Yurok Tribe
Hazard Mitigation Plan
December 2013 Update

Owl Rock
Yurok Reservation

Yurok Tribe
HAZARD MITIGATION PLAN

DECEMBER 2013

Prepared for:
Yurok Tribe
P.O. Box 1027
Klamath, CA 95548

Prepared by:

TETRA TECH

Engineering & Architecture Services
1420 Fifth Avenue, Suite 600, Seattle, WA 98101-2357
Tel 206.883.9300 Fax 206.883.9301 www.tetratech.com

and

Bridgeview Consulting, LLC
Bridging the Gap in Emergency Management Services
915 No. Laurel Lane
Tacoma, WA 98406
Tel 253.301.1330 Fax 253.460.8220

Project #135-73585-12001

Yurok Tribe
Hazard Mitigation Plan

TABLE OF CONTENTS

Acknowledgments ..... **xiv**

Executive Summary **ES-1**
Plan Development Methodology ES-2
Phase 1—Organize and Review ES-2
Phase 2—Risk Assessment ES-3
Phase 3—Engage the Public ES-3
Phase 4—Assemble the Plan ES-3
Phase 5—Plan Adoption/Implementation/Assurances ES-4
Mitigation Guiding Principle, Goals and Objectives ES-4
Guiding Principle ES-4
Goals ES-4
Objectives ES-5
Mitigation Initiatives – Progress Report ES-5
Implementation and Assurances ES-7

PART 1 — THE PLANNING PROCESS

Chapter 1. Introduction to the Planning Process **1-1**
1.1 Why Prepare This Plan? 1-1
1.1.1 The Big Picture 1-1
1.1.2 Yurok Indian Tribe's Response to the DMA 1-1
1.1.3 Purposes for Planning 1-2
1.2 Who Will Benefit From This Plan? 1-2
1.3 How to Use This Plan 1-2
1.4 Guiding Principle, Goals and Objectives 1-4
1.4.1 Guiding Principle 1-4
1.4.2 Goals and Objectives 1-4

Chapter 2. Plan Development Methodology **2-1**
2.1 Planning Resource Organization 2-1
2.1.1 Grant Funding 2-1
2.1.2 Defining the Planning Area 2-1
2.1.3 Formation of the Planning Team 2-3
2.1.4 The Steering Committee 2-6
2.1.5 Coordination with Other Agencies 2-6
2.1.6 Review of Existing Programs 2-7
2.1.7 Public Involvement 2-8
2.1.8 Plan Development Chronology/Milestones 2-14
2.2 Risk Assessment Methodology 2-16
2.2.1 Identification of Hazards of Concern 2-16
2.2.2 Climate Change 2-17
2.2.3 Risk Assessment Tools 2-18

PART 2 — COMMUNITY PROFILE

Chapter 3. Yurok Tribe Profile 3-1
3.1 General Overview 3-1
3.1.1 Tribal History 3-3
3.1.2 Health 3-4
3.1.3 Language 3-4
3.1.4 Tribal Governance 3-6
3.1.5 Tribal Departments 3-7
3.1.6 Land Allotments and Infrastructure 3-12
3.1.7 Membership and Economy 3-13
3.1.8 Timber Harvesting 3-14
3.1.9 Tourism 3-15
3.2 Tribal Infrastructure 3-17
3.2.1 Bridge 3-17
3.2.2 Roadways 3-18
3.3 Archeological Overview 3-19
3.3.1 Archeological Sites 3-19
3.3.2 Cultural Heritage 3-19
3.3.3 Archeological Overview 3-20

Chapter 4. Planning Area Natural Environment 4-1
4.1 The Planning Area 4-1
4.2 Characterization of the Watershed 4-1
4.3 Natural Resources 4-10
4.4 Climate 4-10
4.5 Geology 4-11
4.5.1 Lower Klamath Watershed Geology 4-12
4.6 Major Past Hazard Events 4-12

Chapter 5. Demographics, Development and Regulation 5-1
5.1 Demographics 5-1
5.1.1 Population Characteristics 5-1
5.1.2 Income 5-1
5.1.3 Age Distribution 5-2
5.1.4 Race, Ethnicity and Language 5-2
5.1.5 Disabled Populations 5-4
5.1.6 Economy 5-4
5.2 Development Profile 5-6
5.2.1 Land Use Principles 5-6
5.2.2 Residential Development 5-7
5.2.3 Non-Residential Development 5-7
5.2.4 Critical Facilities and Infrastructure 5-7
5.3 Relevant Regulations 5-9
5.3.1 Federal 5-9
5.3.2 State 5-13
5.3.3 Tribal 5-13

PART 3 — RISK ASSESSMENT

Chapter 6. Dam Failure 6-1
6.1 General Background 6-1

6.1.1 Causes of Dam Failure 6-1
6.1.2 Dam Removal 6-2
6.1.3 Regulatory Oversight 6-2
6.2 Hazard Profile 6-3
6.2.1 Past Events 6-3
6.2.2 Location 6-4
6.2.3 Frequency 6-6
6.2.4 Severity 6-6
6.2.5 Warning Time 6-7
6.3 Secondary Hazards 6-7
6.4 Climate Change Impacts 6-7
6.5 Exposure 6-8
6.5.1 Population 6-8
6.5.2 Property 6-8
6.5.3 Environment 6-9
6.6 Vulnerability 6-9
6.6.1 Population 6-9
6.6.2 Property 6-9
6.6.3 Environment 6-10
6.7 Future Trends in Development 6-10
6.8 Scenario 6-10
6.9 Issues 6-11

Chapter 7. Drought 7-1
7.1 General Background 7-1
7.1.1 Drought in California 7-1
7.1.2 Additional Drought Impact on the Yurok Reservation 7-1
7.2 Hazard Profile 7-2
7.2.1 Past Events 7-2
7.2.2 Location 7-3
7.2.3 Frequency 7-3
7.2.4 Severity 7-6
7.2.5 Warning Time 7-6
7.3 Secondary Hazards 7-7
7.4 Climate Change Impacts 7-7
7.5 Exposure 7-7
7.6 Vulnerability 7-7
7.6.1 Population 7-7
7.6.2 Property 7-8
7.6.3 Critical Facilities 7-8
7.6.4 Environment 7-8
7.6.5 Economic Impact 7-8
7.7 Future Trends in Development 7-9
7.8 Scenario 7-9
7.9 Issues 7-9

Chapter 8. Earthquake 8-1
8.1 General Background 8-1
8.1.1 How Earthquakes Happen 8-1
8.1.2 Earthquake Classifications 8-2
8.1.3 Ground Motion 8-3
8.1.4 Effect of Soil Types 8-3

8.2 Hazard Profile 8-4
8.2.1 Past Events 8-5
8.2.2 Location 8-6
8.2.3 Frequency 8-11
8.2.4 Severity 8-11
8.2.5 Warning Time 8-11
8.3 Secondary Hazards 8-13
8.4 Climate Change Impacts 8-13
8.5 Exposure 8-13
8.5.1 Population 8-13
8.5.2 Property 8-13
8.5.3 Critical Facilities and Infrastructure 8-13
8.5.4 Environment 8-14
8.6 Vulnerability 8-14
8.6.1 Population 8-14
8.6.2 Property 8-14
8.6.3 Critical Facilities and Infrastructure 8-15
8.6.4 Environment 8-16
8.7 Future Trends in Development 8-16
8.8 Scenario 8-16
8.9 Issues 8-16

Chapter 9. Flood 9-1
9.1 General Background 9-1
9.1.1 Measuring Floods and Floodplains 9-1
9.1.2 Floodplain Ecosystems 9-2
9.1.3 Effects of Human Activities 9-2
9.1.4 Federal Flood Programs 9-2
9.2 Hazard Profile 9-3
9.2.1 The Klamath River 9-3
9.2.2 Past Events 9-3
9.2.3 Location 9-6
9.2.4 Frequency 9-6
9.2.5 Severity 9-6
9.2.6 Warning Time 9-12
9.3 Secondary Hazards 9-12
9.4 Climate Change Impacts 9-13
9.5 Exposure 9-17
9.5.1 Population 9-17
9.5.2 Property 9-17
9.5.3 Critical Facilities and Infrastructure 9-18
9.5.4 Environment 9-19
9.6 Vulnerability 9-19
9.6.1 Population 9-20
9.6.2 Property 9-20
9.6.3 Critical Facilities and Infrastructure 9-20
9.6.4 Environment 9-20
9.7 Future Trends 9-21
9.8 Scenario 9-21
9.9 Issues 9-21

Chapter 10. Landslide 10-1

10.1 General Background 10-1
10.2 Hazard Profile 10-1
10.2.1 Past Events 10-2
10.2.2 Location 10-4
10.2.3 Frequency 10-4
10.2.4 Severity 10-4
10.2.5 Warning Time 10-4
10.3 Secondary Hazards 10-7
10.4 Climate Change Impacts 10-7
10.5 Exposure 10-7
10.5.1 Population 10-7
10.5.2 Property 10-7
10.5.3 Critical Facilities and Infrastructure 10-7
10.5.4 Environment 10-8
10.6 Vulnerability 10-9
10.6.1 Population 10-9
10.6.2 Property 10-9
10.6.3 Critical Facilities and Infrastructure 10-9
10.6.4 Environment 10-10
10.7 Future Trends in Development 10-10
10.8 Scenario 10-10
10.9 Issues 10-11

Chapter 11. Severe Weather 11-1
11.1 General Background 11-1
11.2 Hazard Profile 11-1
11.2.1 Overview 11-1
11.2.2 Past Severe Weather Events 11-3
11.2.3 Location 11-4
11.2.4 Frequency 11-4
11.2.5 Severity 11-9
11.2.6 Warning Time 11-9
11.3 Secondary Hazards 11-9
11.4 Climate Change Impacts 11-9
11.5 Exposure 11-10
11.5.1 Population 11-10
11.5.2 Property 11-10
11.5.3 Critical Facilities and Infrastructure 11-10
11.5.4 Environment 11-10
11.6 Vulnerability 11-11
11.6.1 Population 11-11
11.6.2 Property 11-11
11.6.3 Critical Facilities and Infrastructure 11-11
11.6.4 Environment 11-12
11.7 Future Trends in Development 11-12
11.8 Scenario 11-12
11.9 Issues 11-12

Chapter 12. Tsunami 12-1
12.1 General Background 12-1
12.1.1 Tsunami Wave Formation 12-1
12.1.2 Physical Characteristics of Tsunami 12-1

12.2 Hazard Profile 12-4
12.2.1 Past Events 12-5
12.2.2 Location 12-8
12.2.3 Frequency 12-8
12.2.4 Severity 12-8
12.2.5 Warning Time 12-11
12.3 Secondary Hazards 12-14
12.4 Climate Change Impacts 12-15
12.5 Exposure 12-16
12.5.1 Population 12-16
12.5.2 Property 12-16
12.5.3 Critical Facilities and Infrastructure 12-16
12.5.4 Environment 12-17
12.6 Vulnerability 12-17
12.6.1 Population 12-17
12.6.2 Property 12-18
12.6.3 Environment 12-18
12.7 Future Trends in Development 12-19
12.8 Scenario 12-19
12.9 Issues 12-19

Chapter 13. Community Wildfire Protection Plan 13-1
13.1 General Background 13-1
13.1.1 Community Wildfire Protection Plan 13-2
13.1.2 Purpose, Goals and Objectives 13-3
13.1.3 Collaboration 13-4
13.1.4 Humboldt-Del Norte Fire Unit 13-5
13.1.5 Wildland Urban Intermix Planning Area 13-6
13.1.6 Wildfire Management and Agency Roles and Responsibilities 13-10
13.2 Fire Ecology 13-11
13.2.1 Wildfire Behavior 13-11
13.2.2 Wildfire Impact 13-13
13.2.3 Communities at Risk 13-13
13.2.4 Identifying Wildfire Hazard 13-16
13.3 Component-Based Hazard Rating 13-16
13.3.1 Model Projection 13-16
13.3.2 Hazard Assessment Rating Table 13-16
13.3.3 Fuel 13-18
13.3.4 Slope 13-23
13.3.5 Aspect 13-25
13.3.6 Weather 13-28
13.3.7 Roads and Fire-Response Network 13-30
13.3.8 Viewshed 13-32
13.3.9 Departure and Fire Regime Condition Class 13-34
13.3.10 Component-Based Wildfire Hazard Rating 13-39
13.4 Hazard Profile 13-41
13.4.1 Location 13-41
13.4.2 Past Events 13-41
13.4.3 Frequency 13-45
13.4.4 Severity 13-45
13.4.5 Warning Time 13-45

13.5 Secondary Hazards 13-47
13.6 Climate Change Impacts 13-47
13.7 Exposure 13-48
13.7.1 Population 13-48
13.7.2 Property 13-48
13.7.3 Critical Facilities and Infrastructure 13-48
13.7.4 Environment 13-49
13.8 Vulnerability 13-50
13.8.1 Population 13-50
13.8.2 Property 13-51
13.8.3 Critical Facilities and Infrastructure 13-51
13.8.4 Response Capabilities 13-51
13.9 Future Trends in Development 13-56
13.10 Scenario 13-56
13.11 Issues 13-57
13.12 Developing Local Area Community Assessment 13-57
13.12.1 Establishing a Community Base Map 13-57
13.12.2 Community Based Wildland Urban Intermix 13-57
13.12.3 Areas of Community Importance or Value 13-58
13.12.4 Wildfire Hazard Areas 13-59
13.12.5 Response Capabilities and Resources 13-59
13.13 Mitigation Activities 13-60
13.13.1 Prioritized Fuel Reduction 13-60
13.13.2 Hazardous Fuels Management 13-60
13.13.3 Treatment of Structural Ignitability 13-61
13.13.4 Prescribed Fire Treatments 13-61
13.13.5 Previous Mitigation Strategies 13-65

Chapter 14. Human-Caused Hazards 14-1
14.1 General Background 14-1
14.1.1 Terrorism and Weapons of Mass Destruction 14-1
14.1.2 Technological Hazards 14-6
14.1.3 Civil Disorder 14-9
14.2 Human-Caused Hazard Profile 14-9
14.2.1 Past Events 14-9
14.2.2 Location 14-12
14.2.3 Frequency 14-17
14.2.4 Severity 14-18
14.2.5 Warning Time 14-19
14.3 Secondary Hazards 14-19
14.4 Exposure 14-20
14.4.1 Population 14-21
14.4.2 Property 14-22
14.4.3 Critical Facilities and Infrastructure 14-22
14.4.4 Environment 14-23
14.5 Vulnerability 14-23
14.5.1 Population 14-23
14.5.2 Property 14-24
14.5.3 Critical Facilities and Infrastructure 14-24
14.5.4 Environment 14-24
14.6 Future Trends in Development 14-25

14.7 Review of Existing Ordinances, Programs, and Plans 14-25
14.7.1 Yurok Tribe Emergency Operations Plan 14-25
14.7.2 Yurok Tribe Chemical, Biological, Radiological, Nuclear/ Improvised Explosive Device Plan 14-25
14.7.3 Yurok Police Department 14-26
14.7.4 Yurok Public Safety Communications 14-27
14.7.5 Yurok Fire Department 14-27
14.8 Scenario 14-29
14.9 Issues 14-30

Chapter 15. Human Health Hazards 15-1
15.1 General Background 15-1
15.1.1 Influenza 15-1
15.1.2 Smallpox 15-2
15.1.3 Viral Hemorrhagic Fevers 15-3
15.1.4 Plague 15-3
15.1.5 Tularemia 15-4
15.1.6 Mosquito-Borne Disease 15-5
15.1.7 Lyme Disease 15-6
15.1.8 Anthrax 15-7
15.1.9 Severe Acute Respiratory Syndrome 15-7
15.1.10 Extreme Weather 15-8
15.2 Human Health Hazard Profile 15-11
15.2.1 Past Events 15-11
15.2.2 Location 15-12
15.2.3 Frequency 15-12
15.2.4 Severity 15-13
15.3 Secondary Hazards 15-13
15.4 Climate Change Impacts 15-13
15.5 Exposure 15-14
15.5.1 Population 15-14
15.5.2 Property 15-14
15.5.3 Critical Facilities and Infrastructure 15-14
15.5.4 Environment 15-15
15.6 Vulnerability 15-15
15.6.1 Population 15-15
15.6.2 Property 15-15
15.6.3 Critical Facilities/Infrastructure 15-15
15.6.4 Environment 15-15
15.7 Future Trends in Development 15-15
15.8 Review of Existing Ordinances, Programs and Plans 15-16
15.8.1 Memorandums of Agreement 15-16
15.8.2 Integrated Emergency Response 15-16
15.9 Scenario 15-16
15.10 Issues 15-16

Chapter 16. Risk Ranking 16-1
16.1 Probability of Occurrence 16-1
16.2 Impact 16-2
16.3 Risk Rating and Ranking 16-4

PART 4 — MITIGATION STRATEGY

Chapter 17. Mitigation Initiatives 17-1
17.1 Mitigation Alternatives 17-1
17.2 Selected Mitigation Initiatives 17-1
17.3 Benefit/Cost review 17-17
17.4 Action Plan Prioritization 17-17
17.5 Analysis of Mitigation Initiatives 17-18

Chapter 18. Implementation 18-1
18.1 Plan Adoption 18-1
18.2 Plan Maintenance Strategy 18-3
18.2.1 Plan Implementation 18-3
18.2.2 Steering Committee.....18-3
18.2.3 Fire Safe Council 18-4
18.2.4 Annual Progress Report 18-4
18.2.5 Plan Update.....18-4
18.2.6 Continuing Public Involvement 18-5
18.2.7 Incorporation into Other Planning Mechanisms 18-5

References 1

Appendices

A. Acronyms and Definitions
B. Public Outreach
C. Mitigation Alternative Catalogs
D. Example Progress Report
E. 2006 Strategy Status Update

LIST OF TABLES

No. Title *Page No.*

Table 1-1. Grant Opportunities 1-3
Table 1-2. Tribal Hazard Mitigation and Community Wildfire Protection Plan Objectives 1-5

Table 2-1. Planning/Steering Committee Membership and Attendance 2-3
Table 2-2. Plan Development Milestones 2-15

Table 4-1. Presidential Disaster Declarations for Hazard Events in Planning Area 4-14

Table 5-1. Legal and Regulatory Capability 5-15
Table 5-2. Administrative and Technical Capability 5-21
Table 5-3. Fiscal Capability 5-22

Table 6-1. Dams WIth Potential Impact on the Trinity and Klamath Rivers 6-4
Table 6-2. Corps of Engineers Hazard Potential Classification 6-6
Table 6-3. Exposure and Value of Structures in Domino Dam Failure Inundation Areas 6-8
Table 6-4. Facilities in Domino Dam Failure Inundation Areas 6-9
Table 6-5. Loss Estimates for Dam Failure 6-10

Table 8-1. Mercalli Scale and Peak Ground Acceleration Comparison 8-4
Table 8-2. NEHRP Soil Classification System 8-4
Table 8-3. Recent Earthquakes Magnitude 5.0 or Larger Felt in Humboldt and Del Norte Counties 8-5
Table 8-4. Estimated Earthquake-Caused Building Economic damage 8-14
Table 8-5. Estimated Damage to Facilities from 100-Year Earthquake 8-15
Table 8-6. Estimated Damage to Facilities from 500-Year Earthquake 8-15
Table 8-7. Estimated Damage to Facilities from Cascadia Earthquake 8-16

Table 9-1. Highest Recorded Klamath River Flows 9-12
Table 9-2. Area and Structures in the Floodplain 9-17
Table 9-3. Value of Structures in the Floodplain 9-18
Table 9-4. Loss Estimates for Flood 9-20

Table 10-1. Landslide Areas of Impact 1948-1994 10-3
Table 10-2. Additional Landslide Areas of Impact 1983-2006 10-3
Table 10-3. Exposure and Value of Structures in Landslide Risk Areas 10-8
Table 10-4. Structures Exposed to Landslide Risk Areas 10-8
Table 10-5. Loss Estimates for Landslide 10-9

Table 11-1. Past Tornado Events Impacting Planning Area 11-3
Table 11-2. Past Severe Weather Events Impacting Planning Area 11-4
Table 11-3. Loss Estimates for Severe Weather 11-11

Table 12-1. Tsunamis That Have Affected North Coast California 12-6
Table 12-2. Exposure and Value of Structures in Tsunami Inundation Zone 12-16
Table 12-3. Structures Exposed to Tsunami Inundation Zone 12-17
Table 12-4. Loss Estimates for Tsunami 12-18

Table 13-1. Bioregions at Risk 13-15
Table 13-2. Yurok Tribe Communities at Risk as Defined by California Fire Alliance Humboldt and Del Norte Counties Distribution 13-15
Table 13-3. Hazard Assessment Rating levels 13-17
Table 13-4. Planning Area Fuels 13-20
Table 13-5. Slope and Associated Hazard 13-25
Table 13-6. Aspect and Associated Hazard 13-27

Table 13-7. Travel Time and Associated Hazard 13-30
Table 13-8. Fire Regime Condition Class Descriptions.....13-38
Table 13-9. Percent of California Bioregion Area with Class 2 or 3 FIre Regime Condition Class 13-38
Table 13-10. Population Within Wildfire Hazard Areas 13-48
Table 13-11. Exposure and Value of Structures in Wildfire Hazard Areas.....13-49
Table 13-12. Critical Facilities and Infrastructure in Wildfire Hazard Areas.....13-49
Table 13-13. Loss Estimates for Wildfire.....13-51
Table 13-14. Fire Mitigation Treatment Efforts for the Yurok Reservation.....13-66

Table 14-1. Event Profiles for Terrorism.....14-4
Table 14-2. Criticality Factors 14-20
Table 14-3. Vulnerability Criteria.....14-21
Table 14-4. Residential Dwelling Units on the Yurok Reservation as of 2012 14-22

Table 16-1. Probability of Hazards.....16-2
Table 16-2. Impact on People from Hazards 16-3
Table 16-3. Impact on Property from Hazards 16-4
Table 16-4. Impact on Economy from Hazards.....16-4
Table 16-5. Hazard Risk Rating.....16-5
Table 16-6. Hazard Risk Ranking.....16-5

Table 17-1. Hazard Mitigation Action Plan Matrix.....17-3
Table 17-2. Prioritization of Mitigation Initiatives.....17-19
Table 17-3. Analysis of Mitigation Initiatives.....17-22

LIST OF FIGURES

No. Title *Page No.*

Figure 2-1. Planning Area Including Ancestral Boundary.....2-2
Figure 2-2. Sample Page from Questionnaire Distributed to the Public.....2-10
Figure 2-3. Sample Business Card for Hazard Mitigation & CWPP Plan Survey.....2-10
Figure 2-4. Yurok Reservation, Weitchpec Office June 2012 Open House 2-12
Figure 2-5. Open House Announcement Poster.....2-13
Figure 2-6. Sample Page from Hazard Mitigation Plan Web Site 2-14
Figure 3-1. Since Before Time, Yurok Played the Stick Game and the tradition continues with today's generations. (Photo courtesy of Nicole Wright, Yurok Tribe Planner) 3-2
Figure 3-2. Sweathouse.....3-3
Figure 3-3. 2006 Yurok Language Camp, Tuley Creek.....3-5
Figure 3-4. Yurok Voting Districts.....3-6
Figure 3-5. Students Involved in JOM Program During Spring Break.....3-8
Figure 3-6. Yurok Tribal Member Demonstrates Success of Programs 3-9
(Photo Courtesy of Nicole Wright, Yurok Tribe Planner).....3-9
Figure 3-7. Yurok Reservation Ownership Statistics, 2010.....3-13
Figure 3-8. Proposed Site of Yurok Casino and Hotel Project 3-14
Figure 3-9. McGarvey Creek Timber 3-15
Figure 3-10. Yurok Reservation Roadways.....3-17
(Source: Scenic-Byways Program http://www.yuroktribe.org/departments/planning/ScenicByway.htm) .3-17
Figure 3-11. Yurok Tribe Former Village and Burial Site.....3-19
Figure 3-12. Catch of the Day! Austin and Holdyn Nova 3-21
Figure 3-13. Smoke House 3-21

