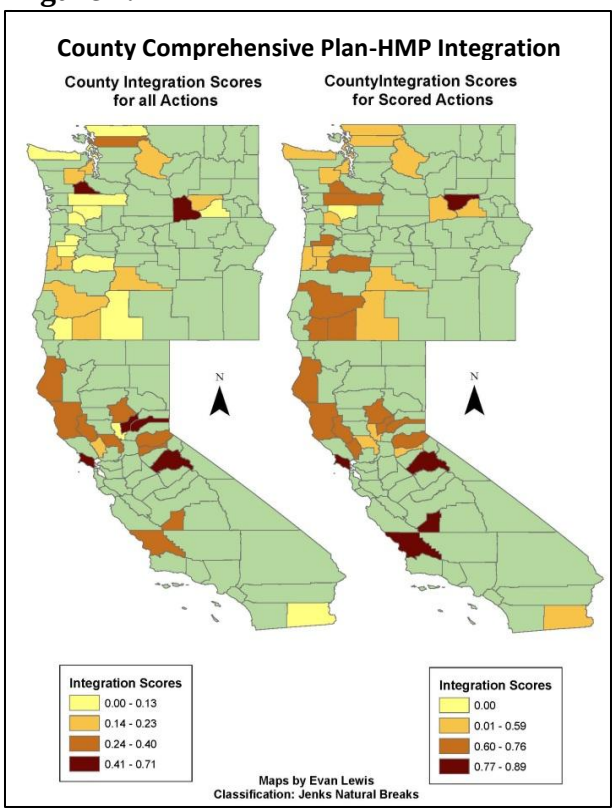
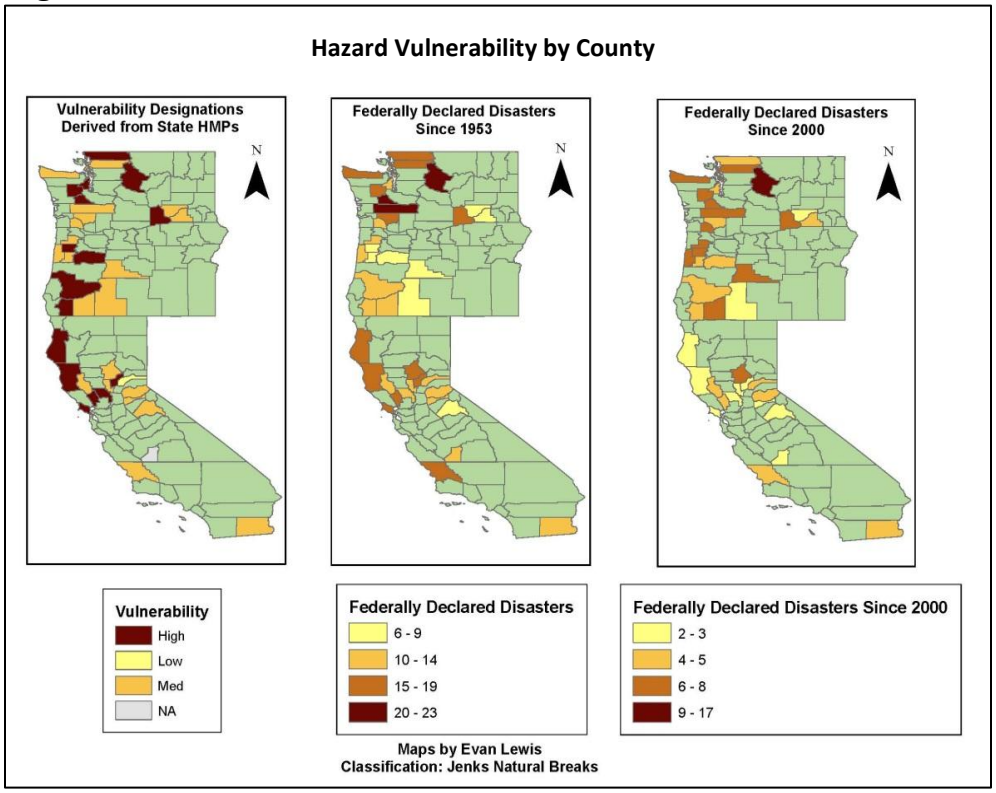


Figure 4.2



The lack of a clear relationship between HMP-comprehensive plan integration scores and various measures of hazard vulnerability variables is confirmed in Table 4.11. The three measures of hazard vulnerability are shown by county in Appendix II.