Figure 4-1. Main Features of Planning Area....4-2
Figure 4-2. Yurok Communities....4-3
Figure 4-3. Watersheds on the Reservation....4-4
Figure 4-4. Land Distribution in the Lower Klamath Watershed....4-5
Figure 4-5. Klamath River, Downriver from Martin's Ferry....4-6
Figure 4-6. McGarvey Creek Watershed....4-8
Figure 4-7. Lower Blue Creek Watershed....4-9
Figure 4-8. Geology of the Lower Klamath Watershed....4-13
Figure 5-1. Planning Area Age Distribution....5-3
Figure 5-2. Planning Area Race Distribution....5-3
Figure 5-3. Industry in the Planning Area....5-5
Figure 5-4. Occupations in the Planning Area....5-5
Figure 5-5. California and Yurok Tribe Unemployment Rate....5-6
Figure 5-6. Housing Units....5-8
Figure 5-7. Year Housing Units Constructed....5-8
Figure 5-8. Tribal Facilities....5-10
Figure 6-1. Historical Causes of Dam Failure....6-2
Figure 6-2. Lower Reservation Potential Dam Failure Inundation Area, Klamath River....6-5
Figure 7-1. Palmer Drought Index Long-Term Drought Conditions (March 2011)....7-4
Figure 7-2. Palmer Hydrological Drought Index Long-Term Hydrologic Conditions (June 2012)....7-4
Figure 7-3. 24-Month Standardized Precipitation Index (April 2009—March 2011)....7-5
Figure 7-4. Palmer Index Drought Conditions (July 2012)....7-5
Figure 8-1. 100-Year Probabilistic Ground Motion Map for The Yurok Reservation....8-7
Figure 8-2. 500-Year Probabilistic Ground Motion Map for the Yurok Reservation....8-8
Figure 8-3. Cascadia 9.0M Scenario Event Ground Motion for the Yurok Reservation....8-9
Figure 8-4. NEHRP Soil Classifications for the Yurok Reservation....8-10
Figure 8-5. PGA with 2-Percent Probability of Exceedance in 50 Years, Planning Area Vicinity....8-12
Figure 9-1. Mouth of the Klamath River on the Pacific Ocean....9-4
Figure 9-2. Lower Reservation Flood Hazard Area....9-7
Figure 9-3. Upper Reservation Flood Hazard Area....9-8
Figure 9-4. Turwar Creek 100-Year Flood Scenario....9-9
Figure 9-5. Turwar Creek 500-Year Flood Scenario....9-9
Figure 9-6. Pecwan Creek 100-Year Flood Scenario....9-10
Figure 9-7. Pecwan Creek 500-Year Flood Scenario....9-10
Figure 9-8. Pine Creek 100-Year Flood Scenario....9-11
Figure 9-9. Pine Creek 500-Year Flood Scenario....9-11
Figure 9-10. Flood Risk from Sea Level Rise in the Requa Area....9-14
Figure 9-11. Flood Risk from Sea Level Rise in the Ah Pah Ridge Area....9-15
Figure 9-12. Flood Risk from Sea Level Rise in the Klamath Glen Area....9-16
Figure 10-1. Deep Seated Slide....10-2
Figure 10-2. Shallow Colluvial Slide....10-2
Figure 10-3. Bench Slide....10-2
Figure 10-4. Large Slide....10-2
Figure 10-5. Landslide Hazard Areas in the Lower Klamath Watershed....10-5
Figure 10-6. Tectah Creek Road Washout, Spring 1999....10-6
Figure 11-1. Yurok Reservation Average Annual Precipitation....11-5
Figure 11-2. Yurok Reservation Average Maximum Temperature....11-6
Figure 11-3. Yurok Reservation Average Minimum Temperature....11-7
Figure 11-4. Yurok Reservation Wind Potential....11-8
Figure 11-5. Severe Weather Probabilities in Warmer Climates....11-10
Figure 12-1. Tsunami Wave Formation....12-1

Figure 12-2. Physical Characteristics of Tsunamis....12-2
Figure 12-3. Comparison of Tsunami to Normal Waves....12-3
Figure 12-4. Effect of Water Depth on Wave Height....12-3
Figure 12-5. March 2011 Tsunami Impact at Klamath River....12-7
Figure 12-6. Yurok Reservation Maximum Tsunami Inundation Zone....12-9
Figure 12-7. Maximum Tsunami Inundation Zone (CalEMA Mapping)....12-10
Figure 12-8. Potential Tsunami Travel Times in the Pacific Ocean....12-11
Figure 12-9. Deep-Ocean Assessment and Reporting of Tsunamis (DART) System....12-12
Figure 12-10. The National Weather Service's Troy Nicollini presents LaBecca Nessier with a Community Leader Award....12-13
Figure 12-11. Tsunami Warning Sign....12-13
Figure 12-12. Tsunami Siren Locations....12-14
Figure 12-13. Projected Debris Flow from March 2011 Tsunami....12-15
Figure 13-1. CWPP 2012 Open House....13-5
Figure 13-2. Fire Hazard Severity Zones on the Yurok Reservation....13-7
Figure 13-3. Del Norte County Fire Hazard Severity Zones as Defined by FRAP....13-8
Figure 13-4. Humboldt County Fire Hazard Severity Zones as Defined by FRAP....13-9
Figure 13-5. The Wildfire Behavior Triangle....13-12
Figure 13-6. Statewide Communities at Risk (CalFire)....13-14
Figure 13-7. Fuel Map....13-19
Figure 13-8. Landfire Fuel with Hazard Ranking....13-21
Figure 13-9. 2012 Vegetation Study Fuel with Hazard Ranking....13-22
Figure 13-10. Fuel Moisture Average May 2011-April 2012....13-23
Figure 13-11. Slope Map....13-24
Figure 13-12. Aspect Map....13-26
Figure 13-13. Solar Radiation on North and South Aspects....13-27
Figure 13-14. Solar Radiation May 2011-April 2012....13-27
Figure 13-15. Climate Hazard Layer....13-29
Figure 13-16. Response Map....13-31
Figure 13-17. Viewshed Map....13-33
Figure 13-18. Fire Regime Groups for the Pacific Southwest....13-35
Figure 13-19. Distribution of Burn Frequency from 1950 to 2008....13-36
Figure 13-20. Fire Regime Condition Class....13-37
Figure 13-21. Component-Based Hazard Map....13-40
Figure 104: Satellite image of Smoke from November 2008 California Wildfires....13-42
Figure 13-23. Planning Area Wildfire Map....13-43
Figure 13-24. Wildfire History Data within the Yurok Planning Region....13-44
Figure 13-107. Pine Creek Fire, September 2012....13-45
Figure 13-108. California Fire Threat Statewide....13-46
Figure 13-109. Humboldt County Local Fire Response Units....13-53
Figure 13-110. Humboldt County Local Fire Planning Units....13-54
Figure 13-111. Lower Klamath Unit 2009-2010 Identified Projects....13-55
Figure 13-112. Fire Mitigation for Residential Structures....13-64
Figure 14-1. California Pipeline Locations....14-16
Figure 14-2. Joint Tribal-State-Federal Dump Cleanup on Steep Slope at Yurok Reservation....14-17
Figure 15-1. Areas with Confirmed H5N1 2003 – August 2010....15-2
Figure 15-2. Distribution of Plague from 1970-2003....15-4
Figure 15-3. Distribution of West Nile Virus by State, 2012....15-6
Figure 15-4. Weather-Related Fatalities in the U.S.....15-8
Figure 15-5. Environmental Changes and Health impacts....15-14
Figure 18-1. Resolution Adopting Hazard Mitigation Plan....18-2

ACKNOWLEDGMENTS

Project Manager

Nicole Wright
Planner IV
Yurok Tribe
190 Klamath Blvd.
Klamath, CA 95531
Phone(707) 482-1350
Email: Nwright@yuroktribe.nsn.us

Other Yurok Tribe Staff

Rachel Rodriguez
GIS Coordinator
Yurok Tribe Tulley Creek Office
rrodriguez@yuroktribe.nsn.us
(530) 625-1942

Tim Sanderson
Emergency Services Specialist
Yurok Tribe Dept. of Public Safety
247 Salmon Ave.
Klamath, CA 95548
tsanderson@yuroktribe.nsn.us
(707) 482-8185 Office

Consultants

Bev O'Dea, Project Manager, Lead Planner, Hazard Mitigation Plan and Community Wildfire Protection Plan, Bridgeview Consulting, LLC

Ed Whitford, GIS Analyst, Tetra Tech, Inc.

Cathy Walker, GIS Analyst, Bridgeview Consulting, LLC.

Dan Portman, Technical Editor, Tetra Tech, Inc.

Traditional Indian House, Yurok Reservation

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The Disaster Mitigation Act (DMA; Public Law 106-390) is the latest federal legislation enacted to encourage and promote proactive, pre-disaster planning as a condition of receiving financial assistance under the Robert T. Stafford Act. The DMA emphasizes planning for disasters before they occur. Under the DMA, a pre-disaster hazard mitigation program and new requirements for the national post-disaster hazard mitigation grant program were established.

In recognition of tribal sovereignty and the government-to-government relationship that currently exists between FEMA and Indian Tribal governments, FEMA amended 44 CFR 201 at 72 Fed. Reg. 61720 on October 31, 2007, and provided further amendments on September 16, 2009, amending 74 Fed. Reg. 47471 to consolidate and clarify the requirements for Indian Tribal governments. These amendments established protocol for Tribal Hazard Mitigation Plans to be separate from State and Local Mitigation Plans. It also finalized the Mitigation Planning Guidelines, which became effective March 2010. It is under those guidelines which this Tribal Hazard Mitigation Plan was developed.

For consistency, 44 CFR 201.2 defines *Indian Tribal Government* as any Federally recognized governing body of an Indian or Alaska Native tribe, band, nation, pueblo, village, or community that the Secretary of Interior acknowledges to exist as an Indian Tribe under the Federally Recognized Indian Tribe List Act of 1994, 25 U.S.C. 479a. This does not include Alaska Native corporations when the ownership is vested in private individuals.

The DMA encourages tribes, states and local authorities to work together on pre-disaster planning, and it promotes sustainability as a strategy for disaster resistance. "Sustainable hazard mitigation" includes the sound management of natural resources, local economic and social resiliency, and the recognition that hazards and mitigation must be understood in the largest possible social and economic context. The enhanced planning network called for by the DMA helps local government's articulate accurate needs for mitigation, resulting in faster allocation of funding and more cost-effective risk reduction projects.

Embracing this initiative as a foundation for proactive planning as well as FEMA's "whole community approach," the Yurok Indian Tribe (Tribe) has developed this Update to the Yurok Tribal Hazard Mitigation Plan in an effort to reduce loss of life and property resulting from disasters. While it is impossible to predict exactly when and where disasters will occur, or the extent to which they will impact the Tribe, with careful planning and collaboration among the various Tribal departments, members, and communities, and the surrounding public jurisdictions, agencies, private non-profit organizations, stakeholders, and local citizens, it is possible to minimize losses that can occur from disasters. This has been and will continue to be the driving force behind this plan development.

"**Whole Community** is an approach to emergency management that reinforces the fact that FEMA is only one part of our nation's emergency management team; that we must leverage all of the resources of our collective team in preparing for, protecting against, responding to, recovering from and mitigating against all hazards; and that collectively we must meet the needs of the entire community in each of these areas. This larger collective emergency management team includes, not only FEMA and its partners at the federal level, but also local, tribal, state and territorial partners; non-governmental organizations like faith-based and non-profit groups and private sector industry; to individuals, families and communities, who continue to be the nation's most important assets as first responders during a disaster."

–FEMA

http://www.fema.gov/whole-community

Utilizing the three primary characteristics of mitigation efforts to: retreat, accommodate or protect, the Yurok Tribe will develop techniques and practices that will contribute to the environment by developing non-regret actions which will, in all hopes, create multiple positive outcomes.

Hazard mitigation is defined as a way to reduce or alleviate the loss of life, personal injury, and property damage that can result from a disaster through long- t-term strategies. It involves strategies such as planning, policy changes, programs, projects, and other activities that can mitigate the impacts of hazards on the Yurok Indian Tribe. The responsibility for hazard mitigation lies with many, including private property owners; business and industry; and Tribal, local, state, and federal governments.

There is a strong desire on the part of the Tribe for this plan to be a user-friendly document that is understandable to the layperson and not overly technical. Many of the Tribe's mitigation efforts involve working with private property owners, so it is important for everyone to understand what "risk" is and how mitigation can reduce its impacts upon the Tribal lands and its members.

Many elements went into making this Tribal Mitigation plan a success, including scientific analyses, expertise of the Tribal members and subject matter experts, the contents of previous written works, and historical photographic evidence, all of which has been compiled in the development of this Tribal Hazards Mitigation Plan. The Tribal Planning Team was instrumental in providing ideas, concepts, historical data and information, discussions, and support needed to develop this plan.

Development of the Yurok Update to the Tribal Hazards Mitigation Plan was completed in coordination with the Planning Committee Members and the Tribe's consultants, Tetra Tech and Bridgeview Consulting, LLC. Lead authorship and project management of this plan was provided by Beverly O'Dea, of Bridgeview Consulting, LLC., with primary GIS support and analysis provided by Ed Whitford of Tetra Tech, and Cathy Walker, of Bridgeview Consulting.

PLAN DEVELOPMENT METHODOLOGY

Development of the hazard mitigation plan included five phases:

- Phase 1—Organize and review
- Phase 2—Risk assessment
- Phase 3—Engage the public
- Phase 4—Assemble the plan
- Phase 5—Plan adoption

Phase 1—Organize and Review

Under this phase, the steering committee was assembled to oversee the development of the plan update. The committee consisted of Tribal staff and Tribal members, as well as other stakeholders in the planning area, as well as a technical consultant was also provided technical support to the planning team. The planning process, planning team and steering committee were formally recognized by the Tribal Council. Full coordination with other tribal, county, state, and federal agencies involved in hazard mitigation occurred from the onset of this plan's development through its completion. A multi-media public involvement strategy centered on a hazard preparedness questionnaire was also implemented under this phase. Also occurring under this phase was a comprehensive review of the exiting plan as well as the State's Enhanced Hazard Mitigation Plan and a comprehensive review of existing programs within the operational area that may support or enhance hazard mitigation actions. A key function of the steering committee was to identify a guiding principal, goals and objectives for this plan.

Phase 2—Risk Assessment

Risk assessment is the process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from natural hazards. This process assesses the vulnerability of people, buildings, cultural resources, and infrastructure to natural hazards. It focuses on the following parameters:

- Hazard identification and profiling
- Identification of Cultural resources
- The impact of hazards on physical, cultural, social and economic assets
- Vulnerability identification
- Estimates of the cost of damage or costs that can be avoided through mitigation.

The risk assessment for this hazard mitigation plan meets the requirements outlined in Chapter 44 of the Code of Federal Regulations (44 CFR). Phase 2 occurred simultaneously with Phase 1, with the two efforts using information generated by one another to create the best possible risk assessment.

Phase 3—Engage the Public

Specific to Tribal plans, 44 CFR 201.7 states that Tribal governments may define who they feel constitute "public" within the planning realm, as many Tribal members have difficulty or apprehension about how to honor traditional beliefs and cultural attributes while still fully participating in the mitigation planning process. For many Tribes, the term *natural hazards* contradicts cultural beliefs of the Elements which are living beings: wind, rain, earth and sky live and breathe, providing for the needs of the Tribal Members. Because of this, it was necessary for the Tribe to meld both western and traditional cultures into a method that met the needs of both worlds.

Under this phase, a public involvement strategy was developed by the Steering Committee that maximized the capabilities of the Tribe, while still maintaining their cultural beliefs and responsibilities to the Elements. While the Steering Committee provided oversight to the actual plan development, the planning team provided information necessary for inclusion within the document. One of the first steps taken was the development of a contact list which included individuals whose input was needed to complete this plan to its fullest capacity. Additionally, the strategy also included: Tribal Council Government weekly meeting updates; public meetings to review the draft plan; distribution of the draft plan to planning committee members; utilization of a hazard mitigation survey; a Tribal sponsored website dedicated to the plan, and media releases throughout various stages in the process. Public engagement also included involvement from the county within the geographic boundary of the Tribe, Humboldt and Del Norte Counties, as well as various state agencies. Throughout the course of this project, numerous meetings were held with, and briefings given to, federal and local officials and other stakeholders. This strategy was deemed by the Steering Committee as a key function in the success of this planning effort.

Phase 4—Assemble the Plan

The Planning Team and Steering Committee assembled key information from Phases 1 and 2 into a document to meet the DMA requirements. Under 44 CFR 201.7, a Tribal Hazards Mitigation Plan must include the following:

- A description of the Planning process
- Risk assessment
- Mitigation Strategy

  - Goals
  - Review of alternatives
  - Prioritized "action plan"
- Plan Maintenance section
- Documentation of Adoption

Phase 5—Plan Adoption/Implementation/Assurances

The Tribe has elected to review and adopt the plan prior to submission to FEMA Region IX for review, allowing for modifications which FEMA may request without the necessity for re-adoption by the Tribe. A copy of the Resolution is included in Section 18. This document includes a plan implementation and maintenance section that details the formal process for ensuring that the plan remains an active and relevant document. The plan maintenance process includes a schedule for monitoring and evaluating the plan's progress annually and producing a plan revision every 5 years. This process seeks to keep a steering body that meets the criteria of the original steering committee intact to perform this annual review. This phase includes strategies for continued public involvement and incorporation of the recommendations of this plan into other planning mechanisms of the Tribe, such as the comprehensive plan, capital improvement plan, building code, and development design guidelines.

This section of the plan also includes the assurances required of the Yurok Tribe pursuant to 44 CFR 13.11(c) with respect to all applicable Federal statutes and regulations in effect for the periods for which it receives grant funding. Additionally, the Tribe also agrees to amend its plan whenever necessary to reflect changes in Tribal or Federal laws and statutes as required under 44 CFR 13.11(d).

MITIGATION GUIDING PRINCIPLE, GOALS AND OBJECTIVES

Guiding Principle

The following guided the Steering Committee/Planning Partnership in selecting the initiatives contained in this plan update:

- Guiding Principle—Reduce the vulnerability to natural hazards in order to protect the health, safety, welfare and economy of the Yurok Tribe and its Members.

Goals

The Steering Committee reviewed the existing Goals and Objectives established within the 2006 Hazard Mitigation Plan, and recommended minor changes in those original goals when developing the following goals for this current plan update:

- **Goal 1**—Reduce or prevent future hazard-related injuries and losses of life, property damage, and environmental impact.
- **Goal 2**—Reduce the adverse impacts on the economy caused by natural disasters.
- **Goal 3**—Encourage the development and implementation of long-term, cost-effective and environmentally sound mitigation projects.
- **Goal 4**—Enhance community emergency management capability through increased public awareness and readiness (i.e., prepare, plan, respond, recover, mitigate).
- **Goal 5**—Promote disaster-resistant and resilient communities.
- **Goal 6**—Preserve the cultural integrity of the Yurok Tribe.

Objectives

Review of the original objectives determined that many were similar in nature, but were broken out for each hazard. As such, the steering committee determined that the number of objectives could be reduced by combining similar objectives to help streamline the planning process.

The plan objectives were revised via a facilitated exercise that focused on finding objectives that meet multiple goals. The objectives are listed in Table ES-2.

MITIGATION STRATEGY AND INITIATIVES – PROGRESS REPORT

The initial hazard mitigation planning effort produced a partnership that embraced the concept of risk reduction through proactive mitigation. The Tribe was able to complete or initiate actions on some of the initiatives as identified within Appendix E at the end of this document.

Since the 2006 HMP was approved, the Yurok Tribe focused many of its resources on other planning efforts (discussed below) in an attempt to increase population and economic growth throughout the Reservation. As such, the initial plan maintenance strategy detailed within the 2006 plan was not followed as closely as the Tribe would have liked as the Tribe had limited resources with which to dedicate to this effort. In addition, the Tribe is also required to adhere to many additional planning requirements than that of a local government, further taxing limited resources and personnel. Appendix E of this plan provides a detailed accounting of the projects' status since the 2006 plan was approved.

In addition to implementation of some of the 2006 mitigation strategies, the Tribe also developed a number of different plans and completed several studies since the 2006 Hazard Mitigation Plan, all of which have enhanced the Tribe's economic viability while also supporting infrastructure development. All of these efforts have further promoted resiliency on Tribal Lands. A detailed list of the various efforts is contained within the Capability Matrix (Chapter 5). Some of the more significant planning efforts which deserve attention include: the Yurok Tribe Comprehensive Emergency Management Plan; the Yurok Tribe Transportation Plan; the Housing and Municipal Facilities Relocation Study, and the Highway/Roadways Safety Improvements Design Report. As part of this 2013 Hazard Mitigation Plan update, the Tribe completed a Community Wildfire Protection Plan, which will provide additional information with respect to fire hazards and potential mitigation efforts to help reduce the impact from fire on the Reservation. Information about the hazards that impact the Yurok Tribe's land and people were incorporated into all of these plans and studies to assist in the decision making process, with the initial 2006 Hazard Mitigation Plan serving as the starting point for all of these documents.

In addition to the development of the above plans and studies, a number of Tribal Departments, including the Planning Department, Yurok Environmental Program, Yurok Land Management, Yurok Watershed Program, and the Yurok Tribe Fisheries Program have incorporated mitigation activities into various day-to-day functions. For example, development projects emphasize hazard planning in site locations, building materials, and overall community usage. In the planning stage, project development includes prioritizing mitigation impacts such as the projects proximity to 100 year flood levels, landslides, and fire suppression (based on information on these hazards in the Tribe's previously-approved hazard mitigation plan. But also, whenever possible, Tribal projects also prioritize community emergency mitigation. Our community buildings were built to the requirements of Red Cross to be designated as a community shelters. In addition, overall Land Use Planning incorporates mitigation strategies in all aspects of land use. For example, water system planning has to consider year round flow levels especially in drought conditions so impacts to aquatic habitats and residential areas are limited as much as possible. Many of our residences located in areas without electricity have surface water systems and this type of mitigation planning is extremely important. Land use planning also considers slope to minimize landslide potential

and increased erosion as well as susceptibility to liquefaction soils common on the reservation. These are just a few of the ways mitigation activities are incorporated into the working of Tribal Departments.

The maintenance strategy as written within the 2013 update requires an annual review, which the planning team determined to be more in line with their existing capabilities. Appendix D of this document provides a reporting tool which the Tribe will utilize to conduct this annual review. While the intentions for the 2006 plan were to do a semi-annual reviews, including the actual projects, the tracking and reporting of those efforts did not occur as outlined in the original plan. However, the Planning Director, Public Safety Director and staff of both departments did utilize the regularly scheduled council meetings to continue to advise the Tribal Members of the hazards and issues of concern, as well as to continue to provide information necessary to protect its citizens. In addition, the Tribe did maintain the mitigation planning website since completion of the 2006 plan, which included a link to the Tribe's Hazard Mitigation Plan, and has engaged in several exercises which included Tribal Members living on the Reservation over the course of the last several years to help enhance resiliency on the reservation based on the hazards identified.

The updated version of the hazard mitigation action plan is a key element of this plan. It is through the implementation of this action plan that the Yurok Indian Tribe can strive to become disaster-resilient through sustainable hazard mitigation. This action plan includes an assessment of the capabilities of the Tribe to implement hazard mitigation initiatives, a review of alternatives, a prioritization schedule, and a mitigation strategy matrix that identifies the following:

- Initiative by hazard addressed
- Objectives addressed
- Lead implementation agency (or agencies)
- Estimated benefits
- Estimated costs
- Timeline for implementation
- Funding sources
- Prioritization

For the purposes of this document, mitigation initiatives are defined as: *activities designed to reduce or eliminate losses resulting from the impacts of natural hazards of concern*.

Although one of the driving influences for preparing this plan was grant funding eligibility, this plan is not a "how to get grant money" plan. It was important to the Tribe that they examine initiatives that would work through all phases of emergency management and that contribute to rather than remove from the environment. It was significant to the Tribal Members that the mitigation efforts include mainstreaming adaptive, 'no-regrets' strategies which improved their abilities to live with the Elements, while not adversely impacting their beliefs and culture. They have adopted a philosophy of "accommodate, retreat or protect" when developing their mitigation strategies. As such, some of the initiatives outlined in this plan are not grant-eligible, and grant eligibility was not the focus of the selection. Rather, the focus was on the initiatives' effectiveness in achieving the goals of the plan and whether or not they are within the Tribe's capabilities. Detailed descriptions for these actions can be found in Chapter 17.

Although the Yurok Tribe has limited resources and staff to implement mitigation strategies, Tribal Departments incorporate mitigation activities into various day-to-day functions. For example, development projects emphasize hazard planning in site locations, building materials, and overall community usage. In the planning stage, project development includes prioritizing mitigation impacts such as the projects proximity to 100 year flood levels, landslides, and fire suppression. But also, whenever possible, Tribal projects also prioritize community emergency mitigation. Our community

buildings were built to the requirements of Red Cross to be designated as a community shelters. In addition, overall Land Use Planning incorporates mitigation strategies in all aspects of land use. For example, water system planning has to consider year round flow levels especially in drought conditions so impacts to aquatic habitats and residential areas are limited as much as possible. Many of our residences located in areas without electricity have surface water systems and this type of mitigation planning is extremely important. Land use planning also considers slope to minimize landslide potential and increased erosion as well as susceptibility to liquefaction soils common on the reservation. These are just a few of the ways mitigation activities are incorporated into the working of Tribal Departments.

IMPLEMENTATION AND ASSURANCES

Full implementation of the recommendations of this plan will require time and resources. This plan reflects an adaptive management approach in that specific recommendations and plan review protocols are provided to evaluate changes in vulnerability and action plan prioritization after the plan is adopted. The true measure of the plan's success will be its ability to adapt to the ever-changing climate of hazard mitigation. Funding resources are always evolving, as are programmatic changes based on new mandates. The Yurok Tribe has a long-standing tradition of proactive response to issues that may impact its members. The Tribe as a whole is forward thinking, and strives whenever possible to improve the lives of its members, and the residents living on the Reservation. This tradition is reflected in the development of this plan, as it is not an easy task to accomplish. The Tribal Council will assume responsibility for adopting the recommendations of this plan and committing Tribal resources toward its implementation. The framework established by this plan will help identify a strategy that maximizes the potential for implementation based on available and potential resources. It commits the Tribe to pursue initiatives when the benefits of a project exceed its costs. Most important, the Tribe developed this plan with community input. These techniques will set the stage for successful implementation of the recommendations in this plan.

As established within 44 CFR 13.11(c), the Tribal Government will continue to comply with all applicable federal statutes and regulations in effect, including those periods during which the Tribe receives grant funding. In compliance with 44 CFR 13.11(d), the Tribe, whenever necessary, will reflect new or revised federal statutes or regulations, or any material changes in Tribal policy or operation. It is understood that the Tribe will submit those amendments for review and approval in coordination with FEMA Region IX and the State of California, Emergency Management Agency.

PART 1 —
THE PLANNING PROCESS

CHAPTER 1.
INTRODUCTION TO THE PLANNING PROCESS

1.1 WHY PREPARE THIS PLAN?

1.1.1 The Big Picture

The federal Disaster Mitigation Act (DMA) emphasizes the importance of planning for disasters before they occur by requiring tribes, states and local governments to develop hazard mitigation plans as a condition for federal grant assistance. The DMA (Public Law 106-390; approved by Congress October 10, 2000), amended the Stafford Disaster Relief and Emergency Assistance Act by repealing its previous mitigation planning provisions and replacing them with a new set of requirements that emphasize the need to closely coordinate mitigation planning and implementation.

Hazard Mitigation Plan Requirements for Indian Tribal Governments

Requirements for Indian Tribal governments were consolidated and clarified when the U.S. Federal Emergency Management Agency (FEMA) amended Title 44 of the Code of Federal Regulations (44 CFR; Section 201) on October 31, 2007 (72 Fed. Reg. 61720) and again on September 16, 2009 (74 Fed. Reg. 47471). These amendments were made in recognition of the status of tribal sovereignty and the government-to-government relationship between FEMA and Indian Tribal governments. They established a protocol for Tribal hazard mitigation plans to be separate from state and local mitigation plans. Final mitigation planning guidelines became effective March 2010. Tribal hazard mitigation plan requirements differ from local hazard mitigation plan requirements, and are more like the requirements for a state-level type plan. This hazard mitigation plan for the Yurok Tribe was developed under those guidelines. The federal statutes define *Indian Tribal Government* as "any Federally recognized governing body of an Indian or Alaska Native tribe, band, nation, pueblo, village, or community that the Secretary of Interior acknowledges to exist as an Indian Tribe under the Federally Recognized Indian Tribe List Act of 1994, 25 U.S.C. 479(a)" (44 CFR 201.2). This does not include Alaska Native corporations when the ownership is vested in private individuals.

Underlying Principles of the DMA

Hazard mitigation is a way to reduce or alleviate loss of life, personal injury and property damage that can result from a disaster through long- and short-term strategies. It involves planning, policy changes, programs, projects and other activities that can mitigate the impacts of hazards. The responsibility for hazard mitigation lies with many, including private property owners; business and industry; and local, state, and federal government. The DMA encourages tribes and state and local authorities to work together on pre-disaster planning, and it promotes sustainability for disaster resistance. "Sustainable hazard mitigation" includes the sound management of cultural and natural resources, local economic and social resiliency, and the recognition that hazards and mitigation must be understood in the largest possible social and economic context. The enhanced planning network called for by the DMA helps tribes and governments articulate accurate needs for mitigation, resulting in faster allocation of funding and more cost-effective risk reduction projects.

1.1.2 Yurok Tribe's Initial Plan

In December 2005 and January 2006, two major floods and a winter storm on the Yurok Reservation resulted in a disaster declaration by the President of the United States. A hazard mitigation plan was

necessary in order to receive FEMA assistance with disaster recovery and to participate in the FEMA mitigation grant program. Tribal staff prepared the Yurok Indian Tribe Hazard Mitigation Plan, and the Tribal Council adopted it in May 2006.

This 2013 update to the 2006 plan has been developed in accordance with requirements of the DMA, including criteria addressing the planning process, risk assessment, mitigation strategy, plan maintenance, and the adoption process. Once the plan is approved by FEMA, the Tribe remains eligible for funding under the Stafford Act. FEMA grant programs provide funding through state emergency management agencies to support mitigation planning and projects to reduce potential disaster damages. It is the intent of the Tribe to pursue grant opportunities in the future to assist in mitigating against the Tribe's hazards of concern. Current grant opportunities are delineated in Table 1-1.

1.1.3 Purposes for Planning

DMA compliance is only one of multiple objectives driving this planning effort. Elements and strategies in this plan were selected because they meet a program requirement and because they best meet the needs of the Yurok Reservation (YR). This hazard mitigation plan identifies resources, information, and strategies for reducing risk from natural hazards. It will also help guide and coordinate mitigation activities. The plan was developed to meet the following objectives:

- Meet or exceed program requirements specified under the DMA.
- Enable the YR to continue using federal grant funding to reduce risk through mitigation.
- Meet the needs of the YR as well as federal requirements.
- Coordinate existing plans and programs so that high-priority initiatives and projects to mitigate possible disaster impacts are funded and implemented.
- Create a linkage between the hazard mitigation plan and established plans of the Yurok Tribe so that they can work together in achieving successful mitigation.

1.2 WHO WILL BENEFIT FROM THIS PLAN?

All citizens and businesses of the Yurok Tribe are the ultimate beneficiaries of this hazard mitigation plan. The plan reduces risk for those who live in, work in, and visit the Yurok Reservation. It provides a viable planning framework for all foreseeable natural hazards. Participation in development of the plan by key stakeholders helped ensure that outcomes will be mutually beneficial. The plan's goals and recommendations can lay groundwork for the development and implementation of local mitigation activities and partnerships.

1.3 HOW TO USE THIS PLAN

This hazard mitigation plan is organized into three primary parts:

- Part 1—The Planning Process
- Part 2—Community Profile
- Part 3—Risk Assessment
- Part 3—Mitigation Strategy.

TABLE 1-1.
GRANT OPPORTUNITIES

Program	Enabling Legislation	Funding Authorization	Hazard Mitigation Plan Requirement	
			Grantee	Sub-Grantee
Public Assistance, Categories A-B (e.g., debris removal, emergency protective measures)	Stafford Act	Presidential Disaster Declaration	□	□
Public Assistance, Categories C-G (e.g., repair of damaged infrastructure, publicly owned buildings)	Stafford Act	Presidential Disaster Declaration	☑	□
Individual Assistance (IA)	Stafford Act	Presidential Disaster Declaration	□	□
Fire Management Assistance Grants	Stafford Act	Fire Management Assistance Declaration	☑	□
Hazard Mitigation Grant Program (HMGP) Planning Grant	Stafford Act	Presidential Disaster Declaration	☑	□
HMGP Project Grant	Stafford Act	Presidential Disaster Declaration	☑	☑
Pre-Disaster Mitigation (PDM) Planning Grant	Stafford Act	Annual Appropriation	□	□
PDM Project Grant	Stafford Act	Annual Appropriation	☑	☑
Flood Mitigation Assistance (FMA)	National Flood Insurance Act	Annual Appropriation	☑	☑
Severe Repetitive Loss (SRL)	National Flood Insurance Act	Annual Appropriation	☑	☑
Repetitive Flood Claims (RFC)	National Flood Insurance Act	Annual Appropriation	☑	□
Tribal Homeland Security	Dept. of Homeland Security	Annual Appropriation	☑	□

☑ = Tribal Hazard Mitigation Plan Required
□ = No Tribal Hazard Mitigation Plan Required

Each part includes elements required under federal guidelines. DMA compliance requirements are often cited at the beginning of a subsection to illustrate compliance with the requirement. The following appendices provided at the end of the plan include information or explanations to support the main content of the plan:

- Appendix A—A glossary of acronyms and definitions.
- Appendix B—Public outreach information, including the hazard mitigation questionnaire and summary and documentation of public meetings.
- Appendix C—Catalogs of hazard mitigation alternatives to be considered for recommendation in the plan.
- Appendix D—A template for progress reports to be completed as this plan is implemented.
- Appendix E – 2006 Strategy Status.

1.4 GUIDING PRINCIPLE, GOALS AND OBJECTIVES

Hazard mitigation plans must identify goals for reducing long-term vulnerabilities to identified hazards (44 CFR Section 201.7(c)(3)(i)). The Steering Committee established a guiding principle, a set of goals and measurable objectives for this plan, based on data from the preliminary risk assessment and the results of the public involvement strategy. The guiding principle, goals, objectives and actions in this plan all support each other. Goals were selected to support the guiding principle. Objectives were selected that met multiple goals. Actions were prioritized based on the action meeting multiple objectives.

1.4.1 Guiding Principle

A guiding principle focuses the range of objectives and actions to be considered. This is not a goal because it does not describe a hazard mitigation outcome, and it is broader than a hazard-specific objective. The guiding principle for the Yurok Tribe Hazard Mitigation Plan was determined at the May 9, 2012 meeting, and is as follows:

> *Assist with the Yurok Tribal Mission as stated in the Yurok Constitution and guiding documents; such as improving the Social and Ecological Balance of the world by protecting and enhancing the lives and safety of all peoples and resources within the Yurok Ancestral Territory.*

1.4.2 Goals and Objectives

The planning team reviewed the goals and objectives from the 2006 Hazard Mitigation Plan. The 2006 Mitigation Plan listed goals which were specific to each hazard, many of which were similar when compared to the goals of the other hazards. In an effort to streamline the establishment of goals, it was determined by the planning team that while the intent would remain the same, the verbiage would change to be more encompassing for all hazards (when applicable) while still maintaining the original intent of the Tribe when the goals were originally established. The following are the mitigation goals for this plan:

- **Goal 1**—Reduce or prevent future hazard-related injuries and losses of life, property damage, and environmental impact.
- **Goal 2**—Reduce the adverse impacts on the economy caused by natural disasters.
- **Goal 3**—Encourage the development and implementation of long-term, cost-effective and environmentally sound mitigation projects.
- **Goal 4**—Enhance community emergency management capability through increased public awareness and readiness (i.e., prepare, plan, respond, recover, mitigate).
- **Goal 5**—Promote disaster-resistant and resilient communities.
- **Goal 6**—Preserve the cultural integrity of the Yurok Tribe.

The effectiveness of a mitigation strategy is assessed by determining how well these goals are achieved.

Each selected objective meets multiple goals, serving as a stand-alone measurement of the effectiveness of a mitigation action, rather than as a subset of a goal. The objectives are measureable in nature, and are used to help establish priorities. The objectives for the 2012 Mitigation Plan Update are similar to those in the 2006 plan with slight modification and include specific objectives fort the community wildfire protection plan, defined in Table 1-2.

TABLE 1-2.
TRIBAL HAZARD MITIGATION AND COMMUNITY WILDFIRE PROTECTION PLAN OBJECTIVES

Objective Number	Objective Statement	Goals for which it can be applied
O-1	Acquire (purchase), retrofit, or relocate structures in high hazard areas.	1, 2, 3, 4, 5
O-2	Encourage open space uses in hazardous areas or ensure that if building occurs in these high-risk areas that it is done in such a way as to minimize risk.	1, 2, 5, 6
O-3	Use best available data, science and technologies to improve understanding of location and potential impacts of hazards, and to promote disaster resilient communities by discourage new development in hazardous areas or ensuring that development is done in such a way as to minimize risk.	1, 2, 3, 4, 5, 6
O-4	Consider the impacts of natural hazards in all planning mechanisms that address current and future land uses on the Reservation.	1, 2, 3, 5, 6
O-5	Educate the reservation residents and surrounding communities on the risk exposure to natural hazards and ways to increase the member's capability to prepare, respond, recover and mitigate the impacts of these events.	1, 2, 3,4, 5, 6
O-6	Increase resilience and the continuity of operations of identified critical facilities within the Reservation.	1, 2, 3, 4, 5, 6
O-7	Preserve the Cultural Resources of the Yurok Tribe.	1, 2, 3, 4, 5, 6
O-8	Provide/improve flood protection through various means, such as with flood control structures and drainage maintenance where appropriate and feasible.	1, 2, 3, 4,5, 6
O-9	Consider NFIP with the ultimate goal to lower the cost of flood insurance premiums through the CRS program.	1, 2, 3, 4, 5, 6
O-10	Establish a partnership among the Tribal Government and Tribal business leaders with surrounding area government and business community to improve and implement methods to protect life, property and the environment, while preserving the cultural integrity of the Yurok Tribe and its members.	1, 2, 3, 4, 5, 6
O-11	Enhance community emergency management capability (i.e., prepare, plan, respond, recover, mitigate).	1, 2, 3, 4, 5, 6
O-12	Encourage the development and implementation of long-term, cost-effective and environmentally sound mitigation projects by encouraging use of incentives.	1, 2, 3, 4, 5
O-13	Develop or improve emergency warning response and communication systems and evacuation procedures.	1, 6
O-14	Provide/improve fire protection activities through various means, such as defensible space, spatial distribution of development, and enhanced water supply systems where appropriate and feasible.	1, 2, 3, 4,5, 6
O-15	Enhance land use regulations to proactively impact the hazards of concern.	1, 2, 3, 4, 5, 6
O-16	Encourage fuel treatment activities that will protect at risk structures and infrastructure.	1, 2, 3, 4, 5
O-17	Encourage hazard mitigation measures that result in the least adverse effect on the natural environment and that use natural processes, while preserving and maintaining the cultural elements of the Yurok Tribe.	1, 2, 3, 4, 5, 6

CHAPTER 2.
PLAN DEVELOPMENT METHODOLOGY

2.1 PLANNING RESOURCE ORGANIZATION

The process followed to develop the Yurok Tribe Hazard Mitigation Plan had the following primary objectives, which are discussed in detail in the following sections:

- Secure grant funding
- Define the planning area
- Establish a planning team/steering committee
- Coordinate with other agencies
- Review existing programs
- Engage the public (as defined by the Tribe)

2.1.1 Grant Funding

This planning effort was supplemented by a grant from the State of California Disaster Recovery Initiative. The grant was applied for in 2008, and funding was appropriated in 2008. It grant provided funding for the development of the Hazard Mitigation Plan and Community Wildfire Protection Plan (CWPP); the Yurok Tribe covered the balance through in-kind contributions. In addition, the grant also funded the development of the Yurok Emergency Land Use Plan, a Safety Plan, and a Vegetation Study to support the development of the CWPP.

2.1.2 Defining the Planning Area

Due to the frequency of hazard events impacting the Yurok Reservation and its remote location, the Tribe elected to conduct its own hazard mitigation planning and not become an annex to any multi-agency local government plan. This Yurok Tribe Hazard Mitigation Plan is a single-jurisdiction plan covering the entire Reservation, and also includes areas defined as having cultural and historical significance to the Tribe. While no specific locations or items of cultural significance have been identified within this document in an effort to protect the areas and items, they have been considered within this planning process and risk assessment analysis, as well as strategy development. It should be understood that the entire Reservation is considered to be of cultural significance, and as such, this process includes all of the people, property, infrastructure and natural environment within the boundaries of the Yurok Reservation as well as any property owned or used by the Yurok Tribe outside this area, such as the hunting, gathering and fishing areas. The planning area for this plan update is shown in Figure 2-1.

Figure 2-1 also depicts the Tribe's ancestral boundaries. The Tribe's intent is to ultimately acquire the area encompassed within that boundary as Tribal lands. The Tribe has already initiated this effort at both the local and federal levels, purchasing land mass as it becomes available, and also addressing the matter before Congress. Presently, there are tribal members who live outside what is the current tribal boundary. It should be noted that for mitigation planning purposes, if those properties are impacted by disaster events, loss estimations are included within this current analysis. As the Tribe provides response activities for those residences and facilities, it is felt that the potential for risk should also be determined so as to provide the Tribe with a realistic portrayal of disaster impact for planning purposes.

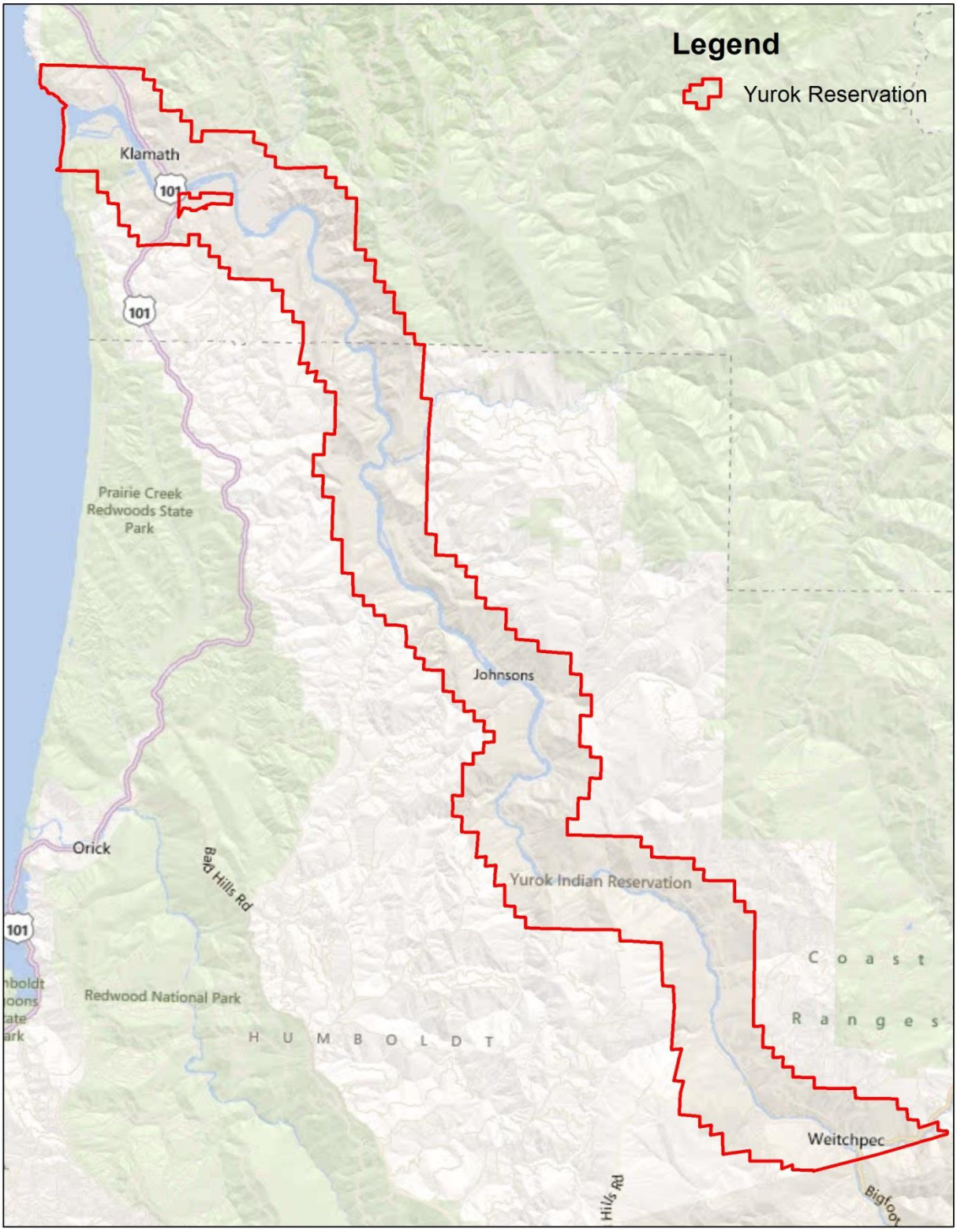

Figure 2-1. Planning Area Including Ancestral Boundary

2.1.3 Formation of the Planning Team

The Yurok Tribe hired Tetra Tech, Inc. to assist with development and implementation of the plan. The Tetra Tech project manager assumed the role of the lead planner, reporting directly to the Yurok Tribe project manager. A planning team was formed to lead the planning effort as identified in Table 2-1.

TABLE 2-1.
PLANNING/STEERING COMMITTEE MEMBERSHIP AND ATTENDANCE

Name	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Peggy O'Neill, Planning Director, Yurok Tribe* Peggy@yuroktribe.nsn.us (707) 482-1366 (Ext 360)	X						X	X	X	X	X
Nicole Wright, Planner IV, Yurok Tribe*(a) Mitigation Plan Project Manager nwright@yuroktribe.nsn.us (707) 482-1350	X	X		X	X		X	X	X	X	X
Rachel Rodriguez, GIS Coordinator (HAZUS Practitioner), Yurok Tribe* rrodriguez@yuroktribe.nsn.us (530) 625-4130 (Ext 1632) OR (530) 625-1942	X	X		X	X		X	X	X	X	X
Ray Martell, Asst. Director, YTEP Pollution Prevention Division, Yurok Tribe rmartell@yuroktribe.nsn.us (707) 482-1822 (Ext 1012)			X		X						
Tim Sanderson—Emergency Services Specialist, Public Safety, Yurok Tribe*(b) tsanderson@yuroktribe.nsn.us (707) 482-8185				X	X		X	X	X	X	X
Mary McQuillen, Police Chief, Public Safety, Yurok Tribe mmcquillen@yuroktribe.nsn.us (707) 482-8185					X				X	X	X
Buffy McQuillen, Repatriation/Collections Manager & NAGPRA Coordinator, Cultural, Yurok Tribe buffy@yuroktribe.nsn.us (707) 482-1350 (Ext 1312)									X		
James Erler, Forestry Director, Yurok Tribe jerler@yuroktribe.nsn.us				X					X		

TABLE 2-1.
PLANNING/STEERING COMMITTEE MEMBERSHIP AND ATTENDANCE

Name	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Robert McConnell, Tribal Heritage Preservation Officer, Cultural, Yurok Tribe rmcconnell@yuroktribe.nsn.us									X		
Walt Lara, III., Manager, Yurok Watershed Dept. Yurok Tribe walt@yurok.com (707) 482-0439 (Ext 1802)									X		
Rich Nelson, Yurok Watershed Dept. richard@yurok.com (707) 482-0439 (Ext)									X		
Bob Blanchard, Yurok Tribe Forestry Program forestrybob@hotmail.com (530) 625-4130 (Ext) OR (530) 625-1942			X	X					X		
Clyde Trimble, Sr. ctrimble@yuroktribe.nsn.us (530) 625-4130 (Ext) OR (530) 625-1942			X						X		
David Frye, Road Foremen, Yurok Watershed Dept./Road Maintenance Division, Yurok Tribe dfry@yuroktribe.nsn.us (530) 625-4130 (Ext) OR (530) 625-1942									X		
Dave Hillemeier, Yurok Tribe Fisheries Dave@yuroktribe.nsn.us									X		
Paul Romero, IS Director, Yurok Tribe Paul@yuroktribe.nsn.us (707)482-1350 ext. 1372	X	X	X						X		
Elaina Albers, GIS Program Manager, ISD, Yurok Tribe esupahan@yuroktribe.nsn.us (530) 625-4130 (Ext 1611) OR (530) 625-1942	X	X	X					X	X	X	
Frankie Joe Meyers, Volunteer Fire Dept. & Yurok Watershed Dept./Road Maintenance Division, Yurok Tribe & Klamath Justice Coalition fmyers@yuroktribe.nsn.us			X		X				X		

TABLE 2-1.
PLANNING/STEERING COMMITTEE MEMBERSHIP AND ATTENDANCE

Name	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Javier Kinney, Yurok Self-Governance Dept. jkinney@yuroktribe.nsn.us									X		
Joe Hostler Yurok Tribe Air Quality Program jhostler@yuroktribe.nsn.us			X						X	X	
Ken Fetcho Yurok Tribe Water Quality Program kfetcho@yuroktribe.nsn.us			X						X		
Skip Lowry, UpRiver Community Organizer, Building Healthy Communities Initiatives (530) 625—5147				X							
Margo Robbins, Indian Education & Native Language Director, KTJUSD mrobbins@ktjusd.k12.ca.us											
Cindy Henderson, Del Norte County Emergency Mgmt. chenderson@co.del-note.ca.us											
Dan Leavitt, Del Norte Fire Safe Council (707) 951-1116											
Mike Downey, Humboldt County Sheriff's Dept. mdowney@co.humboldt.ca.us											
Hugh Scanlon Humboldt-Del Norte CUU		X									
Cybelle Immitt Humboldt County Emergency Mgmt. (707) 268-3736 cimmitt@co.humboldt.ca.us			X	X					X	X	X
Tom Hofweber County of Humboldt			X								
Chris Koczera, Humboldt County Red Cross											
Lori Dengler, Humboldt State Geology & Tsunami Work Group Ladi1@humboldt.edu											
Kristen King-McCovey, Kurak Community Health kking@karuk.us											
Jack Jackson, Hoopa OES plinyj@yahoo.com (530)519-4151											

TABLE 2-1.
PLANNING/STEERING COMMITTEE MEMBERSHIP AND ATTENDANCE

Name	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Capt. Mark Rodgers Cal Fire Mark.Rodgers@fire.ca.gov				X					X		
Rob Flaner, Tetra Tech— NFIP/CRS Expert* (208)939-4391 Rob.flaner@tetratech.com	X	X	X						X	X	X
Beverly O'Dea, Tetra Tech Project Manager Lead Planner* (253) 301-1330 Bev.odea@tetratech.com	X	X	X	X	X		X	X	X	X	X
Ed Whitford, Tetra Tech Senior GIS Analyst* (360)336-3071 (x2302) Ed.whitford@tetratech.com	X	X	X	X			X	X	X	X	X
Cathy Walker, Tetra Tech Senior GIS Analyst Cathy.Walker@tetratech.com								X	X	X	X

* Steering Committee Member
a. Steering Committee Chairperson
b. Steering Committee Vice Chairperson
*Note: July, August and September are ceremonial months for the Yurok Tribe; therefore, little activity with respect to meetings occurred during those months.