Table 4.10: Relationship between hazard integration scores and hazard vulnerability

	Plan Integration and State HMP Hazard Vulnerability Scores	**Plan Integration and Fed. Declared Disasters Since 1953**	**Plan Integration and Federally Declared Disasters Since 2000**
Pearson Correlation	0.061	0.224	-0.239
Significance (2-Tailed)	0.707	0.165	0.138
	Integrated Action Item Int. Scores and State HMP Hazard Vulnerability Scores	**Integrated Action Item Int. Scores and Federally Declared Disasters Since 1953**	**Integrated Action Item Int. Scores and Federally Declared Disasters Since 2000**
Pearson Correlation	-0.126	-0.042	-0.316*
Significance (2-Tailed)	0.438	0.799	0.047

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4.10 reveals no significant correlation between integration scores (total and for scored action items only) and any measure of hazard vulnerability, except for the integration scores for integrated actions and federally declared disasters since 2000. This one relationship suggested a statistically significant, yet weak, negative correlation between these two variables.

Research Question 2 Discussion

This one significant relationship among the six tested is opposite of what I expected, as it suggests that less integration between HMPs and comprehensive plans is associated with higher hazard vulnerability, and visa-versa. However, given that only one of these six relationships showed a significant correlation, it is fair to say that the results are inconclusive on this issue. This is mostly consistent with the literature on this topic. Due to the narrow scope of this question, it does not shed much light on the influence of local conditions on the propensity to plan for natural hazards.

The most meaningful finding that can be gleaned from these results is that no significant relationships exist between integration scores and the state HMP-identified levels of vulnerability. This could be due to the very narrow way that vulnerability was identified in these plans; identified by states as high, medium or low. If these scores were on a larger scale, they would capture a larger range of the vulnerability to these hazards, and there may have been a clearer connection between vulnerability to hazards and the propensity to plan for them.

Implications

While this study is only exploratory, some general guidance can definitely be provided to planning practitioners from the process and results of this study. The following is a list of five hazard mitigation suggestions relevant to local, state and federal planning practitioners, which come out of the findings I discussed for each research question.

Local-Level Recommendations

- **Consider whether copying the action items of other counties is appropriate**. Action items based on a template may make the HMP planning process easier, but templates can reduce critical thinking around the specific mitigation needs of communities. Repetitive-looking actions tended to be a more prominent trend in Oregon counties than California or Washington counties, although they occurred frequently in all three states. For example, the action "*encourage purchase of earthquake hazard insurance*" was found, verbatim, in four of the eleven counties in Oregon. Actions addressing "*data collection*" for "*non-declared*" hazard events were also found in four Oregon Counties. Five Oregon counties "*encourage*" underground power lines for new developments. Often, action items read as though they were being copied from other, outside guidebooks and sources, as they were often not place-specific, and quite broad. There may be situations where this is OK (such as for neighboring counties with similar characteristics) but counties should carefully consider whether copied and pasted actions are truly being used with the intention of implementing them.

- **Avoid broad and redundant action items that are difficult to assign or measure**. Broad and redundant action items were likely one of the contributors to low integration scores in several counties. When one action item concept with no connection to a comprehensive plan is addressed through several action items, rather than one, the integration score of zero is multiplied many times. Here are four redundant action item examples from one Oregon county:

  1) *"Develop and implement programs to keep trees from threatening lives, property, and public infrastructure during windstorm events."*
  2) *"Develop and implement programs to keep trees from threatening lives, property, and public infrastructure as a result of severe weather events."*
  3) "*Encourage harvesting of trees along utility and road corridors, preventing potential winter storm damage."*
  4) *"Identify trees that are potentially susceptible to wind throw."*

  The first two HMP actions are broad enough to capture the second two, yet the second two are more specific and measurable. All of these are quite redundant. Local planners should really examine the worth of including action items that are so broad or redundant that they cannot be relied upon to measure progress made toward HMP implementation.

- **Develop hazard vulnerability scores that reflect a larger range of vulnerability to each hazard**. This will provide a more nuanced reference for mitigation related to each hazard, and will aid in future studies like mine, providing more meaningful results. However, it would be most useful if vulnerability scores were consistent across jurisdictions and states, so "apples-to-apples" vulnerability comparisons could be made.

State-Level Recommendation

In addition to requiring mitigation elements in comprehensive plans, **states should provide more guidance that addresses the reality of HMPs, and ways they can be incorporated into local comprehensive plans.** All three states require local comprehensive planning, and two of them require hazard goal-compliance or elements for comprehensive plans. However, guidance for both comes from two different sources; comprehensive plan guidance comes from the states, and HMP guidance comes from the federal government. Comprehensive planning guidelines in all of these states fail to address both local mitigation plans under the DMA, as well as how such plans can be integrated with comprehensive plans. This is likely one reason why the strength of state mandates for local hazard mitigation did not have the effect on overall integration scores that I expected for each state. If the HMPs were addressed in the guidelines local governments already follow when amending their comprehensive plans, the integration of these two documents might become better engrained in local comprehensive planning practices. States should acknowledge the reality of HMPs, interpret HMP requirements as they are relevant to local comprehensive planning and incorporate them into state comprehensive planning guidelines.