2.1.4 The Steering Committee

Hazard mitigation planning enhances collaboration and support among diverse parties whose interests can be affected by hazard losses. An over-arching planning team was formed to help provide information and input into the plan development, as well as a steering committee who coordinated with the planning team and lead the effort with respect to the actual drafting of the plan. The members of these committees included key Yurok Tribe staff, professional planners, citizens, and other stakeholders from within the planning area. Table 2-1 lists the committee members.

Leadership roles and ground rules were established during the Steering Committee's initial meeting on May 9, 2012. The Steering Committee agreed to meet as needed throughout the course of the plan's development. These meetings occurred in person, via emails, webinar meetings, or via conference calls. The planning team facilitated each Steering Committee meeting, which addressed a set of objectives based on the work plan established for the plan. Various Steering Committee members met 10 times from March 2012 through January 2013, depending on the issue being addressed. Meeting agendas, notes and attendance logs are available for review upon request.

2.1.5 Coordination with Other Agencies

Opportunities for involvement in the planning process must be provided to neighboring communities, local and regional agencies involved in hazard mitigation, agencies with authority to regulate

development, businesses, academia, and other private and nonprofit interests (44 CFR, Section 201.7(b)). This task was accomplished by the planning team as follows:

- **Steering Committee Involvement**—Agency representatives were invited to participate on the Steering Committee.
- **Agency Notification**—The following agencies were invited to participate in the plan development process from the beginning and were kept apprised of plan development milestones:
  - U.S. Dept. of Interior, Bureau of Indian Affairs
  - U.S. Dept. of Health and Human Services, Indian Health Services
  - California Office of Emergency Services
  - California Department of Transportation (Scenic By-Ways Program)
  - U.S. Dept. of Interior, Bureau of Land Management
  - California Department of Forestry and Fire Protection
  - California State Parks
  - American Red Cross

  These agencies received meeting announcements, meeting agendas, and meeting minutes by e-mail throughout the plan development process. These agencies supported the effort by attending meetings or providing feedback on issues.
- **Pre-Adoption Review**— Agencies listed above were provided an opportunity to review and comment on this plan, primarily through the hazard mitigation plan website (see 2.1.7). E-mails were distributed containing informing concerning draft review, as well as a link to download the plan if desired.
- **Newsletters—**In addition to the above, the Tribe distributes a regular newsletter, which announced plan development and milestones. The newsletter also directed Tribal members to the newly developed website, and the on-line survey.
- **Press Release –** The Tribe also distributed a press release in March which announced the planning effort, and provided the address to the Survey, asking citizens to complete the document.

2.1.6 Review of Existing Programs

Hazard mitigation planning must include review and incorporation, if appropriate, of existing plans, studies, reports and technical information (44 CFR, Section 201.7(c)(1)(iii)). Section 5.3 of this plan provides a review of laws and ordinances in effect within the planning area that can affect hazard mitigation initiatives. In addition, the following programs can affect mitigation within the planning area:

- Yurok Tribe 2006 Hazard Mitigation Plan
- Yurok Tribe CBRNE Plan
- Yurok Tribe Comprehensive Emergency Management Plan
- Yurok Tribe Transportation Plan

- Del Norte County Emergency Response Plan—This emergency support function plan directs emergency response actions in the planning area.
- Del Norte County General Plan—Most recently amended in January 2003, this plan directs land use policy in Del Norte County.
- Del Norte County Comprehensive Economic Development Strategy (CEDS)—The CEDS emerged from a planning process developed with broad-based community participation to address the economic problems and potential of the planning area.
- Del Norte Fire Safe Plan
- Humboldt Operational Area Emergency Response Plan—This is an emergency support function-based plan that directs emergency response actions in the planning area.
- Humboldt County General Plan— This plan directs land use policy in Humboldt County.
- Humboldt County Fire Safe Plan
- State of California Enhanced Multi-Hazard Mitigation Plan (2010)
- Various watershed restoration project reports
- Various papers and studies concerning the impacts of climate change on the YR

An assessment of all Yurok Tribe regulatory, technical and financial capabilities to implement hazard mitigation initiatives is presented in Section 5.3.3. Many of these relevant plans, studies and regulations are cited in the capability assessment.

2.1.7 Public Involvement

Broad public participation in the planning process helps ensure that diverse points of view about the planning area's needs are considered and addressed. The public must have opportunities to comment on disaster mitigation plans during the drafting stages and prior to plan approval (44 CFR Section 201.7(b), 201.7(c)(1)(i) and 201.7(c)(1)(ii)). For this planning effort, "public" is defined as tribal members, tribal employees, the contractor, and some members of surrounding jurisdictions. While surrounding jurisdictions and governmental agencies had some involvement in the planning effort, the Steering Committee was limited to Tribal members, Tribal employees, and the contractor. Part of the reason for this decision was to preserve information concerning the Tribe's cultural resources.

The Tribe did extensive outreach and used different methods to increase involvement, such as pairing meetings with existing Tribal Council meetings, holding Web-based meetings, and scheduling conference calls that allowed participation by agencies and individuals. Interviews were also conducted with individuals and specialists from outside organizations. Those interviews identified common concerns related to natural and manmade hazards, and key long- and short-term activities to reduce risk. Interviews included representatives from water providers, public safety personnel, planning department personnel, natural resources personnel, cultural resource personnel, (volunteer) fire departments, other Tribal government, utility providers, and agencies and entities from surrounding jurisdictions.

The planning team developed a comprehensive public involvement strategy using websites, media sources, and utilized existing meetings to gain input on the process. The Tribe created a new website, which hosted a mitigation section, wherein all notices and survey links were posted. During meetings on the reservation or attended elsewhere by tribal employees or members, individuals were directed to the website to gain better insight of the Tribe's endeavors, and to solicit input. The planning team also identified stakeholders to target through the public involvement strategy. The Tribe also developed

business-card size announcements, which were widely distributed, requesting input to the on-going survey, as well as soliciting information for input into the plan.

Strategy

The strategy for involving the public in this plan emphasized the following elements:

- Include members of the public on the planning team.
- Use a questionnaire to determine general perceptions of risk and support for hazard mitigation and to solicit direction on alternatives. This outreach was not limited to tribal members, but was to all planning participants. The questionnaire was available to anyone wishing to respond via the website, as well as distributed by hand during Tribal survey team deployments. The Tribe also posted a news release in the Tribal Newsletter, seeking response and input.
- Attempt to reach as many planning area tribal members and citizens as possible using multiple formats. This is of significant importance because portions of the Reservation does not have power. This is one of the primary reasons why door-to-door surveys were conducted.
- Identify and involve planning area stakeholders.

Planning Team Input

The majority of the members of the planning team live or work on the Yurok Reservation. The make-up of the steering committee proved to be integral in the success of this planning effort. This helped to add a historical perspective to this committee that proved to be valuable in identifying direction for the plan development process.

Questionnaire

A hazard mitigation plan questionnaire (see Figure 2-2) was developed by steering committee members. The questionnaire was used to gauge household preparedness for natural hazards and the level of knowledge of tools and techniques that assist in reducing risk and loss from natural hazards. This questionnaire was designed to help identify areas vulnerable to one or more natural hazards. The answers to its questions helped guide the planning team in selecting goals, objectives and mitigation strategies. Over 50 hard copies of the questionnaires were disseminated throughout the planning area by multiple means, including door to door distribution of the surveys. Additionally, a web-based version of the questionnaire was made available on the hazard mitigation plan website. Surveys were also made available at Tribal office locations in hardcopy format. Limited questionnaires were completed during the course of this planning process. The complete questionnaire and a summary of its findings can be found in Appendix B.

1. Survey Introduction

A planning partnership comprised of stakeholders from the Yurok Tribe, other local Native American Tribes, private industry, federal, state, county, and local governments are working together to develop the Yurok Tribe Hazard Mitigation Plan, the Community Wildfire Protection Plan, a Safety Element to the Comprehensive Plan, and the Yurok Emergency Land Use Plan. This is in response to Federal programs that will enable the Tribe to use pre- and post-disaster financial assistance to reduce the exposure of Tribal residents to risks associated with natural hazards.

In order to identify and plan for future natural disasters, we need your assistance. This questionnaire is designed to help us gather information from Tribal Members and local citizens about disaster issues, and to find out from you about areas vulnerable to various types of natural disasters. The information you provide will help us coordinate activities to reduce the risk of injury or property damage in the future.

The survey consists of various questions related to the Reservation and its Tribal Members, and provides an opportunity for any additional comments at the end. The survey should take less than 10 minutes to complete and is anonymous, unless you decide to provide contact information. When you have finished the survey, please click "Done" on the final page.

The Yurok Tribal Planning Partnership thanks you for taking the time to participate in this information-gathering process.

1. Are you a Federally recognized member of the Yurok Tribe?

- ◯ Yes
- ◯ No

***2. Do you live on the Reservation?**

◯ Yes ◯ No

***3. Do you work on the Reservation?**

◯ Yes ◯ No

***4. Do you make use of the services provided by the Tribe?**

◯ Yes ◯ No

***5. Which of the following natural hazard events have you or has anyone in your household experienced in the past 20 years? (Check all that apply)**

- ☐ Avalanche
- ☐ Dam/Levee Failure
- ☐ Drought
- ☐ Earthquake
- ☐ Flood
- ☐ Hazardous Materials
- ☐ Household Fire
- ☐ Other (please specify)
- ☐ Landslide
- ☐ Severe Weather (wind, lightning, winter storm, etc.)
- ☐ Tsunami/Seiche (waves generated by wind or seismic activity)
- ☐ Volcanic Eruption (lahar, ash fall)
- ☐ Wildland Fire
- ☐ None

Figure 2-2. Sample Page from Questionnaire Distributed to the Public

Figure 2-3. Sample Business Card for Hazard Mitigation & CWPP Plan Survey

Public Meetings

An open-house public meeting was held on June 20, 2012 in Weitchpec (see Figure 2-4), and again on October 9, 2012 at the Tribal Council. The June 20 meeting ran from 12:00 to 6:00 p.m., and was held in conjunction with several other meetings in hope to capture more interest. The meeting format allowed attendees to examine maps and handouts and have direct conversations with project staff. Reasons for planning and information generated for the risk assessment were shared with attendees. Tables were set up for each of the primary hazards to which the planning area is most vulnerable. A Hazus-MH workstation allowed citizens to see information on their property. This tool was effective in illustrating risk to the public. Planning team members were present to answer questions. Each citizen attending the open houses was asked to complete a questionnaire, and each was given an opportunity to provide written comments to the Steering Committee. Information was also captured concerning fire treatment activities by citizens, as well as information concerning defined wildland-urban interface areas. This information was incorporated into both the strategy portion of the plan, as well as into the Community Wildfire Protection Plan component.

A second open house meeting was held on October 9, 2012. This meeting was approximately 2 hours in length, starting at 3:00 p.m. and was held in conjunction with a vegetation study presentation which was conducted simultaneous with the development of this mitigation plan. During this meeting, the meeting attendees were advised that the draft plan was available for review, and were asked to review the second draft plan. The final draft plan was also available via download from the Tribal website, as well as distributed reservation wide. The final two week public review period began January 17, 2013, lasting through February 6, 2013.

The third and final public meeting was held on February 7, 2013, during which time the plan was presented to the Council, and at which time the Council approved and adopted the plan, pending FEMA approval.

News Releases

A news release was also published to draw attention to the Tribe's survey. The Tribe also has a regularly distributed newsletter, which was used to disseminate information through the planning process. In addition, the Tribe also has a monthly Newsletter, in which regular updates were posted, as well as notice of the draft reviews.

Internet

At the beginning of the plan development process, both an internal SharePoint site was created for planning team and steering committee member use for ease in dissemination of information, and a website was created to keep the public posted on plan development milestones and to solicit relevant input. The plan was also provided via a file -transfer site, which allowed for the plan downloading for review.

The Tribe's website address was publicized in all press releases, mailings, questionnaires and public meetings. Information on the plan development process, the planning team, the questionnaire and phased drafts of the plan was made available to the public on the site throughout the process. The Yurok Tribe intends to keep a website active after the plan's completion to keep the public informed about successful mitigation projects and future plan updates.

In addition, business-card type announcement were also developed, and made available at various locations throughout the reservation, as well as handed out at public meetings. This was done in an effort to gain outreach with respect to the survey.

Figure 2-4. Yurok Reservation, Weitchpec Office June 2012 Open House

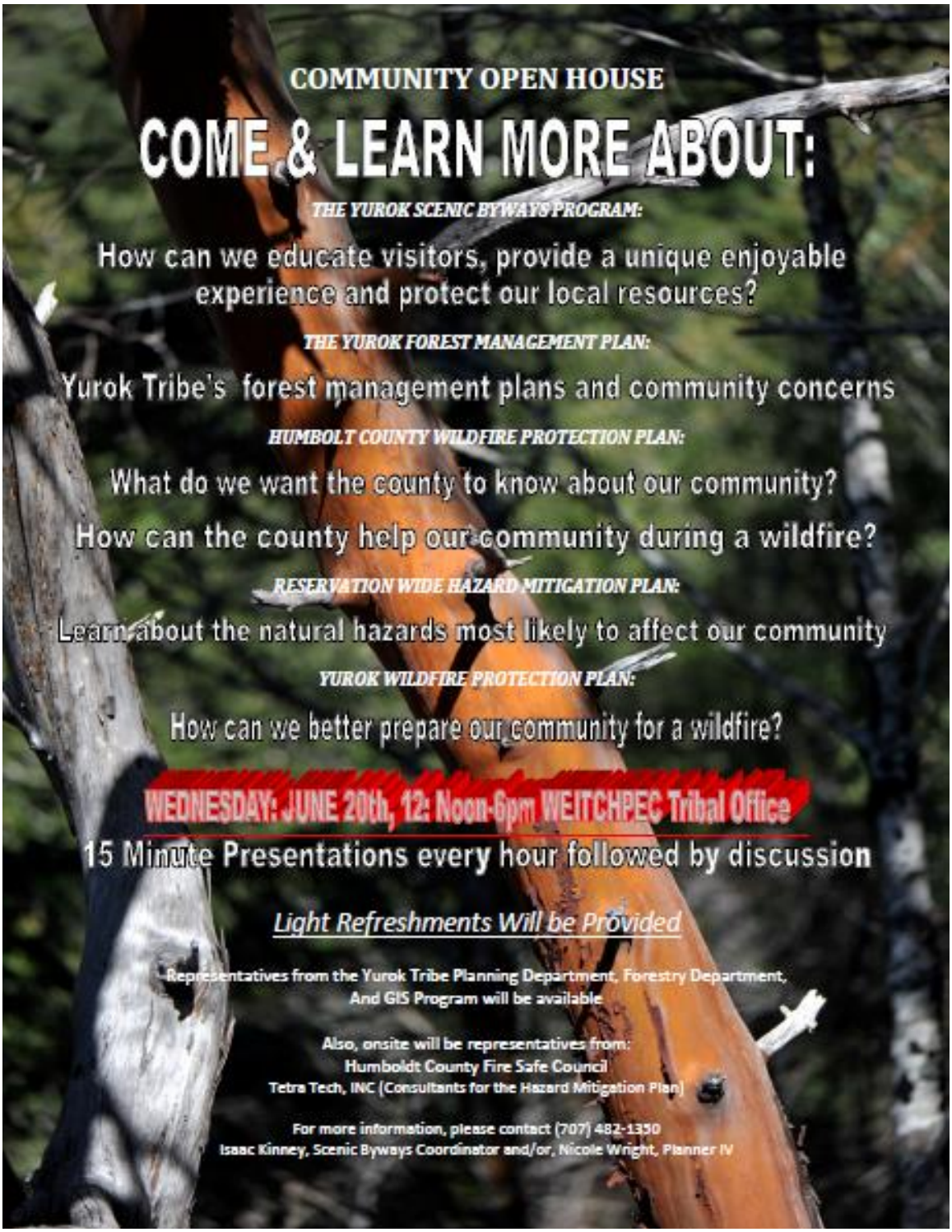

Figure 2-5. Open House Announcement Poster

Yurok Tribal Hazard Mitigation Plan

The Yurok Tribe is presently in the process of updating its Tribal Hazard Mitigation Plan. Information on the current plan (2006) is available here.

The Tribe also provides an opportunity for comments relevant to the development of the Plan and seeks to gather information concerning the communities' input on the hazards of concern. Currently the Tribe is seeking public participation in completing the online survey available at the following link: http://surveymonkey.com/s/Yurok_Tribe_Mitigation_Survey.

Hard copies of the survey may also be sent to Nicole Wright, Yurok Tribe Hazard Mitigation Plan Project Manager, Post Office Box 1027, Klamath, California 95548-1027. For additional information concerning this process please contact Nicole Wright at (707) 482-1350, or Beverly O'Dea, Tetra Tech Project Manager at (253) 301-1330.

© Yurok Tribe 2006

Figure 2-6. Sample Page from Hazard Mitigation Plan Web Site

Public Involvement Results

By engaging the public through the public involvement strategy, the concept of mitigation was introduced to the public, and the Steering Committee received feedback that was used in developing the components of the plan. As indicated, detailed analysis of the questionnaire findings is presented in Appendix B; as summary, while over 50 questionnaires were hand-delivered to residences and made available during all public outreach sessions, as well as at Tribal facilities, only five questionnaires were returned and analyzed.

2.1.8 Plan Development Chronology/Milestones

Table 2-2 summarizes important milestones in the development of the plan.

TABLE 2-2.
PLAN DEVELOPMENT MILESTONES

Date	Event	Description	Attendance
2007 – 2008			
2007	Submit grant application	Seek funding for plan development process	N/A
2008	Receive notice of grant award	Funding secured.	N/A
2011			
12/11	Initiate consultant procurement	Seek a planning expert to facilitate the process	N/A
2012			
2/10	Select Tetra Tech to facilitate plan development	Facilitation contractor secured	N/A
2/15	Begin Identifying planning team members	Begin formation of the planning team; Consultant begins review of various documentation	N/A
3/7	Identify planning team	Formation of the planning team and core project management team. Began review of existing plan and existing documentation supporting effort (e.g., studies, other planning documents, etc.)	N/A
4/2	Public Outreach	Deployed Survey both via web and door-to-door. Surveyors conducted interviews of residents, or left surveys with tribal members as they went door-to-door.	50
5/9	Planning meeting	Presentation on plan process, hazards, goals, objectives and guiding principle presented.	12
5/9	Steering Committee formed	Committee members nominated. The planning team received commitments from 4 members, finalizing the formation of the Steering Committee. General plan template discussed. Discussed hazards to be addressed;	N/A
6/19	Steering Committee Meeting	Goals, Objectives & Guiding Principles confirmed; discussed disaster events; continued gathering data for general plan update;	12
6/20	Public Outreach	Weitchpec Public Meeting Mitigation Planning, CWPP, Scenic By-Ways, Forestry	30
8/9	Draft Plan	Internal review of plan by planning team members to provide input and data for general plan update	All
9/24	Steering Committee Meeting	Review of the risk assessment and methodology used to conduct the analysis	4
10/9	Public Outreach	Presentation of hazard information; fire hazard data presented with incorporated vegetation layer; vegetation layer discussed at length; announcement of open review process for HMP and CWPP	20
11/8	Steering Committee meeting	Strategy/action items reviewed and discussed	4
11/8	2nd Draft Plan	Draft provided by planning team to Steering Committee	All

2013			
1/17	2nd Public Comment Period	Initial public comment period of draft plan opens. Draft plan provided electronically to all planning members, both tribal and non-tribal, as well as the plan being made available at the Klamath Administrative Office for Review.	N/A
2/7	Public Outreach – Presentation at Tribal Council	Final public meeting on Plan presented at Tribal Council Meeting	XX
2/7	Adoption	Tribal Council adopted plan, allowing for modifications as required by FEMA/State after adoption is completed without the need for re-adoption.	N/A
X/X	Ratification/Adoption	CWPP Presented to tribal fire department and Cal Fire agency, and Tribal Government for approval and adoption	
X/X	Plan Approval	Final plan approved by FEMA	N/A

2.2 RISK ASSESSMENT METHODOLOGY

Risk assessment is the process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from natural hazards. It focuses on the following elements:

- Hazard identification—The systematic use of all available information to determine the types of disasters likely to affect a jurisdiction ("hazards of concern"), how often these events can occur, and their potential severity.
- Vulnerability identification—The process of determining the impact of these events on the people, property, environment, economy and lands of a region
- Estimation of the cost of damage or cost that can be avoided through mitigation.

Mitigation planning provides risk assessment information that allows emergency management personnel to establish early response priorities by identifying potential hazards and vulnerable assets. The risk assessment for the Yurok Tribe evaluates the risk of natural hazards prevalent within the reservation and its cultural resources locations, meeting the requirements of 44 CFR Section 201.7(c)(2).

2.2.1 Identification of Hazards of Concern

For this plan, the Planning Team considered the full range of natural hazards that could impact the planning area and then listed hazards that present the greatest concern. The process incorporated review of state and local hazard planning documents, as well as information on the frequency, magnitude and costs associated with hazards that have impacted or could impact the planning area. Anecdotal information regarding natural hazards and the perceived vulnerability of the planning area's assets to them was also used. The 2006 Hazard Mitigation Plan addressed the following hazards:

- Bridge Failure
- Coastal Storm
- Dam Failure
- Drought
- Hailstorm
- High Winds
- Landslide
- Levee Failure
- Tornado
- Tsunami
- Water Contamination
- Wildfire

- Earthquake
- Extreme Heat
- Flood
- Road Failure
- Winter Storms
- Structural Fires
- Windstorm
-
-

Based on the geographic make-up of the Yurok Reservation, there may be significant distinctions between hazards of concern, impact from those hazards, and capabilities to address those impacts between the Upper Reservation and Lower Reservation. Based on that, the planning team determined when those differences between the two reservations varied significantly, those hazards would address the Upper (Humboldt County region) and Lower (Del Norte County region) Reservations separately.

After review of the hazards of concern by the planning team, it was determined the same hazards as addressed in the 2006 mitigation plan would be identified; however, some of the hazards will be grouped together for ease in maintaining the plan, for tracking impacts of like-hazards, and for the risk assessment element, as appropriate. Therefore, the following hazards of concern will be addressed in this plan update:

- Dam/Levee Failure
- Drought
- Earthquake
- Flood (Water contamination)
- Landslide
- Severe weather (combining Coastal Storm, Extreme Heat, Hailstorm, High Winds, Winter Storms, Windstorm and Tornado)
- Tsunami (Water contamination)
- Wildfire/Structural Fire will be addressed within the Community Wildfire Protection Plan, which is a portion of this planning document.
- Road failure, bridge failure and water contamination will be addressed within the critical facilities assessment of each hazard of concern, and not as independent hazards.
- Health Hazards
- Human-Caused Hazards

2.2.2 Climate Change

Climate includes patterns of temperature, precipitation, humidity, wind and seasons. Climate plays a fundamental role in shaping natural ecosystems, and the human economies and cultures that depend on them. “Climate change” refers to changes over a long period of time. It is generally perceived that climate change will have a measurable impact on the occurrence and severity of natural hazards around the world. Impacts include the following:

- Higher temperatures
- Changing landscapes
- Wildlife and fish habitats at risk that impact the Tribe’s cultural resources
- Sea level rise
- Increased risk of drought, fire, floods and landslides
- Stronger storms and increased storm damage, including erosion

- More heat-related illness and disease
- Economic losses
- Depletion of fish stock
- Degradation of forestlands

This hazard mitigation plan addresses climate change as a secondary impact for each identified hazard of concern. Each chapter addressing one of the hazards of concern includes a section with a qualitative discussion on the probable impacts of climate change for that hazard. While many models are currently being developed to assess the potential impacts of climate change, there are currently none available to support hazard mitigation planning. As these models are developed in the future, this risk assessment may be enhanced to better measure these impacts.

2.2.3 Risk Assessment Tools

The risk assessments in Chapter 6 through Chapter 15 describe the risks associated with each identified hazard of concern. Each chapter describes the hazard, the planning area's vulnerabilities, and probable event scenarios. The following steps were used to define the risk of each hazard:

- Identify and profile each hazard—The following information is given for each hazard:
  - Geographic areas most affected by the hazard
  - Event frequency estimates
  - Severity estimates
  - Warning time likely to be available for response.
- Determine exposure to each hazard—Exposure was determined by overlaying any available hazard maps with an inventory of structures, facilities, and systems to determine which of them would be exposed to each hazard. Where such mapping is not available, the need to develop it is included among the mitigation actions recommended in this plan.
- Assess the vulnerability of exposed facilities—Vulnerability of exposed structures and infrastructure was determined by interpreting the probability of occurrence of each event and assessing structures, facilities, and systems that are exposed to each hazard. Tools such as GIS and FEMA's hazard-modeling program called HAZUS-MH were used to perform this assessment for the flood, dam failure and earthquake hazards. Outputs similar to those from HAZUS were generated for other hazards, using maps generated by the HAZUS program.

Earthquake, Flood and Tsunami—HAZUS-MH

Overview

In 1997, FEMA developed the standardized Hazards U.S., or HAZUS, model to estimate losses caused by earthquakes and identify areas that face the highest risk and potential for loss. HAZUS was later expanded into a multi-hazard methodology, HAZUS-MH, with new models for estimating potential losses from hurricanes and floods.

HAZUS-MH is a GIS-based software program used to support risk assessments, mitigation planning, and emergency planning and response. It provides a wide range of inventory data, such as demographics, building stock, critical facility, transportation and utility lifeline, and multiple models to estimate potential losses from natural disasters. The program maps and displays hazard data and the results of

damage and economic loss estimates for buildings and infrastructure. Its advantages include the following:

- Provides a consistent methodology for assessing risk across geographic and political entities.
- Provides a way to save data so that it can readily be updated as population, inventory, and other factors change and as mitigation planning efforts evolve.
- Facilitates the review of mitigation plans because it helps to ensure that FEMA methodologies are incorporated.
- Supports grant applications by calculating benefits using FEMA definitions and terminology.
- Produces hazard data and loss estimates that can be used in communication with local stakeholders.
- Is administered by the local government and can be used to manage and update a hazard mitigation plan throughout its implementation.

Levels of Detail for Evaluation

HAZUS-MH provides default data for inventory, vulnerability and hazards; this default data can be supplemented with local data to provide a more refined analysis. The model can carry out three levels of analysis, depending on the format and level of detail of information about the planning area:

- **Level 1**—All of the information needed to produce an estimate of losses is included in the software's default data. This data is derived from national databases and describes in general terms the characteristic parameters of the planning area.
- **Level 2**—More accurate estimates of losses require more detailed information about the planning area. To produce Level 2 estimates of losses, detailed information is required about local geology, hydrology, hydraulics and building inventory, as well as data about utilities and critical facilities. This information is needed in a GIS format.
- **Level 3**—This level of analysis generates the most accurate estimate of losses. It requires detailed engineering and geotechnical information to customize it for the planning area.

Building Inventory

A User Defined Facility approach was used to model exposure and vulnerability. GIS building data utilizing detailed structure information for 892 facilities was loaded into the GIS and HAZUS model. Building information was developed using best available Tribal data, including building address points, aerial imagery, Parcel Quest data and Tribal staff resources. Building and content replacement values were estimated using values from the Tribe's 2006 Hazard Mitigation Plan, as well as national replacement cost estimating guides. Emphasis was put on developing the most accurate representation of buildings using best available resources. Tribal building inventory included 17 Tribal facilities:

- Childcare Center
- Fire and Fitness Center
- Headstart Building
- Judson Brown Building
- Klamath Dump
- Klamath Beach Rd Pump House/Water System
- Klamath Health Clinic

- Klamath Lodge—(Natural Resources)
- Klamath Water Treatment Plant
- Pem-Mey Fuel Mart
- Requa Resort
- Wautec Fire Station
- Weitchpec Transfer/Fire Station
- Yurok Indian Housing Authority
- Yurok Tribe Main Office
- Yurok Tribe Public Safety (Police)
- Yurok Tribe Weitchpec Office

The remaining 875 structures included in the inventory were broken down as follows:

- Non-Tribal Government Facilities – 19
- Non-Single Family Residential Facilities (Commercial, etc.) – 44
- Single Family Residential Facilities—812

Application for This Plan

The following methods were used to assess specific hazards for this plan:

- **Flood**—A Level 2 analysis was performed. Current DFIRM data was not an adequate representation of flood hazard areas, therefore, HAZUS-MH version 2.1 was used to model an estimated 100-year flood event. A combination of 1 meter LiDAR data and 10-meter digital elevation data was used to generate a 100-year flood depth grid that was integrated into the risk assessment.
- **Tsunami**—Tsunami inundation mapping for the planning area was collected where available. This data was imported into HAZUS-MH and a modified Level 2 analysis was run using the coastal flood methodology. An estimated Tsunami depth grid was created using 1 meter LiDAR data. Modified Coastal Depth Damage Functions were selected from the HAZUS Library to more accurately represent the economic impact from a tsunami event. These updated damage functions were applied to the asset inventory using typical HAZUS protocol to estimate damage costs.
- **Earthquake**—A Level 2 analysis was performed to assess earthquake risk and exposure. Earthquake shake maps and probabilistic data prepared by the U.S. Geological Survey (USGS) were used for the analysis of this hazard. A modified version of the National Earthquake Hazard Reduction Program (NEHRP) soils inventory was used. One scenario event and two probabilistic events were modeled:
  - The scenario event was a Magnitude-9.0 event on the Cascadia Fault and was developed by USGS in 2011.
  - The standard HAZUS analysis for the 100- and 500-year probabilistic events was run.

Dam Failure, Landslide, Severe Weather and Wildfire

For dam failure, landslide, severe weather and wildfire, historical data was not adequate to model future losses. However, GIS is able to map hazard areas and calculate exposures if geographic information is

available on the locations of the hazards and inventory data. Areas and inventory susceptible to some of the hazards of concern were mapped and exposure was evaluated. For other hazards, a qualitative analysis was conducted using the best available data and professional judgment. Locally relevant information was gathered from a variety of sources. Frequency and severity indicators include past events and the expert opinions of geologists, tribal staff, emergency management personnel and others. The primary data source was the Yurok Tribe GIS database, augmented with state and federal data sets. Additional data sources for specific hazards were as follows:

Dam Failure—Inundation data was available for the upper Klamath watershed and included a domino scenario event which depicts inundation from multiple dam failures, including Iron Gate, Copco No. 1 and Copco No. 2.

Landslide—Klamath Watershed historic landslide hazard data was used to assess exposure to landslides.

Severe Weather—Severe weather data was downloaded from the Natural Resources Conservation Service and the National Climatic Data Center.

Wildfire—Information on wildfire analysis was captured from various sources, including the 2012 Yurok Vegetation Study, CAL FIRE, the Counties of Humboldt and Del Norte, completed vegetation studies, LIDAR data, US Forest Service, and LAND FIRE, among other sources.

Drought

The risk assessment methodologies used for this plan focus on damage to structures. Because drought does not impact structures, the risk assessment for drought was more limited and qualitative than the assessment for the other hazards of concern. In addition, the impact from drought also references fish loss historically experienced by the Tribe, as well as issues related to illegal grow-operations and their negative impact on water levels, and sedimentation issues resulting from drought situations.

Limitations

Loss estimates, exposure assessments and hazard-specific vulnerability evaluations rely on the best available data and methodologies. Uncertainties are inherent in any loss estimation methodology and arise in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from the following:

- Approximations and simplifications necessary to conduct a study
- Incomplete or outdated inventory, demographic or economic parameter data
- The unique nature, geographic extent and severity of each hazard
- Mitigation measures already employed
- The amount of advance notice residents have to prepare for a specific hazard event.

These factors can affect loss estimates by a factor of two or more. Therefore, potential exposure and loss estimates are approximate. The results do not predict precise results and should be used only to understand relative risk.

PART 2 —
COMMUNITY PROFILE

CHAPTER 3.
YUROK TRIBE PROFILE

3.1 GENERAL OVERVIEW

Because this plan is a comprehensive update from the 2006 plan, all information from the Tribe's 2006 Hazard Mitigation Plan has been incorporated into this update to preserve that information. Additional information to enhance the data was taken from the Tribe's website (http://www.yuroktribe.org/) or from communications with tribal members. All information presented in this chapter was taken from the 2006 Plan, the web site or input from tribal members except where otherwise noted. Photos included in this chapter are from the Tribe's website or from other open source documents as referenced. The intent of the photographs is to demonstrate the historic nature of the Tribe and its members, as well as to preserve cultural information.

The Yurok Tribe's people are known historically as the Pohlik-la, Ner-er-er, Petch-ik-lah and *Klamath River Indians*. For millennia, traditional Yurok religion and sovereignty was pervasive and practiced throughout all its historic villages along the Pacific Coast and inland on the Klamath River.

Yurok people have always been adamantly committed to hold on to their traditional ways during times when the Western culture was being taught to the Tribal children in an attempt to eliminate the continued use of cultural and religious teachings that Indian children's families taught. Many hardships plagued Indian students for generations, and these hardships are major factors behind the decline of the Yurok language and traditional ways. When government policy forbade the use of traditional languages and outlawed the practice of traditional ceremonies, Yurok people continued. Some traditional activities stopped while others were revitalized. Most importantly, the knowledge and beliefs continued and has remained constant. Today, younger generations of Yurok who survived the era of attempted Western influence, whom are now elders, have become strong advocates (as elders) for cultural revitalization.

The Yurok Tribe's Territory consists of all Ancestral Lands including, but not limited to, the Yurok Reservation's lands which currently extend from one mile on each side from the mouth of the Klamath River and upriver to the confluence of the Klamath and Trinity Rivers for an distance of 54 miles.

In times past, the Yurok people carried on extensive trade and social relations throughout the region and beyond. Yurok commerce traditionally included a monetary system based on the use of dentalium shells, Terk-n-term and other items as currency.

Traditional ceremonies include the Deerskin Dance, Doctor Dance, Jump Dance, Brush Dance, Kick Dance, Flower Dance, Boat Dance, and others, that have drawn Yurok people and neighboring Tribes together for renewal, healing and prayer. The Yurok people held traditional ceremonies to prevent famine, earthquakes, tsunamis and floods. The Jump Dance or World Renewal Dance was held to end disaster during an early autumn ceremony. The land as a whole, referred to as Yurok Country, stayed in balance and was kept that way by its members' good stewardship, hard work, wise laws and constant prayers to the Creator.

Figure 3-1. Since Before Time, Yurok Played the Stick Game and the tradition continues with today's generations. (Photo courtesy of Nicole Wright, Yurok Tribe Planner)

The following is an excerpt from the Yurok Tribe's Website, which provides great insight into the history of the Yurok People:

> *Our world began long before non-Indian exploration and settlement occurred in our area.*
>
> At one time our people lived in over fifty villages throughout our ancestral territory. The laws, health and spirituality of our people were untouched by non-Indians.
>
> Culturally, our people are known as great fishermen, eelers, basket weavers, canoe makers, storytellers, singers, dancers, healers and strong medicine people. Before we were given the name "Yurok" we referred to ourselves and others in our area using our Indian language. When we refer to ourselves we say Oohl, meaning Indian people.
>
> When we reference people from down river on the Klamath we call them Pue-lik-lo' (Down River Indian), those on the upper Klamath and Trinity are Pey-cheek-lo' (Up River Indian) and on the coast Ner-'er-ner' (Coast Indian). The Klamath-Trinity River is the lifeline of our people because the majority of the food supply, like ney-puy (salmon), Kaa-ka (sturgeon) and kwor-ror (candlefish) are offered to us from these rivers. Also, important to our people are the foods which are offered from the ocean and inland areas such as pee-ee (mussels), chey-gel' (seaweed), woo-mehl (acorns), puuek (deer), mey-weehl (elk), ley-chehl (berries), and wey-yok-seep (teas). These foods are essential to our people's health, wellness and religious ceremonies. Our way was never to over harvest and to always ensure sustainability of our food supply for future generations.

'Culturally, our people are known as great fishermen, eelers, basket weavers, canoe makers, storytellers, singers, dancers, healers and strong medicine people.'

Our traditional family homes and sweathouses are made from fallen keehl (redwood trees) which are then cut into redwood boards. Before contact, it was common for every village to have several family homes and sweathouses. Today, only a small number of villages with traditional family homes and sweathouses remain intact. Our traditional stories teach us that the redwood trees are sacred living beings. Although, we use them in our homes and canoes, we also respect redwood trees because they stand as guardians over our sacred places. The yoch (canoe) makers are recognized for their intuitive craftsmanship. The primary function of the canoes is to get people up and down the river and for ocean travel. The canoe is also very important to the White Deerskin Dance, a ceremony recently rejuvenated. The canoes are used to transport dancers and ceremonial people. The traditional money used by Yurok people is terk-term (dentalia shell), which is a shell harvested from the ocean. The dentalia used on necklaces are most often used in traditional ceremonies, such as the u pyue-wes (White Deerskin Dance), woo-neek-we-ley-goo (Jump Dance) and mey-lee (Brush Dance). It was standard years ago, to use dentalia to settle debts, pay dowry, and purchase large or small items needed by individuals or families.

Tattoos on men's arms measured the length and the value of the dentalia.

Source: Yurok Tribe Website; http://www.yuroktribe.org/culture/culture.htm

Figure 3-2. Sweathouse

3.1.1 Tribal History

The Yurok social and ecological balance, thousands of years old, was shattered by the invasion of the non-Indians beginning in the 17th century. As white explorers, gold-miners and settlers came to this region, the Yurok people lost more than three-fourths of our population through fatal contact with European diseases and unprovoked massacres by vigilantes.

While miners established camps along the Klamath and Trinity Rivers, the federal government worked toward finding a solution to the conflicts, which dramatically increased as each new settlement was established. The government sent Indian agent Redick McKee to initiate treaty negotiations. Initially, local tribes were resistant to come together, some outright opposed meeting with the agent. The treaties negotiated by McKee were sent to Congress, which was inundated with complaints from settlers claiming the Indians were receiving an excess of valuable land and resources.

The Yurok people agreed to sign a "Treaty of Peace and Friendship" with representatives of the President of the United States in 1851; however, the US Senate failed to ratify the treaty while also failing to notify the Tribe of their decision, and in 1855, the U.S. Government ordered the Yurok people be confined to the Klamath River Reserve, which was created by Executive Order. The relocation of Yurok families to unfamiliar lands caused great hardships. The forced removal of Tribal children to U.S. Government boarding schools where they were denied the right to practice their cultural traditions caused great disruption of Tribal heritage.

Throughout historical contacts with the U.S. Government and State of California, Tribal Members have fought to protect and maintain access to Ancestral Lands. These struggles were legally complicated by the fact that the Yurok people had never established a formal structure with a written form of government but recognizing traditional forms of government. After the land-based natural resources and fisheries of our aboriginal lands had been decimated, and the traditional stewardship of the Yurok people ignored, the Yurok people knew it was time to establish and organize a Tribal Council federally to protect and preserve both the traditions of its people and the land and river of its ancestors.

3.1.2 Health

The primary health care provider for the Yurok Tribe is through the United Indian Health Services, Inc., which provides medical, dental, pharmaceutical, and behavioral health services to the Tribal Members. There are currently two health clinics on the Reservation, one in both the upper and lower areas.

Beyond the general medical care, the Tribe has also been proactive in supporting community health on different fronts. In 2010, the Tribe received a $1 million grant from the U.S. Department of Health and Human Services to operate its first-ever Early Head Start program, providing crucial services to families with young children.

In coordination with the California Rural Indian Health Board, the Yurok Department of Public Safety applied for and received a four year grant from the Centers for Disease Control & Prevention. Working with local community and Tribal government officials, the Yurok volunteer fire department, tribal clinic staff, and other public health officials, the Tribe has developed effective strategies to increase seat belt and car seat use among the Yurok population. These strategies have been tailored to meet the specific needs of the Yurok Tribe. In July 2011, the Yurok Department of Public Safety, a Head Start teacher, and one Public Health Nurse, received Child Passenger Safety Technician training/certification at the Yurok Tribal Office in Klamath and hosted a car seat event following the training. At that event, 18 car seats were distributed to families in need and 6 car seats were correctly fitted into the vehicles.

3.1.3 Language

The use of the Yurok language dramatically decreased when non-Indians settled in the Yurok territory. By the early 1900s the Yurok language was near extinction. It took less than 40 years for the language to reach that level. It took another 70 years for the Yurok language to recover.

When the language revitalization effort began, the use of old records helped new language learners. However, it was through hearing fluent speakers that many young learners' fluency level increased. When the Yurok Tribe began to operate as a formal tribal government, a language program was created. The program includes formal classes in public schools, community language classes, summer camps, and other activities sponsored by the Yurok Tribe language office and by community groups such as the Yurok Elder Wisdom Preservation Project. With a dedicated website, the Tribe has made great strides in bringing back much of its culture through its original language (http://linguistics.berkeley.edu/~yurok/web/texts.html).

Figure 3-3. 2006 Yurok Language Camp, Tuley Creek

During the development of a Long Range Restoration Plan, a survey was distributed and completed by Tribal Members which results showed that there were only 20 fluent speakers and 12 semi-fluent speakers of the Yurok language. After a decade of language restoration activities, the Tribe most recently documented that there are 11 fluent Yurok speakers; 37 advanced speakers; 60 intermediate speakers and approximately 311 basic speakers. The Yurok Tribe continues to look to new approaches like the use of digital technology, internet sites, short stories, and supplemental curriculum. The Tribe continues to increase the number of language classes taught on and off the Reservation, at local schools for young learners and at community classes.

The significance of nature and the environment is something which the Yurok people have always held in high regards, and something which they have always seen as a responsibility to protect. Since time immemorial up through the current day, Yurok people have had words to describe extreme weather conditions which have traditionally impacted the Reservation:

- To-Miik-Ro-Riith—Deep Snow
- Ploop—Flood
- Nek-Kec-Ek-Kt-It-Tan Pe-Weh—I hope it doesn’t flood
- Lep-te-Nok—Clouds Blowing
- Mec—Fire
- Cwa-Pih—Hard Rain
- Ta-A-Ndh—Hot Weather
- Tan-Pe-Weh—Storm
- Ka-Ma-Geh—Bad Weather (Stormy)

Through collaborative efforts, the Tribe seeks to develop a Yurok documentary corpus that is as comprehensive as possible and contributes as much as possible to understanding the complexities of the Yurok language. Through these sustained efforts, the language program on the Reservation has evolved to one which will help ensure the continued growth and knowledge of the Yurok language.

3.1.4 Tribal Governance

On November 24, 1993, the Constitution of the Yurok Tribe was certified and approved, after having passed a Ratification Election by a majority of the Yurok Tribal members. The Constitution defines the territory, jurisdiction and authority of its Tribal Government. The Yurok Tribe's main offices are located in Klamath, California. Tribal members who are enrolled and registered to vote elect nine of its members to the Tribal Council. The Tribal Chairperson and Vice Chairperson are elected at-large. Seven Council members represent the seven Tribal Districts (Figure 3-4).

Figure 3-4. Yurok Voting Districts

Each Council member serves a term of three years. The Council meets at least monthly. Individual Council members have District meetings at least quarterly. All regular and special meetings of the Council are open to members of the Yurok Tribe. All votes of the Council are a matter of public record.

In accordance with the Tribe's Constitution, in order to exercise the inherent sovereignty of the Yurok Tribe, the Tribal Council pledges in common to:

- Preserve forever the survival of our Tribe and protect it from forces which may threaten its existence.
- Uphold and protect our Tribal sovereignty which has existed from time immemorial and which remains undiminished.
- Reclaim the Tribal land base within the Yurok Reservation and enlarge the Reservation boundaries to the maximum extent possible within the Ancestral Lands of our Tribe and/or any compensatory land area.
- Preserve and promote our culture, language, religious beliefs and practices and pass them on to our children, our grandchildren, and to their children forever.
- Provide for the health, education, economy and social well-being of our members and future members.
- Restore, enhance and manage Tribal fishery, Tribal water rights, Tribal forests and all other natural resources.
- Insure peace, harmony and protection of individual human rights among our members and among others who may come within the jurisdiction of our Tribal government.

3.1.5 Tribal Departments

The Yurok Tribe maintains a significant number of departments and agencies within its structure of government, all of which have been established for the enhancement and viability of the Reservation and its Tribal Members. With significant focus placed on the growth of the Reservation and (re)acquisition of both ancestral and new lands, the various departments have been established to further that goal, while concurrently improving the Reservation for its members. This section describes some, but not all, of the Tribe's departments and capabilities.

The Yurok Department of Public Safety provides emergency services throughout the Reservation. The Department includes law enforcement, emergency management, and (volunteer) firefighting. The law enforcement agency includes two offices—one in Klamath and the other in Weitchpec. The law enforcement officers are commissioned through the State of California, and provide services throughout the Reservation, and are also cross-deputized as Del Norte and Humboldt County law enforcement officers. Beyond policing both land and waterways to ensure safety through enforcement activities which capture the spirit of the law, the agency also establishes specific programs which address issues of concern on the Reservation, such as the COPS Methamphetamine Initiative Project.

Within the Yurok Department of Public Safety is also the Tribe's Volunteer Fire Department. While volunteer in nature, the department personnel works closely with the citizens of the Reservation to establish fire programs and awareness efforts to help mitigate the fire danger on the Reservation. Fire protection services are also provided by the Klamath Fire Protection District, which provides fire services to the down-river portion of the Reservation.

The Tribe maintains an extensive Tribal Code, which includes both Civil and Criminal regulatory authority. While already progressive in its established codes, the Tribe, in its effort to promote resiliency,

is in the early stages of developing its first land use authority. Once adopted, the new codes will enhance the viability of the Tribe by providing guidance which will directly mitigate the impacts of the hazards of concern upon the Tribe and its members.

Figure 3-5. Students Involved in JOM Program During Spring Break

Education Department provides a wide-range of support services designed to ensure academic success, while building and maintaining the Yurok cultural identity. The Department provides assistance to its members for health, education, economy and social well-being, while preserving and promoting the Tribe's culture, language and religious beliefs and practices such as those taught at the Klamath River Early College of the Redwoods, a charter school that incorporates fishing and other cultural knowledge into the curriculum. The Education Department is responsible for the Head Start Program, the Yurok Language School, Childcare, Higher Education, and providing assistance to students and their families for scholarships and financial aid.

The Yurok Social Services Department administers a broad variety of services including: Yurok Food Distribution, General Assistance, Indian Child Welfare Program, Low Income Home Energy Assistance Program, Yurok Youth, Social Work, Emergency Assistance, Temporary Assistance for Needy Families and the new Yurok Domestic Violence/Sexual Assault Project. The mission of the Department is to help tribal members and families achieve independence, self-sufficiency and healthy, productive communities.

Figure 3-6. Yurok Tribal Member Demonstrates Success of Programs

(Photo Courtesy of Nicole Wright, Yurok Tribe Planner)

The Yurok Tribal Fisheries Program is dedicated to understanding, managing, conserving, and restoring fish populations of the Klamath Basin for the benefit of present and future generations of Yurok People. The Yurok Tribal Fisheries Program is comprised of the following four major divisions: Harvest Management Division (engages in all aspects of fishery harvest management and monitors the Yurok fishery); Lower Klamath Division (conducts research, monitoring, and restoration of fisheries resources in the Lower Klamath River Sub-basin); Trinity River Division (research, monitoring, and restoration of Trinity River fishery resources); and, Klamath River Division (conducts research and monitoring throughout the watershed with a focus on informing water management policy).

The Yurok Tribe Environmental Program's (YTEP) mission is to protect the lands, air and water resources of the Yurok Reservation for the benefit of current and future generations of tribal members.

YTEP's Community and Ecosystems Division consist of programs in: Air Quality, Environmental Health, Pesticides, Brownfields and Climate Change. The work of this division researches the condition of key Yurok subsistence resources, potential contaminants such as pesticides, and potential impacts on Tribal member health. Environmental research includes identifying and assessing potential environmental impacts on the Yurok Tribe and its members and resources as a result of climate change.

YTEP staff utilize science, traditional knowledge and environmental regulation for the purposes of enhancing tribal sovereignty and expanding environmental regulatory authority of the Tribe to promote and protect these resources within the Yurok Reservation. YTEP also provides response activities for post-disaster assessment, and conducts natural resource damage and/or risk assessments to determine impact to the Tribe's environment.

The YTEP's Air Quality Program holds authority to regulate air quality under the Yurok Constitution, which maintains Tribal jurisdiction throughout the Yurok Reservation. In 2005, the Yurok Tribe adopted the Yurok Tribe Air Quality Ordinance (AQO) and Smoke Management Plan. The AQO applies to all persons who discharge pollutants into the air of the Yurok Reservation. The AQO prohibits certain activities and requires compliance with any burn permit issued under the ordinance. It authorizes YTEP to enforce AQO provisions. This reservation-wide jurisdiction over air quality is also consistent with the broad language of Clean Air Act (CAA) section 301 recognizing Tribal primacy over "the management and protection of air resources within the exterior boundaries of the reservation."

YTEP's Environmental Health and Pesticides Program conducts monitoring and research to answer community-based questions regarding the potential and adverse impacts resulting from the exposures to environmental contaminants (pesticides, toxic chemicals, environmental hazards). A primary area of focus is community outreach and notification on pesticide applications within the Yurok Reservation or those that have the potential to impact the reservation lands, waters and residents.

The Yurok Tribe Environmental Program started its Brownfields Program in 2007 with funding from the USEPA Brownfields 128(a) Program. The Brownfields Program has inventoried the Yurok Reservation for potential Brownfields sites and by 2012 over 200 sites have been added to that inventory. YTEP is currently working to complete Phase I Environmental Site Assessments on priority sites identified as potential Brownfields.

YTEP began work on Climate Change impacts, mitigation and adaptation research and planning in 2010 with a grant from USEPA. Due to the interdisciplinary and cross cutting and complex nature of Climate Change, YTEP has focused its efforts on capacity building and technical training for staff on Climate Change research and issues, planning and preparation, and impacts that could affect the lands and resources of the Yurok Tribe.