Federal-Level Recommendation

The DMA should require communities to show that HMP actions were incorporated into local comprehensive plans prior to HMP-approval. As clearly demonstrated in my results, most of the action items integrated into comprehensive plans were only partially or indirectly integrated. This fact, and the overall low integration scores among these three states, is evidence that HMP outcomes are not driving local governments to amend their comprehensive plans with new hazard mitigation priorities. If HMP approval was contingent on such amendments, local governments would find more ways to incorporate new mitigation priorities with existing planning priorities. If this requirement is added now, the integration of these two documents should be stronger in all of the FEMA-required plan updates that will take place in the next few years.

Suggestions for Future Research

This study could be used as a starting point for other areas of research on the effectiveness of hazard mitigation planning in a post-DMA planning context. I can identify four important opportunities to follow up on this exploratory analysis:

1) Case studies of hazard mitigation in Oregon and California could help determine why the results for part of my first research question were opposite of what was expected.
2) This study could be expanded to other local plans, such as CIPs, zoning ordinances, and subdivision regulations. This could lead to a more complete understanding of the extent to which HMP actions are implemented through existing planning mechanisms.
3) My second research question could be expanded to show how local HMP integration varies by available funding, community size, and other local attributes.
4) My methodology could be used as a starting point for adapting policy content analysis for the analysis of large numbers of actions and/or policies, and showing how they are included in other plans.

Chapter 5: Conclusion

This study analyzed outcomes of a new hazard mitigation policy, the DMA, by exploring how mitigation actions are integrated with existing planning mechanisms. It explored how this varies under different state mandates for hazard mitigation, and different levels of local hazard vulnerability. Through a hybrid content analysis method adapted for the integration of two local planning documents, I was able to assess, among dozens of counties in three states, how HMPs have been integrated with comprehensive plans. The results reveal an overall low degree of integration between HMPs and comprehensive plans, yet with significant variation by state, hazard types, and types of action items. Furthermore, they bear little relationship to the extent of hazard vulnerability that communities face. The characteristics of action items themselves provide clues in understanding these results, and lead to ideas for practitioners that can improve the integration of these plans in the future. In addition, this first-time attempt at scoring the integration of several actionable elements of two planning documents opens several avenues for future research on the integration of these, and other planning documents. The outcomes of this project are a narrowly focused, yet important step toward understanding and improving local hazard mitigation planning, so communities can put *mitigation in motion*, and maximize their resilience to the hazards they face.

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Appendices

Appendix I

Key Facts for Sampled Counties

State	County	Population (2005-2009 American Community Survey)	Year of 1st HMP	Year Comp. Plan last Amended	# of Scored HMP Action Items
CA	San Luis Obispo	262,149	2005	2010	9
CA	Marin	246,711	2006	2007	7
CA	Butte	217,917	2007	2010	13
CA	Yolo	192,974	2004	2009	12
CA	El Dorado	175,941	2004	2004	7
CA	Imperial	160,034	2007	2008	6
CA	Kings	146,696	2007	2010	20
CA	Napa	132,173	2004	2008	20
CA	Humboldt	129,003	2008	2010	49
CA	Nevada	97,063	2006	2010	14
CA	Sutter	90,731	2007	2010	8
CA	Mendocino	86,030	2007	2010	24
CA	Yuba*	70,906	2007	2011	30
CA	Lake	64,756	2005	2008	25
CA	Tuolumne	55,761	2004	2010	15
CA	Amador*	38,039	2006	2011	9
OR	Jackson	198,036	2006	2008	26
OR	Deschutes	151,879	2006	2009	7
OR	Linn	112,843	2005	2005	25
OR	Douglas	103,385	2003	2006	33
OR	Yamhill**	95,494	2006	2005	71
OR	Benton	81,107	2006	2008	25
OR	Josephine	80,672	2004	2005	17
OR	Polk	74,550	2006	2009	57
OR	Klamath	66,170	2007	2010	42
OR	Columbia	48,612	2005	2010	27
OR	Lincoln	45,892	2009	2009	15
WA	Thurston	239,248	2003	2010	7
WA	Kitsap	238,825	2004	2006	29
WA	Benton	192,886	2004	2009	4
WA	Whatcom	192,886	2004	2009	26
WA	Skagit	116,152	2003	2007	6
WA	Cowlitz**	99,874	2004	1996	8
WA	Island	80,723	2008	2008	6
WA	Lewis	73,459	2005	2010	15
WA	Chelan	70,668	2005	2009	17
WA	Clallam	70,208	2004	2007	13
WA	Franklin	69,757	2004	2008	10
WA	Walla Walla	57,795	2005	2007	34
WA	Mason	56,341	2004	2005	24