The YTEP's Water Division focuses on protecting water resources for the Yurok Tribe through monitoring, research and permitting. Programs in this division include Water Quality, Tribal WQ Permitting, Wetlands, and Hydrology. The Yurok Tribe Environmental Program holds authority to regulate water quality under the Yurok Constitution, which maintains Tribal jurisdiction throughout the Yurok Reservation. The Clean Water Act contains language that provides funding and abilities to delegate federal authorities to federally recognized Tribes.

In 2004, the Yurok Tribe adopted the Yurok Tribe Water Pollution Control Ordinance (WPCO) and Water Quality Control Plan (WQCP) for the Yurok Reservation by way of passing Resolution 04-46. The WPCO and WQCP apply to all federal, state, county and Tribal government actions that have the potential to affect waters of the Yurok Reservation. The WPCO and WQCP prohibit certain activities and require compliance with any water quality certification issued under the WPCO and WQCP. It authorizes

YTEP to enforce WPCO provisions. This reservation-wide jurisdiction over water quality is also consistent with the broad language of CWA section 106 that funds Tribes to develop water pollution regulatory programs to protect water quality within the exterior boundaries of the reservation.

The Yurok Tribe asserts inherent Tribal authority through the WPCO and WQCP to regulate government actions that have the potential to affect waters of the Yurok Reservation and delegate YTEP authority to issue water quality certifications for projects that have the potential to impact water quality.

YTEP's water division implements its Non-Point Source Program consistent with its Non-Point Source Assessment and Management Plan. YTEP works in coordination with Yurok Tribe Fisheries Programs and Yurok Tribe Watershed Restoration Department to implement its non- point source reduction program to reduce erosion and sedimentation to the streams in the Lower Klamath River Basin. These projects include; planting trees in riparian areas, planting trees after road decommissioning has occurred and by identifying various Non-Point source pollution sources and remedying them accordingly. In addition, the Water Division delivers watershed stewardship education at the schools on the Reservation to teach young school children the values of healthy watersheds to sustain the salmon populations.

YTEP's Water Division is responsible for implementing the Yurok Tribe's comprehensive program to monitor and assess the chemical, physical, and biological integrity of the Klamath River and its tributaries in a scientific and defensible manner. YTEP has developed a wide spread water quality and monitoring program covering the Klamath and Trinity Rivers including the Klamath River Estuary. YTEP's monitoring program began in 2001 with EPA's approval of the YTEP Quality Assurance Program Plan for Water Quality Assessment and Monitoring.

YTEP's Wetlands Program is dedicated to the inventory, monitoring, assessment and protection of wetlands within the Yurok Reservation. The Yurok Reservation, specifically areas adjacent to the Klamath River Estuary (KRE), contain several wetland complexes in various ecological conditions that serve as critical habitat for anadromous salmonids, especially for ESA listed Coho salmon. Understanding and improving the functional role of KRE wetlands (i.e.: critical fish habitat) is a unifying goal for all three tribal programs that work with wetlands resources. YTEP's Wetlands Program intends to support tribal wetlands protection and restoration efforts by collecting a range of baseline environmental data on wetland complexes within the Yurok Reservation and developing a tribal regulatory framework for wetlands protection. YTEP plans to continue seeking funding and support from USEPA and other agencies to refine its Wetlands Program through continued data gathering and analysis, and promulgation of tribal codes and ordinances in support of the larger goal of wetlands protection.

The YTEP's Pollution Prevention Division focuses on protecting Yurok Reservation resources and lands through the integrated prevention and remediation of solid and hazardous waste. Programs in this division include the Underground Storage Tank Program, Solid Waste Management, Recycling, Source Water Assessment and Protection, Hazardous Materials Response, and Environmental Complaints Investigation.

In 2004, the Yurok Tribe Environmental Program implemented its Integrated Solid Waste Management Program for the reduction and prevention of illegal dumping on the Yurok Reservation. Since then, the program has been extremely effective in its cleanup and remediation activities and enforcement on illegal dumping, as well as educating the public on the benefits of recycling and proper disposal methods.

The Yurok Tribe Pollution Prevention Division has developed its Hazardous Waste Program to respond to, collect, and properly dispose of Hazardous Wastes that may be generated, collected, or illegally released on the Yurok Reservation.

Hazardous waste can have immediate and long term negative effects on human health and the environment. Hazardous waste can seep into the ground and degrade ground water, and or affect the soils and fauna used for traditional gathering and cultural practices. Hazardous waste can also migrate to the Klamath River, ultimately affecting the fish that are gathered for subsistence. Education and Outreach are important in preventing the release of hazardous and toxic substances within the Reservation.

In 2010, the Yurok Tribe Environmental Program created the Source Water Assessment Program (SWAP) and began the first phase of its Source Water Assessments of all tribal drinking water supplies by identifying the area of land that most directly contributes raw (untreated) water used for drinking water. The key elements of an effective source water protection program are those that aim to prevent hazardous substances from releasing deadly toxins where they may degrade the quality of drinking water. Once water quality is diminished, it is difficult and expensive to restore it back to its pristine and usable condition. That is why it is imperative to prevent contamination from occurring in the first place.

3.1.6 Land Allotments and Infrastructure

Yurok Tribe Residential Land Assignment Ordinance (YTC 10) establishes the procedures for assignment of parcels of trust lands to individual members in an effort to preserve and regulate tribal resources, and to encourage development and inhabitation of assigned lots by tribal members. The Ordinance applies only to land held in trust by the Tribe, or in individual trust, and does not apply to lands held individually in fee, whether or not a Yurok person, nor does it impact lands held by way of allotment. The Ordinance conveys land assignments for residential purposes to Yurok Tribal Members within the interior boundaries of the Yurok Reservation. Authorized under Article IV, Section 5 of the Constitution of the Yurok Tribe, the purpose of the Ordinance is to "enact legislation, rules and regulations …[to] manage Tribal lands and assets."

As Figure 3-7 demonstrates, the majority of the land on the reservation belongs to private industry—timber companies, which own a significant portion of lands once owned by the Tribe. The Tribe is in the process of re-acquiring much of this land whenever possible through private sales.

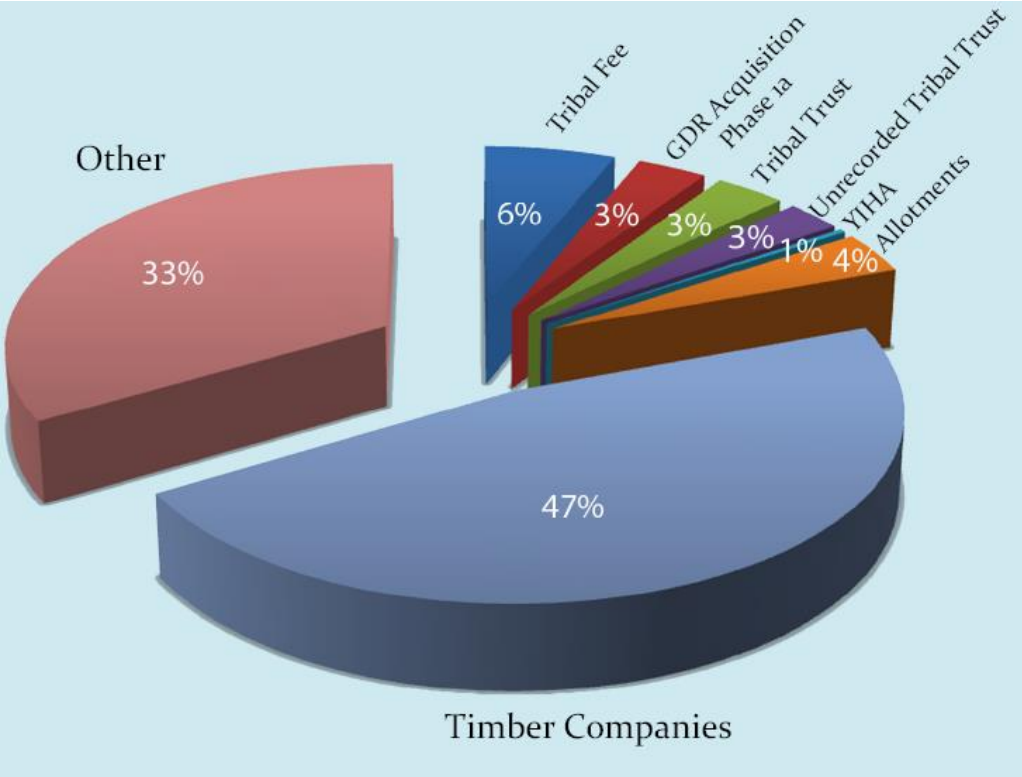

Figure 3-7. Yurok Reservation Ownership Statistics, 2010

3.1.7 Membership and Economy

"The Tribe is hopeful about our increasing capacity for self-governance and cultural preservation and for a bright future of the Yurok Tribe and our people."

The Yurok Tribe is the largest Indian Tribe in California, with 5,628 (plus) enrolled members. At present, the Tribe's economy is greatly stifled by the lack of necessary infrastructure which will support economic growth and development. Unemployment on the Tribe is one of the highest within the State of California as a result of restricted economic development, due largely to the fact that 80% of the Reservation lacks basic infrastructure to support development.

The Yurok Tribe employs 325 full time individuals, 200 part-time and 18 seasonal in more than 12 departments, including: Environmental Protection, Social Services, Forestry, Administration, Planning, Public Safety, Fisheries and Education.

At present, the Tribe is in the process of project development for a casino and hotel to be developed at the Klamath Townsite within the downriver portion of the Reservation, which lies within Del Norte County on the northern side of the Klamath River (Figure 3-8). The intent is to develop a Class II/III Gaming Complex with a 120-room hotel (proposed). The casino would be approximately 30,000 square feet, and would accommodate 340 +/- gaming machines. The 120-room hotel would be constructed adjacent to the casino. In addition, two restaurants would also be constructed as part of the proposed project. This project, once completed, would greatly enhance the economic outlook for the Tribe and its members, not only by creating a source of revenue for the Tribe, but by providing in excess of 200 jobs for tribal members once completed, and enhancing tourism in general on the Reservation. In addition, development of the casino and hotel would mean funding for infrastructure on the Reservation, which is severely limited.

Figure 3-8. Proposed Site of Yurok Casino and Hotel Project

As the Yurok government is funded almost entirely by grants that are specifically earmarked for purposes other than repairing outdated utilities, water and sewer systems, or new roads, completion of this project will have a major impact on the Reservation with respect to development of desperately needed infrastructure. At present, there is no anticipated completion date for the project, as the Tribe is continuing to work through all of the various processes. However, they have received approval at many levels, and are continuing the process of project development.

3.1.8 Tribal Timber Harvesting

Timber harvesting is one of the main economic staples for the Lower Klamath River Basin's portion of the "Redwood Empire" for more than a century. With the advent of hydraulic technology, timber cutting quickly spread across the entire Klamath basin, with clear-cutting accounting for much of the removal of timber. By 1994, much of the old growth trees along the McGarvey Creek basin had been removed (Figure 3-9).

Tribal timber harvesting on the Yurok Reservation is guided by the Tribe's Forest Management Plan, which is currently pending final approval. The plan includes a forest inventory and history, environmental and economic assessments, and three plan components: a resource protection plan; a timber management plan; and a woodland management plan.

Source: US Forest Services: http://www.fws.gov/yreka/Final-Reports/ehrp/2001-HR-02-YT.pdf

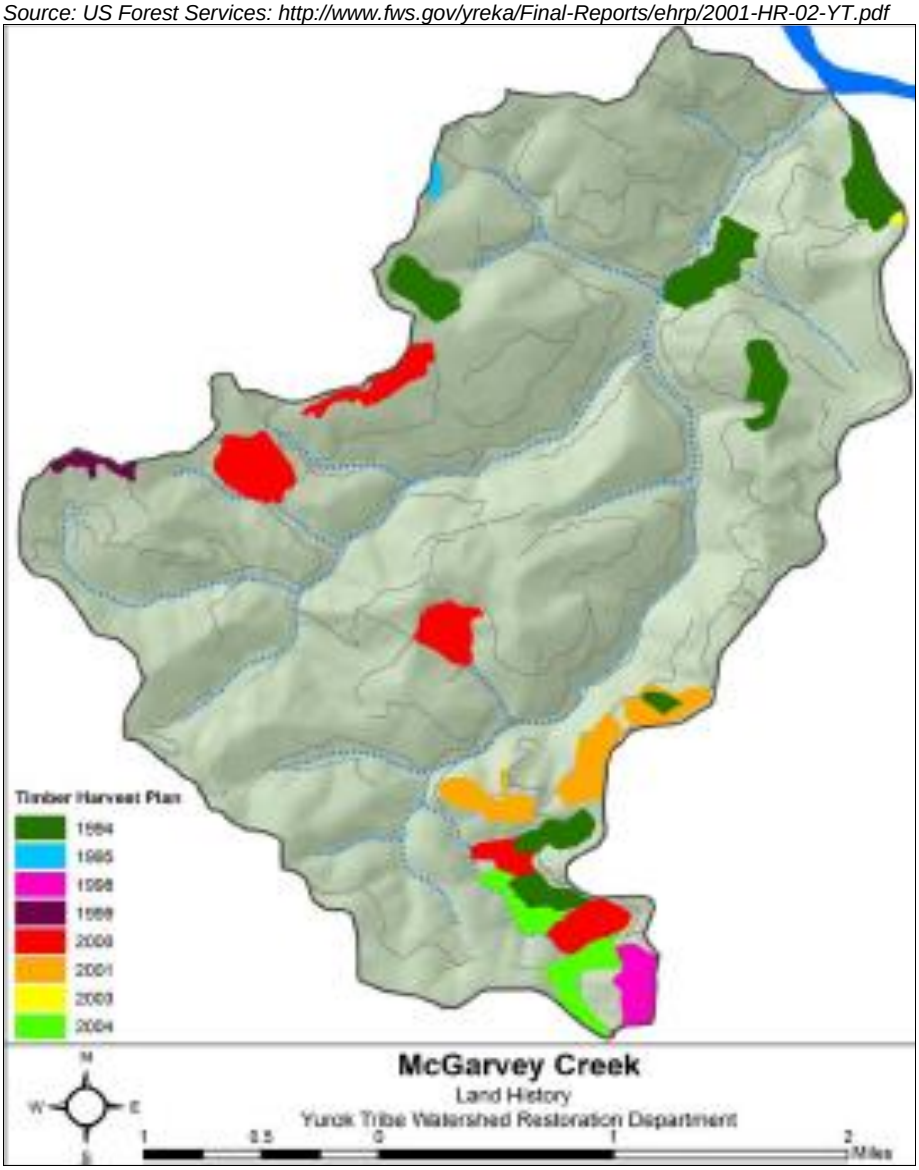

Figure 3-9. McGarvey Creek Timber

3.1.9 Tourism

With the decline in both the fishing and timber industries, tourism remains of vital importance to the Tribe as the number one source of income for the Lower Klamath River Region. As a result of the significance of tourism, restoration of the Tribe's surrounding watersheds became of paramount importance to the Reservation's economic well-being. As such, in 1991, long-range planning included the Congressionally created Klamath Restoration Program (Public Law 99-552).

The Reservation is also home to the only one-lane highway in the state. State Highway 169 is the main vein of transportation for part of the 54-mile-long, 2-mile-wide reservation along the Klamath River basin. The two-way, one-lane road has a sheer cliff drop-off on either side. The highway is not continuous for the entire length of the Reservation; it extends from Highway 101 to the Andy McBeth Airport, and does not resume until about 12 miles upriver at Johnsons.

During the summer months, over 8,000 people travel along U.S. Highway 101 during any given day. The maximum number of residents, tourists, Tribal workers and guests that may be found on the Yurok Reservation at any one time is estimated at greater than 3000. This could occur during the summer months when approximately 1,000 tourists come to Klamath River for salmon fishing, camping and visits to Redwood National and State Park. This causes an enormous strain on the roadways running through the Reservation.

As a result of the limited access on and off the Reservation, the Tribe has become part of the Scenic By-Ways Program for three roadways described below. The Tribe elected to pursue this program for many reasons, one of the most significant being to increase tourism traffic which will enhance the Tribe's economy through recreational, consumer and cultural opportunities. Upon designation of a byway, a Corridor Management Plan (CMP) will be drafted to aid the ongoing implementation and management of the byway. This will be a comprehensive document including marketing plans to promote the byway and interpretive management elements to ensure preservation of Resource Values recognized in the designation. At present, three roadways are selected for the program:

- **Highway 169 South: Weitchpec to Martin's Ferry Bridge**—This segment begins at the intersection of Highway 169 and Highway 96, near the Yurok Tribal Offices and Community Center in Weitchpec. It ends at the Martin's Ferry Bridge, which provides the only vehicular crossing between Weitchpec and Klamath connecting the Yurok Reservation to points west. Highway 169 continues downriver past the bridge to Johnsons. Scenic and natural resource values are evident throughout the segment. There are numerous cultural sites within proximity of this segment includingvillages and traditional ceremonial areas. These provide both interpretive opportunities and significant challenges to protect the sites from adverse impacts. The road is narrow and winding with numerous blind curves and is shared with construction truck traffic, requiring slow travel speeds. The California Department of Transportation (Caltrans) Route Concept Report (2010) identifies various future widening improvements for safety purposes. There are currently several widened areas along the shoulder that have been informally used as pullouts. These could be improved in coordination with Caltrans efforts as small (1 – 2 car) turnouts with interpretive signage or kiosks, providing appropriate traffic control signs were installed along the road. Intermittent breaks in the forest provide scenic vistas of the river at multiple locations. Visitor services are limited to a guide business with cabins located at Spey-gee Point. The Yurok Tribal transfer station is located adjacent to the route but below the elevation of the road and is screened from view.
- **Highway 101: From about 0.6 miles north of the Yurok Ancestral Boundary south to the Yurok Reservation Boundary and Hunter Creek Road**—This segment starts at the Ancestral Boundary located in the Del Norte Coast Redwoods State Park, passing through dense redwood forests. Several existing turnouts could provide interpretive signage locations. The trailhead for Damnation Creek Trail provides access to a dramatic overlook above Damnation Cove coast via a steep descent through old growth redwood forests. The route continues nearer to the coast with the middle portion located within the California Coastal Zone. There are occasional splendid views out to the Pacific Ocean and Footsteps Rock, eventually passing Wilson Beach at False Klamath Cove. Wilson Beach offers visitor facilities and access to multiple trails, including the Coastal Trail and the Yurok Loop trail within the Redwood National Park. The road then veers southwest away from the coast and over a coastal ridge to descend and enter the Klamath watershed. This section ends at Hunter Creek Road, where the Yurok Reservation boundary is located.
- **Bald Hills Road: From Martins Ferry Bridge at Tulley Creek Road to approximate Yurok Reservation Boundary**—This segment begins with a dramatic vista up and down the

Klamath River from the historic Martins Ferry Bridge. The road immediately enters lush coniferous forest as it ascends through a series of switchbacks towards French Camp Ridge. Dramatic intermittent views of the Hoopa Valley and the Pine Creek drainage are seen through openings in the vegetation. Segment is paved and approximately 18 feet wide throughout.

Figure 3-10. Yurok Reservation Roadways
(*Source: Scenic-Byways Program http://www.yuroktribe.org/departments/planning/ScenicByway.htm*)

3.2 TRIBAL INFRASTRUCTURE

3.2.1 Bridge

There is an extensive system of 24 bridges on the Reservation distributed between Humboldt and Del Norte Counties, each of which connect one area of the Reservation to each other, in some cases, serving as the only connection. Several of the bridges on the Reservation are constructed of wood, and are very dated, having endured impact from various hazards multiple times since their construction. All of these bridges are subject to failure during an earthquake or flood.

- Del Norte County Bridges
  - Klamath River Bridge @ US 101
  - Hoppaw Creek @101/169
  - Hoppaw Creek Bridge @ Off Ramp Bridge
  - Hoppaw Creek (Klamath Mill Rd)
  - Minot Creek Bridge @ US 101
  - Panther Creek Bridge @ US 101
  - Hunter Creek Bridge @ US 101
  - Salt Creek Bridge
  - Turwar Creek Bridge @ hwy 169

- Humboldt County Bridges
  - Klamath River Bridge @ 96
  - Tulley Creek Bridge
  - Pine Creek Bridge on Dowd Road
  - Rock Chute Creek Bridge
  - Martin's Ferry Bridge
  - Martin's Ferry School Creek Bridge
  - Rube Ranch Creek Bridge
  - Rube Creek Bridge
  - Miner's Creek Bridge
  - Coon Creek Bridge @ 169
  - Mawah Creek Bridge
  - Cappell Creek Bridge
  - Pecwan Creek Bridge
  - Blue Creek Bridge on Simpson Road B10 (connection of Pecwan to Klamath)

3.2.2 Roadways

The transportation system on the Reservation is among the worst in the nation. A one-lane substandard state highway is the primary road in and out of the upper Reservation. During the summer months, approximately 8,000 people travel along U.S. Highway 101 during any given day. The maximum number of residents, tourists, Tribal workers and guests that may be found on the Yurok Reservation at any one time is estimated at approximately 3000. This could occur during the summer months when approximately 1,000 tourists come to Klamath River for salmon fishing, camping and visits to Redwood National and State Park. This causes an enormous strain on the roadways running through the Reservation.

US 169 runs east to west and is the only route in and out of the upper Reservation. The one-lane highway meanders along a steep river gorge with few turnouts or guardrails. Highway 169 is subject to slips, slides and mudflows and complete failure during winter storms and floods.

Highway 101 runs north to south on the coast portion of the Reservation. During periods of extreme flooding, portions of US 101 are closed for periods of up to 24 hours. Caltrans currently has plans to raise the grade on the portions that are subject to closure from flooding.

Other roads critical to the community and provide escape routes during hazards, such as wildfires, flooding, and dam failure, are Tulley Creek Road, Upper Cappell Road, Lower Cappell Road, Bald Hills Road and Requa Road.

Further discussion on the roadways and infrastructure throughout the Reservation are discussed in greater detail within several of the hazard profiles as potential critical infrastructure impacted by hazard incidents.

3.3 ARCHEOLOGICAL OVERVIEW

3.3.1 Archeological Sites

The North Coast Information Center at the Yurok Tribe maintains records for 2,040 cultural resource sites, including cemeteries, villages, and lithic scatters (surface-visible concentrations of stone chips, flakes, and tools). Three-quarters of these resources are located along rivers and major tributaries; the remainder is located in flat mountainous areas or prairies. High-density sites (villages, cemeteries, and ceremonial and gathering areas) are concentrated in the Hoopa and Yurok Reservations, on Karuk tribal lands and riverine areas. Ridgelines along rivers and creeks, where traveling between villages likely occurred, are considered medium-density resource sites.

3.3.2 Cultural Heritage

The Yurok People have inhabited the lands of the Klamath River for centuries, sustaining themselves by the resources provided by the river. The river and ocean were the central focus of the Yurok Tribal life. Anthropologic studies noted that the Yurok language and oral history reflected the relationship between the people and the Klamath River. Indeed, Yurok myths and legends are rich with references to the river, and nearly every aspect of the Yurok life continues to be associated with the River.

The first “commercial” fishermen in the region, they traded their surplus catch, as well as fishing rights and territory, for needed supplies and regalia. Undoubtedly, the Tribe’s entire culture is largely based upon the Klamath River and its associated fish populations.

The Yurok Tribe is the largest aboriginal tribe in the state of California, with approximately 5,000 enrolled members. The Yurok people are amongst the few aboriginal inhabitants in California with a land base. What is now the Yurok Reservation was created by federal actions between 1853 and 1891. The Reservation encompasses a strip of land one mile wide on each side of the Klamath River, from just upstream of its confluence with the Trinity River at Weitchpec, California, to its mouth at the Pacific Ocean.

Figure 3-11. Yurok Tribe Former Village and Burial Site

Green Diamond Timber Company (formerly Simpson Timber Company) owns a significant portion of the land within the boundaries of the Reservation, as well as the surrounding ancestral lands. A smaller portion of the Reservation consists of public lands managed by Redwood National/State Parks, the U.S. Forest Service (USFS), the Bureau of Land Management (BLM), and about 40,000 acres of private landholdings.

The Yurok Tribe has vigorously pursued prosecution whenever possible of anyone desecrating an object or thing of archeological or historical value. Protection of the cultural resources and ancestral heritage of the Tribe is of paramount importance, and disturbing burial sites is considered one of the most offensive crimes committed against Yurok ancestors. In support of this protection, the Yurok Tribe worked with then State Senator Wes Chesbro to create laws protective Native American graves.

3.3.3 Archeological Overview

Many of the materials captured throughout the plan, and specifically within this section, have been gathered from various sources written and prepared by Yurok Tribal Members. While not specifically sited, the Planning Team wishes to thank all of those who, albeit unknowingly at the time, contributed to this planning effort!

Yuroks have had rights to specific fishing places on the river. Most were passed down from family member to family member, but fishing places could also be exchanged to absolve a debt. There were and are still places that are open to all tribal members. If you fish in someone's fishing spot, you must get prior approval, and it is customary to give them something in return. If a claimed spot is open, under traditional Yurok law, the hole could be fished with permission from the spot's holder.

"Fishing allowed you to trade and barter. It allowed you to have things," Merk Oliver explained, while shaving down a redwood stick to cook salmon the old way. "Just like commercial fishing gives you money to buy clothes and food for your family." Traditionally, Yuroks fished with dip nets, trigger nets and gill nets. "It used to take all winter long to make a (gill) net," said Neil Mckinnon, an 85-year-old Yurok elder. He still holds onto one of the old nets, of which there are very few left.

Human habitation on the Klamath dates to time immemorial. Native American people along the river depended on the vast runs of Pacific Salmon, second only to that of the Columbia River. These Tribes included the Shasta along the mid and upper river, the Yurok, Hoopa and Karuk, along the canyons of the lower river and the Modoc, Klamath, and Yahooskin in the arid valleys of the upper basin. The Shasta Tribe controlled 129 miles (208 km), over half of the middle and upper Klamath River flowing through the great Shasta Tribal lands. The Yurok were probably one of the more powerful Tribes on the Klamath River, controlling about 45 miles of the lower Klamath River and a large section of the Northern California coast. Along with the Hoopa and Karuk, the lower to mid-upper Tribes caught salmon from the river with weirs, basket traps and even harpoons. One well-known ancient fishing ground is Ishi Pishi Falls, a set of rapids on the river near the confluence with the Salmon River. Most of the upstream groups had a nomadic hunting-gathering lifestyle, and did not depend on salmon as much as downstream Tribes.

Figure 3-12. Catch of the Day! Austin and Holdyn Nova

Figure 3-13. Smoke House

(Photos Courtesy of Nicole Wright, Yurok Tribe Planner

CHAPTER 4.
PLANNING AREA NATURAL ENVIRONMENT

4.1 THE PLANNING AREA

The Yurok Reservation (YR) is located in Northern California in the counties of Humboldt and Del Norte (see Figure 4-1. Forests, mountainous terrain, the Klamath River and Pacific coastline characterize this region. Much of the coastline and adjacent forests are set aside as state and national parks and forestlands, including Redwood National Park. As a result, communities are limited to scattered towns and villages along highways U.S. 101, U.S. 169, U.S. 96, and other rural tribal and county roads. A private timber company, Green Diamond Resources Company, owns a vast majority of the land in the Lower Klamath Basin surrounding the YR and access roads are generally off limits for public use compounding emergency transportation routes.

The Reservation consists of 63,035 acres of land located from the center line of the Klamath River and the banks of the river from the mouth of the Klamath at the Pacific Ocean to one air mile above the confluence of the Klamath and Trinity Rivers. The Klamath River is the second largest California river, second only to the Sacramento River in size. The segment of the Klamath River running through the Reservation is approximately 47 miles long, or about 16% of the total length of the Klamath River measured from the outlet of the Upper Klamath Lake in Oregon to the Pacific Ocean. The River flows from the Upper Klamath Lake west through a water gap in the Cascade lavas, entering the Klamath Mountains.

The Klamath River defines the very shape of the Reservation and includes two disperse, separate populated areas on the Reservation, generally known as *up-river* and *down-river*. The total population on the Reservation is approximately 2,100. The *up-river* area is located in Humboldt County and includes several small communities or villages: Weitchpec, Bald Hills, Tulley Creek, McKinnon Hill, Notchco, Ke'pel, Pecwan, and Wautec. The *down-river* portion is primarily located in Del Norte County and includes: Klamath Glen, Klamath, Hunter Creek (not on Reservation), Hoppel, Requa, Resighini Rancheria and Klamath Beach Road. Village names and locations are shown on Figure 4-2.

4.2 CHARACTERIZATION OF THE WATERSHED

The Yurok Reservation is home to many watersheds and sub-basins, all of which maintain cultural significance to its members. Figure 4-3 demonstrates the watersheds within the planning area, a few of which are described in greater detail below. The distribution of land ownership within the Lower Klamath River watershed is shown in Figure 4-4.

The Tribe has been very proactive over the years in protecting its various watersheds, and has implemented many restoration projects to return the areas to their once pristine conditions. In an effort to maintain the health of the waterways on the Reservation, the Lower Klamath Restoration Partnership (LKRP), composed of representatives of the Yurok Tribe Natural Resources Department, Green Diamond/Simpson Timber Company, the California State Coastal Conservancy, and the Northern California Indian Development Council was formed in 1995. This Project Advisory Committee was formed in order to facilitate a coordinated approach to watershed restoration planning and to find innovative solutions to resource management issues between private landowners, Tribal interests, and public agencies.

Figure 4-1. Main Features of Planning Area

Figure 4-2. Yurok Communities

Figure 4-3. Watersheds on the Reservation

Source: Yurok Tribe—Lower Klamath Restoration Plan.

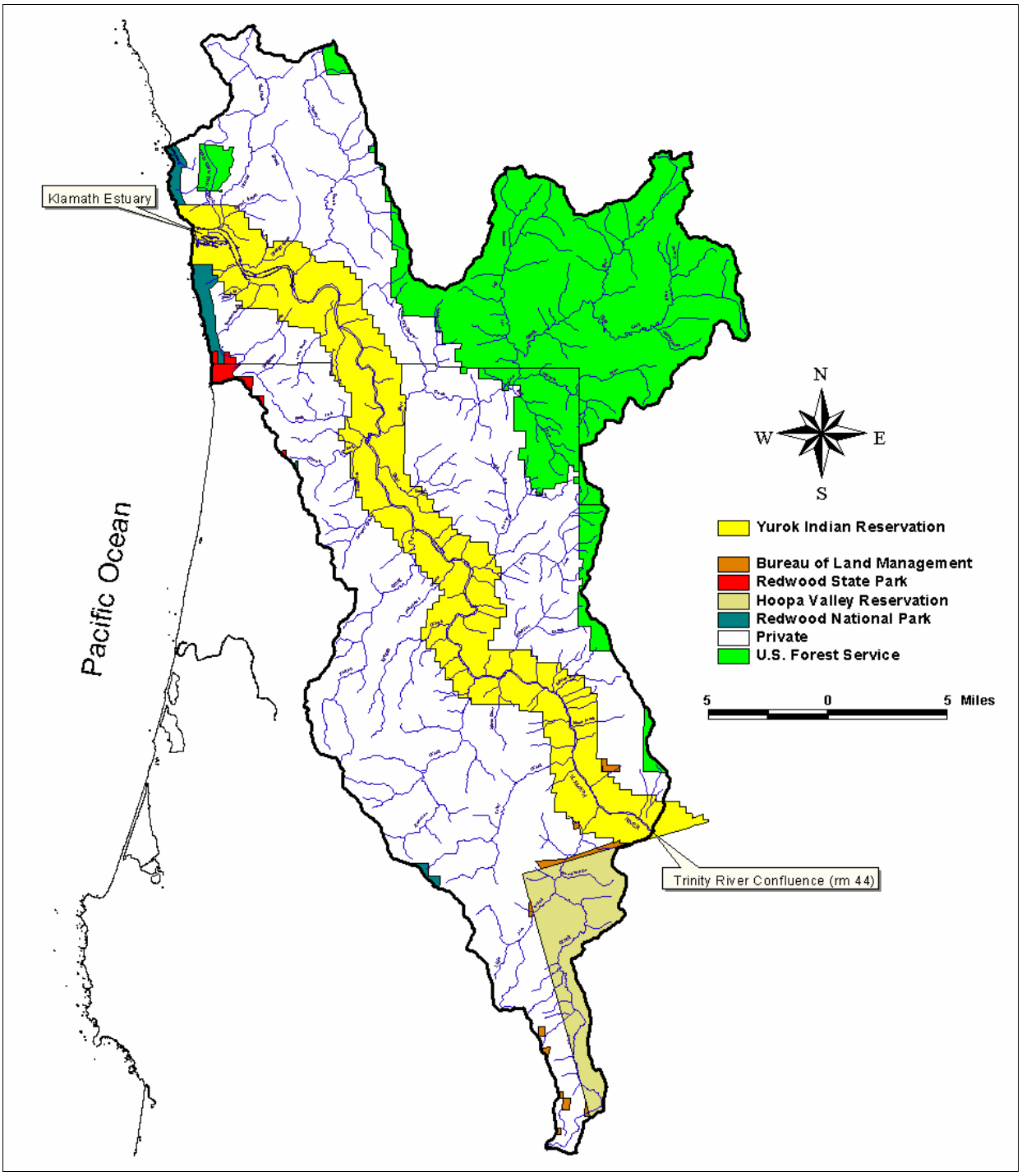

Figure 4-4. Land Distribution in the Lower Klamath Watershed

The Yurok Tribe is providing personnel, administration, planning, and logistical support for The Lower Klamath Restoration Partnership. The Yurok Tribal Fisheries Program and the Watershed Restoration Program have begun implementation of the restoration plan for the Lower Klamath River sub-basin. Green Diamond (formerly Simpson) Timber Company has, and will continue to provide access to their Lower Klamath land holdings, heavy equipment support, materials and supplies, and financial and

logistical support. The California Coastal Conservancy facilitates the overall Lower Klamath River Restoration Program, providing funding for both planning and project implementation.

The Klamath River system is the second largest river system in California, draining an area of 10,039 square miles in California and 5,560 square miles in Oregon. The Klamath River Watershed drains parts of three Oregon counties and five counties in California and includes a diversity of landscapes. The northernmost part of the watershed is drained by the Williamson River and the Sprague River, both which flow generally southwest into Upper Klamath Lake. The middle basin is characterized by extensive wetland, grassland and agricultural areas, and is partially filled by two major bodies of water: Upper and Lower Klamath Lake. Finally, steep canyons and high ridges typify the extensive lower basin, which encompasses over one half of the 15,751-square-mile (40,790 km^2) watershed (see Figure 4-5).

Figure 4-5. Klamath River, Downriver from Martin's Ferry

The Klamath Mountains constitutes the majority of the river's course and takes it from the arid high desert climate of its upper watershed into a temperate rainforest which is nourished by Pacific rains. From the Scott River confluence, the river generally runs west along the south side of the Siskiyou Mountains until it takes a sharp southward turn near the town of Happy Camp. From there, it flows southwest over whitewater rapids into the Klamath National Forest, receiving the Salmon River, and passes Orleans. At

Weitchpec, the river reaches the southernmost point in its entire course and veers sharply northwards as it receives the Trinity River. The Trinity River confluence also marks the point where the Klamath's current dramatically slows. For the remainder of its course, the Klamath flows generally northwest through the Yurok Reservation, passing the town of Klamath and flowing out to sea 16 miles (26 km) south of Crescent City. The mouth of the Klamath River is at Requa in an area shared by the Yurok Reservation and Redwood National Park.

The mouth of the Klamath and nearby sections of the river are susceptible to oceanic tsunami surges, and fatalities have occurred there during the 1964 and 2011 Pacific tsunamis.

McGarvey Creek watershed is located in the lower portion of the Klamath River Basin (Figure 4-6). The McGarvey Creek main stem lies in Humboldt and Del Norte Counties, and is a moderately sized tributary that feeds directly into the main stem of the Klamath River system. In 2004, the Yurok Tribe began a watershed restoration project on the Creek to enhance fish spawning. McGarvey Creek, at that time, was one of the most productive anadromous fish tributaries on the Reservation. The restoration project included the entire hydrological system draining into the creek.

The Blue Creek Watershed is located in the lower portion of the Klamath River Basin, its main stem lying in both Humboldt and Del Norte Counties. The watershed is shown in Figure 4-7. The Yurok consider the Blue Creek their "golden stairway" and weave its stepped pattern into their basketry. As with other watershed areas on the Reservation, the Yurok have worked diligently in restoring the Blue Creek Watershed to its original state. In 2001, the Tribe undertook efforts to decommission 1.6 miles of roads in the watershed.

The Salt Creek Watershed is the lower-most anadromous tributary to the Klamath River, entering the estuary less than one mile upstream of the Pacific Ocean. Salt Creek flows through a low gradient valley and is comprised of shallow meandering channels interspersed with immense beaver ponds and wetland habitats. In contrast, High Prairie Creek (Salt Creek's major tributary) is a steeper and more confined, gravel dominated stream. Climate of the area is classified as Marine West Coast, with the Pacific Ocean maintaining relatively moderate air temperatures with cool summers and wet winters. Mean air temperatures for the area are 54.6 ºF for July and 6.8 ºF in January, with annual average precipitation for the area being 65.4 inches based on hourly rainfall data collected at the USGS gaging station located near Terwer Creek, Del Norte County, California (Station ID: TUR; Sensor ID: 8237). Salt Creek drains 5.85 square miles of low-lying forested hillsides and an expansive valley comprised of pastures and wetlands. Geological evidence suggests that Wilson Creek, a third order watershed now draining to the Pacific Ocean, formed the valley currently inhabited by Salt Creek. Tectonic processes and coastal erosion are believed responsible for the capture of Wilson Creek by the Pacific Ocean. Contained in the watershed is the 1.46 square mile Yurok Redwood Experimental Forest established in 1940 to conduct silvicultural research on coastal redwoods (USFS 1990). Approximately 45 percent of the experimental forest was clear-cut between 1956 and 1985. A research and natural area was established in the experimental forest and comprises 16 percent of the forest area.

The Terwer Creek Watershed is approximately 14 miles long and meets the Klamath just outside of Klamath Glen. In past decades, nearly the entire Terwer Creek watershed has been logged, damaging habitat for animals and fish. Despite the high flows, the water is clear, no doubt due somewhat to the massive amount of restoration work the Tribe's Fisheries and Watershed Programs have accomplished over several years. The Watershed Program has been removing logging roads in the Terwer watershed for several years to reduce the amount of fine sediment delivered to the creek. Fisheries has also been working in the riparian zone of lower Terwer for many years as well in an effort to restore the area and enhance fish and wildlife in the area.

Source: US Fish & Wildlife. Available at: http://www.fws.gov/yreka/Final-Reports/ehrp/2001-HR-02-YT.pdf

Figure 4-6. McGarvey Creek Watershed.

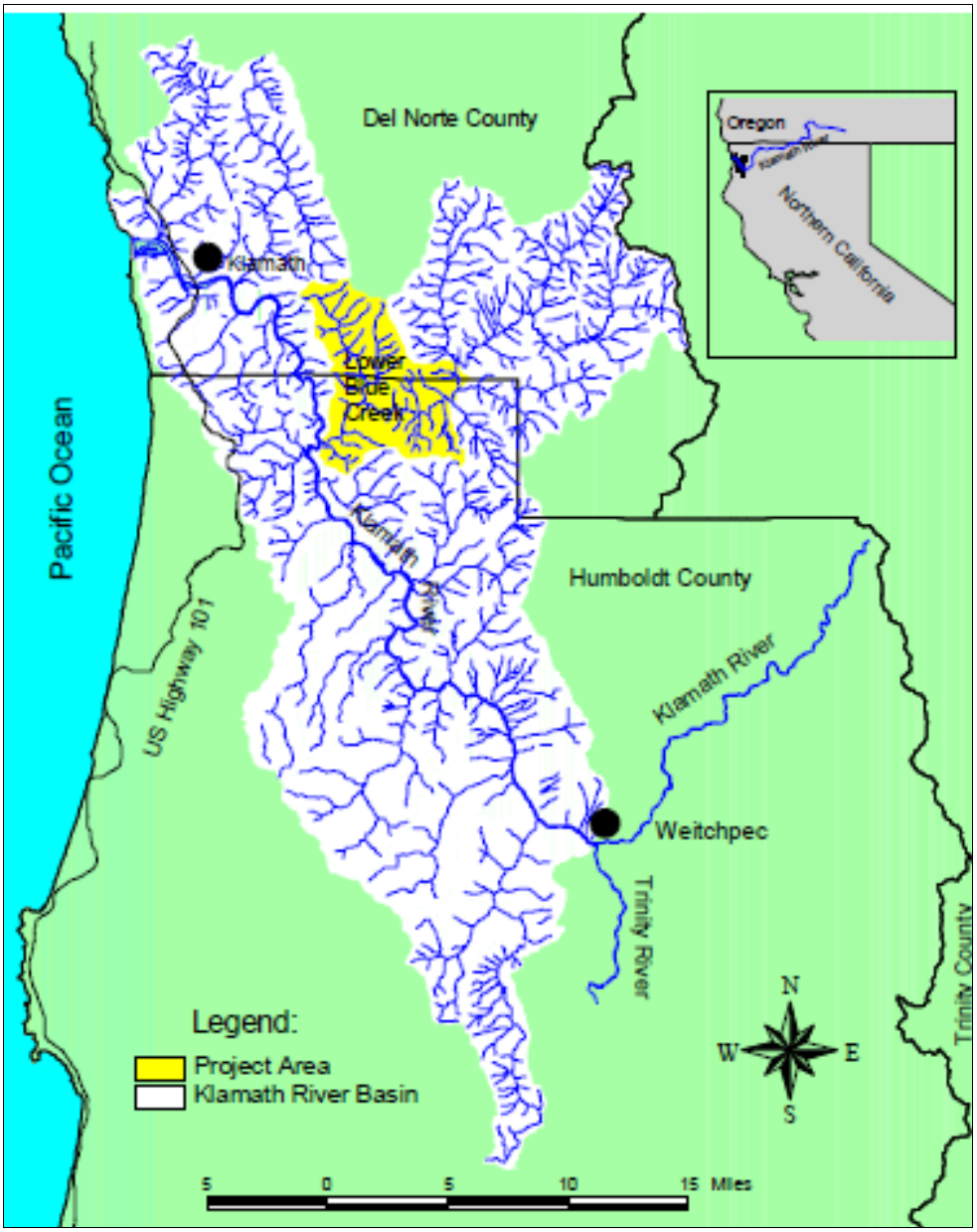

Figure 4-7. Lower Blue Creek Watershed

While in general sediment load is a natural part of any watershed, the amount of sediment is what matters. Sediment occurs naturally in a water course from activities such as: natural landslides, seasonal storms, surface erosion, and channel bank erosion. Mankind, however, has increased the amount of sediment which results from these natural events due to road construction. Roads, by their very nature, increase surface erosion, cause water diversion problems, decrease slope stability, and place dirt in natural water courses. Only changes in land management practices can lead to reduced sediment and an improved ecosystem. Road construction should be subject to more rigid environmental impact standards.

Road management should be approached from an environmental point of view. Fewer roads and better drainages would not only have a positive effect on the environment, but would also reduce maintenance costs on the road network.

4.3 NATURAL RESOURCES

In an effort to protect the natural resources of the Reservation, several initiatives have been undertaken which are hoped to revitalize the vitality of the environment the area to what it once was. Many of those programs are referenced in different areas throughout this planning document, but a few are mentioned below. It should be understood that preservation of natural resources is of the utmost importance to the members of the Yurok Tribe, and their daily activities and manner in which they live support preservation and protection at all levels.

Yurok Tribe Watershed Restoration Program assess and implements slope stabilization projects within the Lower Klamath River Basin in their effort to restore the fisheries population of the basin by reducing sediment from the streams that flow into the river.

Today, only a fraction of historic anadromous fish runs return to spawn in the Klamath River and its tributaries. Although many factors have contributed to these declines in native fish runs, degradation of freshwater habitat has been pervasive in the Klamath River Basin. Kier and Associates (1991) note that "the fish habitats of the basin have been greatly diminished in extent and value in the past century by the construction of impassable dams and by stream diversions and sand and silt from mining, logging, grazing, road development, and floods."

The declining health and productivity of the Klamath River's anadromous fisheries is of great economic and cultural concern to the Yurok Tribe. To proactively address this decline, the Tribe has initiated a large-scale, coordinated watershed restoration effort in the Lower Klamath sub-basin. This sub-basin, as defined in the Klamath Restoration Program's Long Range Plan (Kier and Associates 1991), includes all Klamath tributaries downstream of the confluence of the Trinity River, encompassing a drainage area of approximately 450 square miles. The Long Range Plan states that, "the low number of anadromous salmonids in the Lower Klamath tributaries is directly related to sediment problems...Only changes in land use management and large scale watershed stabilization efforts can effectively address these problems and begin the process of recovery of the Lower Klamath tributaries" (Kier and Associates 1991).

The Tribe also established the 1.46 square mile Yurok Redwood Experimental Forest established in 1940 to conduct silvicultural research on coastal redwoods (USFS 1990). Approximately 45 percent of the experimental forest was clear-cut between 1956 and 1985. A research and natural area was established in the experimental forest which comprises 16 percent of the forest area.

4.4 CLIMATE

The Yurok Reservation is in an area of moderate temperatures and considerable precipitation. The climate of Humboldt and Del Norte Counties ranges from very mild along the coast to cold, wet winters and hot, dry summers just 30 miles inland. The major population areas are along the coast where the temperature ranges from 40-65 degrees year round. Cooling fog and breezes off the cold northern Pacific Ocean regulate the moderate temperatures along the coast while triple-digit temperatures in the summer and freezing temperatures in the winter are common in the inland areas. Temperatures along the coast vary only 10 degrees from summer to winter. July mean maximum readings are in the 60s for the area 15 to 30 miles wide along the coast. Largely as a result of the proximity of the cool Pacific Ocean, the coastal area has a cool, stable temperature regime. With increasing distance from the ocean, the marine influence is less pronounced, and inland areas experience wider variations of temperature and lower humidity. Temperatures in the inland areas can reach as high as 105 degrees during the summer months.

Precipitation in the planning area is of greater frequency and annual magnitude than anywhere else in California. In most years, rainfall is experienced each month of the year, although amounts are negligible

from June through August. About 90 percent of the seasonal total rainfall falls from October through April. Most of this is associated with storm fronts that move in from the Pacific Ocean. Fog is also present along the coastline for much of the year. The Lower Klamath sub-basin receives the highest level of precipitation in the Klamath Basin, with average annual rainfall of up to 100 inches, 75% of which occurs between November and March.

The average annual precipitation is influenced by distance from the ocean, elevation, and shape and steepness of mountain slopes in addition to the direction of slopes in relation to moisture-bearing winds. In general, precipitation increases from south to north and is much heavier on southern and western than on northern and eastern mountain slopes. The wide range in average annual precipitation is striking, decreasing from 120 in. in the northwest to a low of only 10 in. in the northeast.

The seasonal distribution of precipitation is largely controlled by the presence of an anti-cyclonic cell (high pressure area) normally found off the California coast, especially during dry periods. The frequent and heavy winter precipitation usually occurs when this anticyclone is far south of its usual position. When this occurs warm moist tropical air masses are free to migrate eastward to the Pacific Coast. Snow falls in moderate amounts at elevations above 2,000 feet, but only at elevations above 4,000 feet does snow remain on the ground for any appreciable length of time. With many mountain peaks at 6,000-7,000 feet above sea level and a few about 9,000 feet, features of past glaciation exist.

4.5 GEOLOGY

As the North American Plate moved slowly southwestward over the past 10 million years, successive oceanic terrains dating from the Cambrian to the late Jurassic were added to the bulk of the North American continent. There are four distinct terrains from west to east. While the coastal mountains date to less than 3 million years ago, the farther inland High Cascades are as old as 7.5 million years. Granite batholiths, overlying sedimentary rock, and volcanic rock were crumpled into the massif of southwestern Oregon and northwestern California. Instead of being diverted southwards, however, the Klamath continued to flow westward and created a steep-walled gorge through the rising range. One of these terrains brought with it a long north–south running band of easily eroded mica that now lies about 30 miles (48 km) inland from the Pacific coast of Northern California. When the Klamath encountered this layer, it began cutting its canyon along the mica instead of continuing southwest to the Pacific, resulting in the sharp northward bend where the Trinity River joins. The lower Trinity also follows portions of the mica and its south fork as well.

The geology of the planning area also includes the Klamath Mountains, which are rugged and somewhat inaccessible. They lie between the Northern Coast Ranges and the Southern Cascades physiographic provinces. The Klamath Mountains are underlain by highly metamorphosed volcanic and sedimentary rocks that have been intruded by granitic and ultramafic rocks. Structurally these mountains are more complex than the Northern Coast Ranges but display very well defined regional trends. The Coast Ranges province joins the Klamath Mountains province along the distinct 6,000-foot high ridge-like South Fork Mountains, which have the topographic expression of the coast ranges but are underlain by rocks similar to the Klamath Mountains.

Accordant summits and highly dissected old land surfaces are common along major watercourses in the Klamath Mountains. The modern drainage, unlike that of the coast ranges is transverse to both lithic and structural trends and is deeply incised, thus suggesting superposition. The Cascade Range lies east of the Klamath Mountains and north of the Sierra Nevada. The Klamath River drainage heads in this plateau of effusive volcanic and pyroclastic rocks. From near the California-Oregon border the Klamath River flows in a well-defined canyon cut deeply in the volcanic rocks. Upstream from the border, however, surface

drainage is poorly developed, perhaps because the highly permeable rocks allow ready infiltration of snowmelt and precipitation.