*****Final general plan pending approval

******Comprehensive plan last amended before HMP approved

Appendix II

Full Content Analysis Results for All Counties

State	County	Filtered Actions	Total Possible Score	Total Score	Integr-ation Score	Integrated action integration scores	Vuln. score	Fed. Decl. Dis.	Fed Decl. Dis. 2000
CA	Amador	9	36	14	0.39	0.58	2.33	11	3
CA	Butte	13	52	17	0.33	0.71	2.33	18	7
CA	El Dorado	7	28	10	0.36	0.63	2.33	12	5
CA	Humboldt	49	196	70	0.36	0.73	2.67	18	2
CA	Imperial	6	24	2	0.08	0.50	2.33	10	4
CA	Kings	20	80	32	0.40	0.80	0.00	12	2
CA	Lake	25	100	39	0.39	0.70	2.33	13	4
CA	Marin	7	28	20	0.71	0.83	3.00	17	3
CA	Mendocino	24	96	27	0.28	0.61	3.00	18	3
CA	Napa	20	80	17	0.21	0.61	3.00	16	5
CA	Nevada	14	56	27	0.48	0.68	1.33	11	4
CA	San Luis Obispo	9	36	14	0.39	0.88	2.33	16	4
CA	Sutter	8	32	2	0.06	0.50	1.67	12	2
CA	Tuolumne	15	60	32	0.53	0.89	2.33	9	2
CA	Yolo	12	48	19	0.40	0.59	3.00	11	2
CA	Yuba	30	120	55	0.46	0.76	2.67	16	3
OR	Benton	25	100	16	0.16	0.57	2.20	8	4
OR	Columbia	27	108	8	0.07	0.50	2.40	11	6
OR	Deschutes	7	28	6	0.21	0.50	2.40	9	6
OR	Douglass	33	132	22	0.17	0.61	2.55	13	5
OR	Jackson	26	104	24	0.23	0.60	2.00	10	6
OR	Josephine	17	68	8	0.12	0.67	2.60	10	5
OR	Klamath	42	168	16	0.10	0.57	2.40	6	2
OR	Lincoln	15	60	10	0.17	0.50	1.80	12	6
OR	Linn	25	100	10	0.10	0.63	2.60	9	5
OR	Polk	57	228	24	0.11	0.55	2.75	9	6
OR	Yamhill	71	284	18	0.06	0.64	2.33	11	6
WA	Benton	4	16	9	0.56	0.56	3.00	15	6
WA	Chelan	17	68	10	0.15	0.50	2.80	23	17
WA	Clallam	13	52	2	0.04	0.50	2.20	16	8
WA	Cowlitz	8	32	0	0.00	0.00	2.40	16	5
WA	Franklin	10	40	7	0.18	0.88	2.00	6	2
WA	Island	6	24	2	0.08	0.50	2.40	11	6
WA	Kitsap	29	116	20	0.17	0.56	2.60	14	5
WA	Lewis	15	60	5	0.08	0.63	2.25	22	7
WA	Mason	24	96	19	0.20	0.59	2.60	19	8
WA	Skagit	6	24	7	0.29	0.44	2.40	17	8
WA	Thurston	7	28	15	0.54	0.75	2.75	22	8
WA	Walla Walla	34	136	16	0.12	0.57	1.75	8	4
WA	Whatcom	26	104	13	0.13	0.46	3.00	16	5

Appendix III

List of HMP mitigation action categories suggested by FEMA
(Specific definitions were somewhat adapted from FEMA's for the purpose of this study)

Prevention (P): Actions dealing with land use planning and development regulations that manage development in a way that avoids adding to the county's hazard vulnerability. These included actions dealing with plan making, intergovernmental coordination, mapping and identification of hazards, and others.

Property Protection (PP): Actions dealing with the structural mitigation of existing buildings and development, both public and private, and non-structural protective measures.

Public Education and Awareness (PE): Actions aimed at increasing the public's knowledge of their vulnerability to hazards and mitigation actions they can take. This includes both signage and, in some cases, mapping.

Natural Resource Protection (NR): Actions that help protect natural systems and features.

Emergency Services (ES): Actions that protect the ability of residents to receive, and the county to provide emergency services and access.

Structural Projects (SP): Actions addressing public infrastructure projects that protect developed areas from hazards.

Appendix IV

List of action words found in comprehensive plan policies that distinguished whether an action was integrated into the policy in a prescriptive or exhortatory way.

Prescriptive	**Exhortatory**
shall	should
command statements	promote
commit and committed	support
Continue to…	encourage
will	consider
require	can
ensure	
must	
emphasize	