4.5.1 Lower Klamath Watershed Geology

The lowest portion of the Lower Klamath River Basin, from the river's mouth up to around Pecwan, is located within a belt of rocks known as the "Franciscan Formation" (Figure 4-8) Rocks of the "Franciscan (geological) Formation" underlie many of the watershed drainage basins. These collections of rock comprised predominantly of sandstones, shales, and minor conglomerates, which are composed of the fluvial/oceanic sediments that are commonly found along a continental shelf margin. These sediments were essentially thrust up onto the edge of North America by faulting, as part of the construction of the North Coast Ranges. This mountain building began around the end of the Jurassic Period (approximately 140 million years ago), and continues to this day. "Splinters" of metamorphic rocks have become incorporated into the Franciscan Formation. These rocks were derived from the deep-sea volcanic and sedimentary rocks upon which the continental shelf sediments were originally deposited. High pressures and temperatures associated with deep burial beneath the continental sediments have essentially "baked" these deep-sea rocks into denser forms. These denser metamorphic rocks are more resistant to weathering than surrounding sedimentary rocks, and are therefore being exposed (by erosion) as prominent monolithic knobs known as "knockers." Since the rocks of the Franciscan Formation were generally uplifted along the continental rim by faults, they have been broken up and pulverized along fault zones. Shearing along these zones is typically so intense that the rocks are ground into clays, which form extremely unstable hill slopes. This, coupled with heavy seasonal precipitation, greatly increases the potential for landslides within the McGarvey Creek region.

4.6 MAJOR PAST HAZARD EVENTS

Presidential disaster declarations are typically issued for hazard events that cause more damage than state and local governments can handle without assistance from the federal government, although no specific dollar loss threshold has been established for these declarations. A presidential disaster declaration puts federal recovery programs into motion to help disaster victims, businesses and public entities. Some of the programs are matched by state programs. Table 4-1 lists disaster events which have occurred in Humboldt and Del Norte Counties since 1955 for which presidential disaster declarations were issued, or in the case of fire, where the state issued an emergency. As the Reservation falls within both counties, incidents occurring within either jurisdiction must be taken into consideration, as disaster events are not impacted by geographic boundaries. Review of these events helps identify targets for risk reduction and ways to increase a community's capability to avoid large-scale events in the future. Still, many natural hazard events do not trigger federal disaster declaration protocol but have significant impacts on their communities. These events are also important to consider in establishing recurrence intervals for hazards of concern.

In addition to those Federal Disaster Declarations referenced in Table 4-1, the Tribe has also received disaster declarations from other federal agencies. These disaster declarations, while not reaching the thresholds established to gain Stafford Act declarations, have had a significant impact in providing additional funding opportunities for mitigation efforts and during times when damages to the Reservation are below the standard FEMA threshold for recovery efforts.

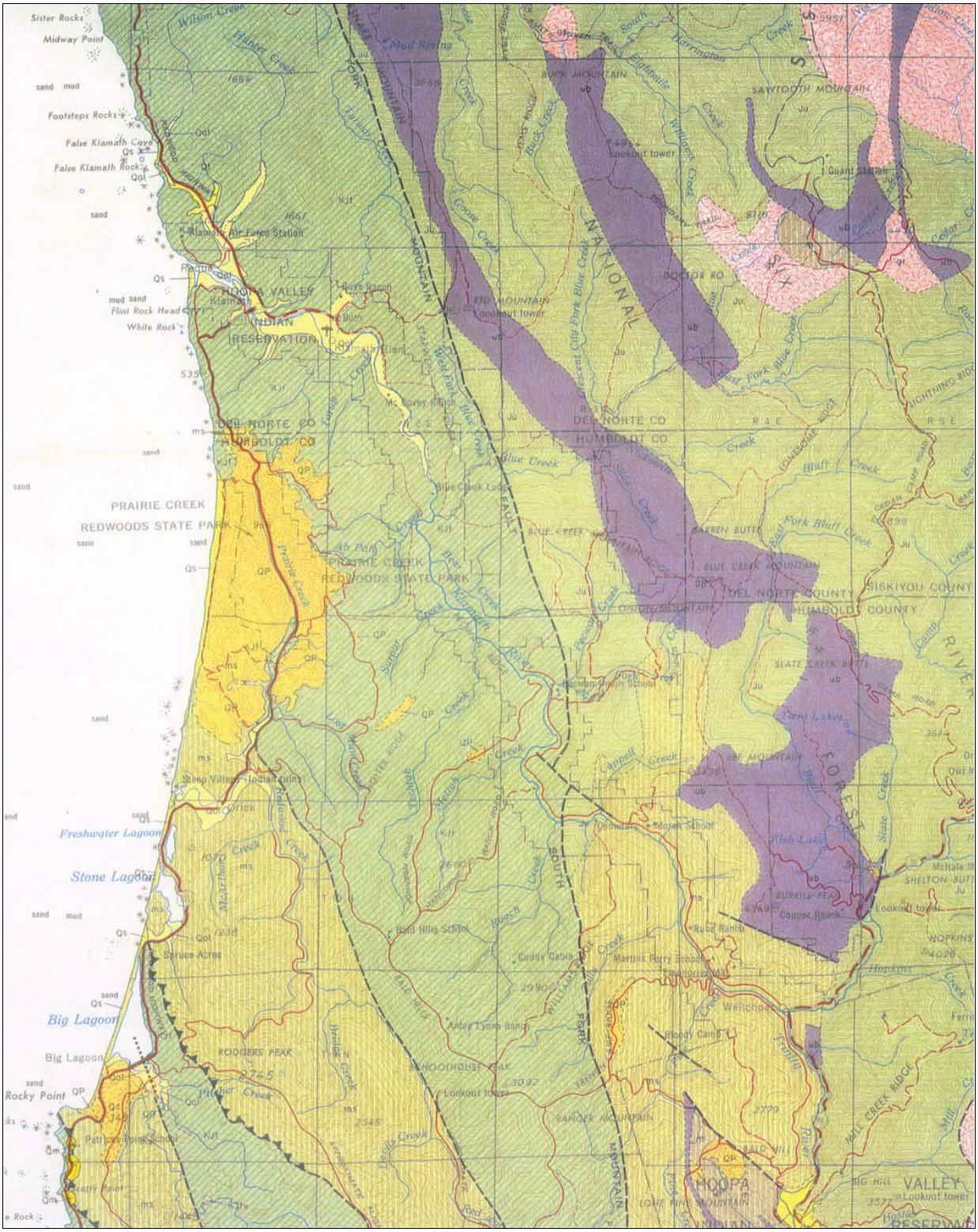

Figure 4-8. Geology of the Lower Klamath Watershed

TABLE 4-1.
PRESIDENTIAL DISASTER DECLARATIONS FOR HAZARD EVENTS IN PLANNING AREA

Type of Event	Disaster Declaration #	Date
Severe winter storms, Flooding	DR-47	12/1955
Tsunami	DR-169	0/1/1964
Heavy rains, Flooding	DR-183	12/24/1964
Severe storms, Flooding	DR-212	1/22/1966
Severe Storms, Flooding	DR-329	4/5/1972
Severe storms, High Tides, flooding	DR-364	02/08/1973
Drought	DR-3023	01/20/1977
Coastal Storms, Floods, Slides, Tornados	DR-677	01/25/1983
Severe Storms, Flooding	DR-758	2/18/1986
Wildland fire (lightning)	DR-1987	9/10/1987
Flooding	DR-935	02/25/1992
Earthquake	DR-943	04/04/1992
Fishing Losses (El Nino effect)	DR-1038	9/20/1994
Winter storms, flooding, landslides, mud flows	DR-1044	01/09/1995
Severe Winter Storms, flooding	DR-1046	03/12/1995
Severe storms, Flooding	DR-1155	1/4/1997
Severe winter storms, flooding	DR-1203	02/09/1998
Extreme Fire Hazards	DR-3140	09/01/1999
State road damage(landslide)	DR-2003	1/1/2003
Severe Storms, flooding, landslides	DR-1628	2/3/2006
Wildfire	EM-3287	6/28/2008
Tsunami (Del Norte County Declared for damages, but Tribe sustained 1 death)	DR-1968	04/18/2011

CHAPTER 5.
DEMOGRAPHICS, DEVELOPMENT AND REGULATION

5.1 DEMOGRAPHICS

Some populations are at greater risk from hazard events because of decreased resources or physical abilities. Elderly people, for example, may be more likely to require additional assistance. Research has shown that people living near or below the poverty line, the elderly, the disabled, women, children, ethnic minorities and renters all experience, to some degree, more severe effects from disasters than the general population. These vulnerable populations may vary from the general population in risk perception, living conditions, access to information before, during and after a hazard event, capabilities during an event, and access to resources for post-disaster recovery. Indicators of vulnerability—such as disability, age, poverty, and minority race and ethnicity—often overlap spatially and often in the geographically most vulnerable locations. Detailed spatial analysis to locate areas where there are higher concentrations of vulnerable community members would help to extend focused public outreach and education to these most vulnerable citizens. The Yurok Tribe has done an excellent job of capturing demographic data for individuals with access and functional needs. This information will enhance the Tribe's ability to respond to needs for assistance as a result of disaster events.

5.1.1 Population Characteristics

Knowledge of the composition of the population and how it has changed in the past and how it may change in the future is needed for making informed decisions about the future. Information about population is a critical part of planning because it directly relates to land needs such as housing, industry, stores, public facilities and services, and transportation. The U.S. Census Bureau estimated the planning area's population at 1,302 as of 2010 (U.S. Census, 2012). (It should be noted that Tribal census data estimates the population living on the Reservation to be approximately 2,100.)

Population changes are useful socio-economic indicators. A growing population generally indicates a growing economy, while a decreasing population signifies economic decline. According to U.S. Census data, the population on the Yurok Reservation was 1,103 in 2000, so the 2010 population of 1,302 represents an 18-percent increase over the 10-year period. However, the 2010 population is 2.5 percent less than the 2009 estimate of 1,333.

5.1.2 Income

In the United States, individual households are expected to use private resources to prepare for, respond to and recover from disasters to some extent. This means that households living in poverty are automatically disadvantaged when confronting hazards. Additionally, the poor typically occupy more poorly built and inadequately maintained housing. Mobile or modular homes, for example, are more susceptible to damage in earthquakes and floods than other types of housing. In urban areas, the poor often live in older houses and apartment complexes, which are more likely to be made of un-reinforced masonry, a building type that is particularly susceptible to damage during earthquakes. Furthermore, residents below the poverty level are less likely to have insurance to compensate for losses incurred from natural disasters. This means that residents below the poverty level have a great deal to lose during an event and are the least prepared to deal with potential losses. Personal household economics significantly impact people's decisions on evacuation: those who cannot afford gas for their cars will likely decide not to evacuate.

Based on U.S. Census Bureau estimates, per capita income in the planning area in 2010 was $13,729, and the median household income was $26,953. It is estimated that about 2 percent of households receive an annual income over $100,000 per year and 45 percent receive an annual income below $25,000. About 35 percent of the families in the planning area are below the poverty level.

Tribal data reflects a poverty rate of 80% on the Reservation, with major contributing factors being the lack of land for economic development and community facilities, inadequate telecommunications and electrical infrastructure, and a grossly substandard transportation system which inhibit the opportunities for economic growth, and inhibit access to health care and educational opportunities, and further reduce any potential for agricultural production, thereby limiting job opportunities.

5.1.3 Age Distribution

As a group, the elderly are more apt to lack the physical and economic resources necessary for response to hazard events and are more likely to suffer health-related consequences making recovery slower. They are more likely to be vision, hearing, and/or mobility impaired, and more likely to experience mental impairment or dementia. Additionally, the elderly are more likely to live in assisted-living facilities where emergency preparedness occurs at the discretion of facility operators. These facilities are typically identified as “critical facilities” by emergency managers because they require extra notice to implement evacuation. Elderly residents living in their own homes may have more difficulty evacuating their homes and could be stranded in dangerous situations. This population group is more likely to need special medical attention, which may not be readily available during natural disasters due to isolation caused by the event. Specific planning attention for the elderly is an important consideration given the current aging of the American population.

Children under 14 are particularly vulnerable to disaster events because of their young age and dependence on others for basic necessities. Very young children may additionally be vulnerable to injury or sickness; this vulnerability can be worsened during a natural disaster because they may not understand the measures that need to be taken to protect themselves from hazards.

The overall age distribution for the planning area is illustrated in Figure 5-1. Based on U.S. Census data estimates, 16 percent of the planning area’s population is 65 or older, compared to the state average of 11 percent. It is also estimated that 24 percent of the population is 14 or younger, compared to the state average of 21 percent. According to U.S. Census data, 12 percent of the over-65 population have incomes below the poverty line. Children under 18 account for 42 percent of individuals who are below the poverty line.

5.1.4 Race, Ethnicity and Language

Research shows that minorities are less likely to be involved in pre-disaster planning and experience higher mortality rates during a disaster event. Post-disaster recovery can be ineffective and is often characterized by cultural insensitivity. Since higher proportions of ethnic minorities live below the poverty line than the majority white population, poverty can compound vulnerability. According to the U.S. Census, the predominant racial groups in the planning area are white, at 39.4 percent, and American Indian, at 36.7 percent. The planning-area populations includes 12.5 percent who report belonging to two or more races. Figure 5-2 shows the racial distribution in the planning area. Almost 6 percent of the population is Hispanic.

Census, Fact Finder web site

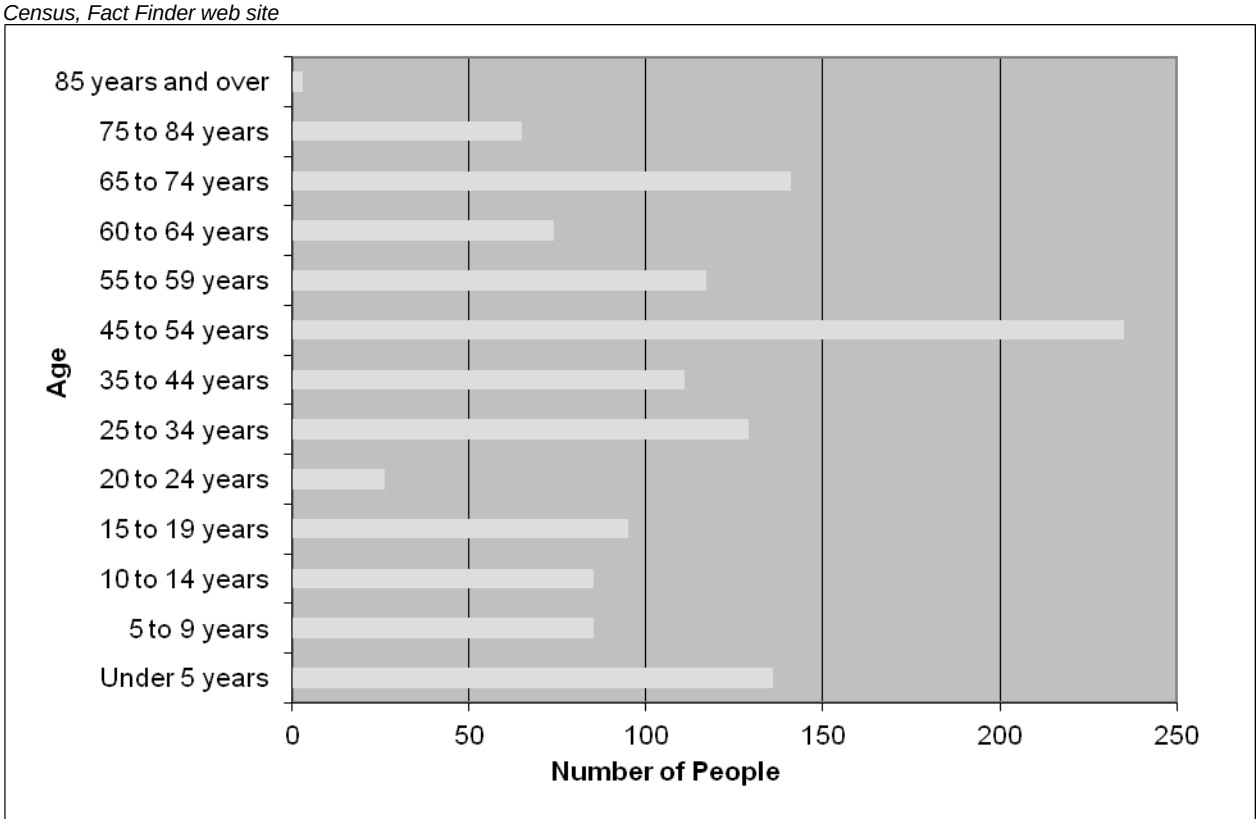

Figure 5-1. Planning Area Age Distribution

Census, Fact Finder web site

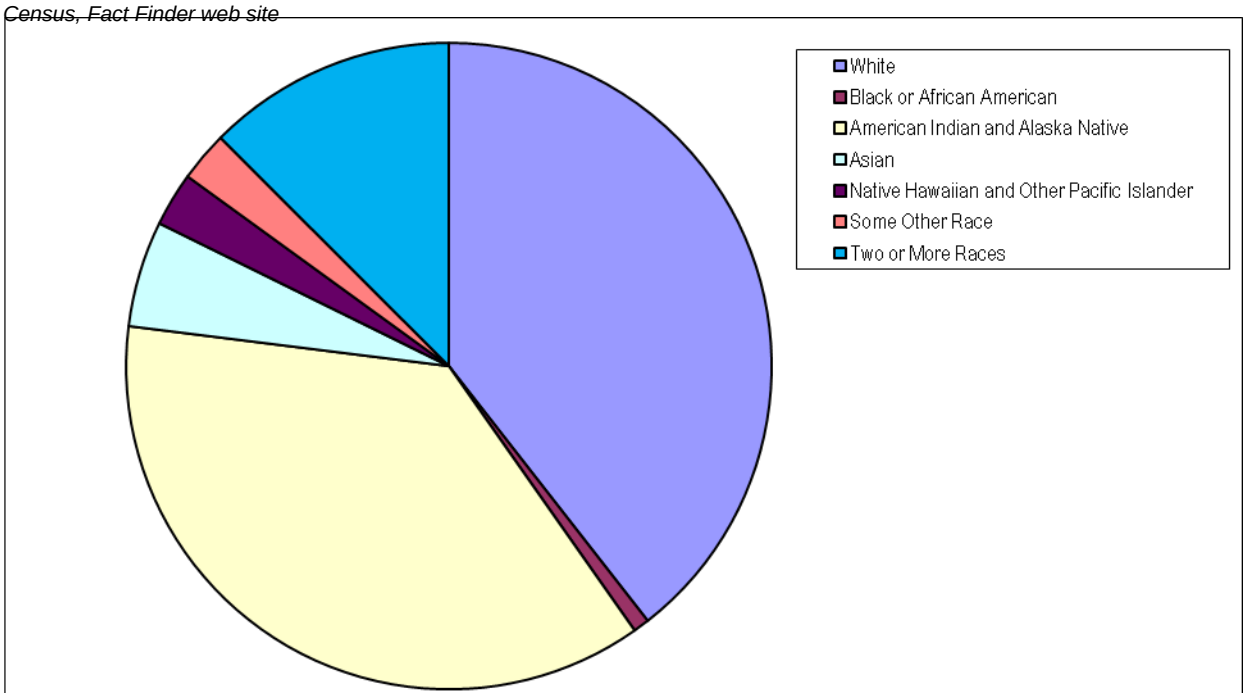

Figure 5-2. Planning Area Race Distribution

The planning area has a 6-percent foreign-born population. Other than English, the most commonly spoken languages in the planning area are Asian and Pacific Islander languages The census estimates 3.8 percent of the residents speak English "less than very well." *[Census, Fact Finder web site]*

5.1.5 Disabled Populations

The 2010 U.S. Census Bureau estimates 54 million (non-institutionalized) Americans with disabilities in the U.S. This equates to about one-in-five persons. People with disabilities are more likely to have difficulty responding to a hazard event than the general population. Knowing that local government is the first level of response to assist individuals, coordination of efforts to meet the access and functional needs of individuals with disabilities is paramount to life safety efforts. In this respect, it is important for emergency managers to distinguish the differences between *functional* and *medical* needs to allow them to plan accordingly for incidents which require evacuations and sheltering needs. Pre-determining the percentage of population impacted with a disability will provide emergency management personnel and first responders the information necessary to pre-plan by having individuals available who can provide those services necessary to meet the requirements of those with access and functional needs.

The 2010 Census does not provide data on individuals with disabilities specific to the Yurok Reservation. However, the Tribe is currently in the process of conducting a survey on the Reservation for that information, which will be available for future plan updates. For all of California, the Census estimates that 10 percent of the non-institutionalized civilian population has a disability.

5.1.6 Economy

Industry, Businesses and Institutions

The planning area's economy is strongly based in the social service industry (educational, health care and social assistance), which employs 29 percent of the employed population 16 or older, followed by the recreational industry (arts, entertainment, recreation, accommodation and food services) employing 18 percent and retail trade with 13 percent. The manufacturing, wholesale trade and information industries make up the smallest local employment industries, each with less than 5 percent of the 16+ employed population. Figure 5-3 shows the breakdown of industry types in the planning area.

Employment Trends and Occupations

According to the American Community Survey, the planning area's labor force makes up 50 percent of the population 16 years or older. The largest portion of occupations are in management, business, science and arts, representing 31 percent. Other major occupations are sale and office at 26 percent, and service at 23 percent (see Figure 5-4).

The largest employer is the Tribal Government, with 325 full-time employees, 200 part-time employees, and 18 seasonal employees.

Figure 5-5 compares California's and the Yurok Tribe's unemployment trends from 2000 through 2010. The Yurok Tribe's unemployment rate was lowest in 2009, at 20.5 percent. Unemployment rates again rose slightly in 2010 to 21.9 percent, but this rate is lower than the 24.9 percent unemployment of 2000.

The U.S. Census estimates that over 70 percent of workers in the planning area commute alone (by car, truck or van) to work, and mean travel time to work is 24.5 minutes (the state average is 26.9 minutes).

Census, Fact Finder web site

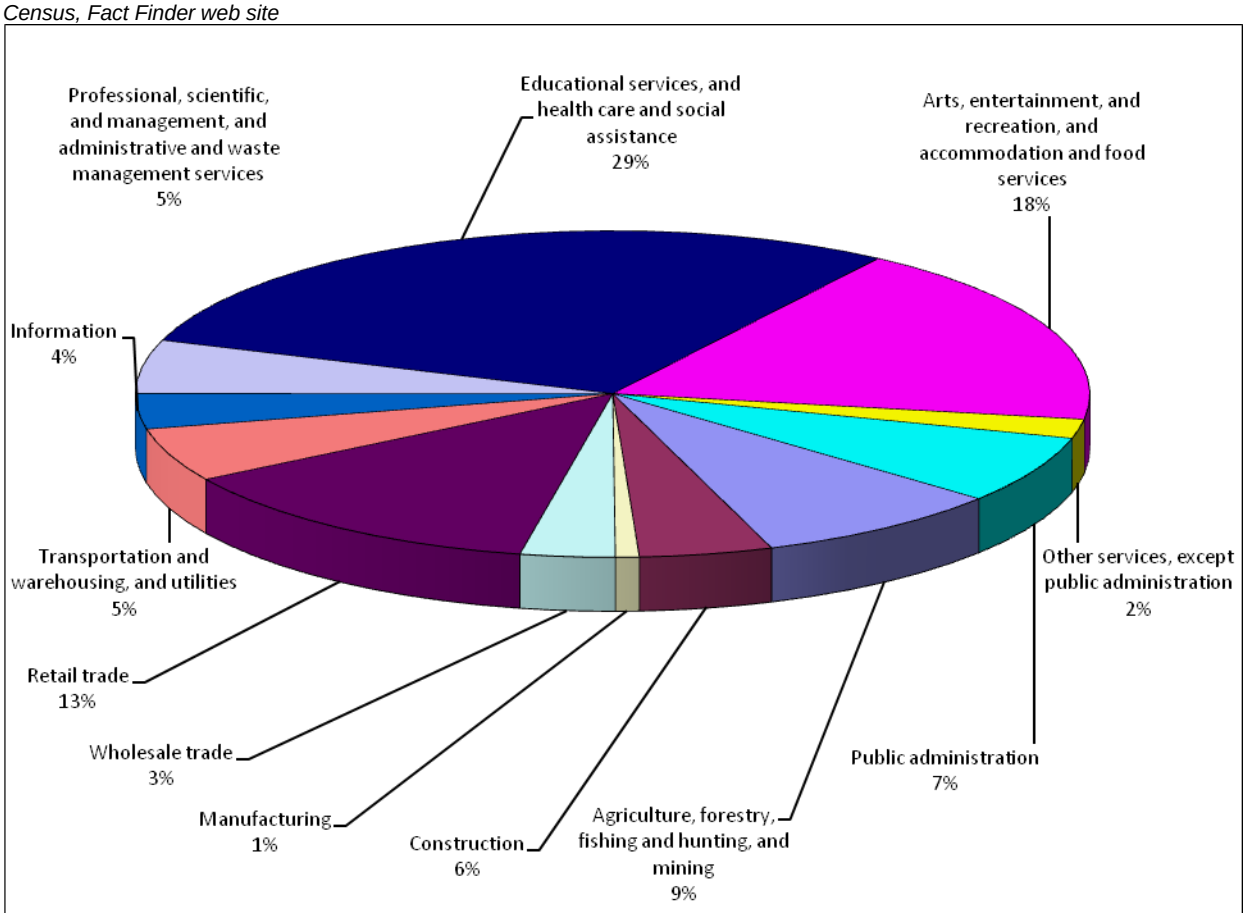

Figure 5-3. Industry in the Planning Area

Census, Fact Finder web site

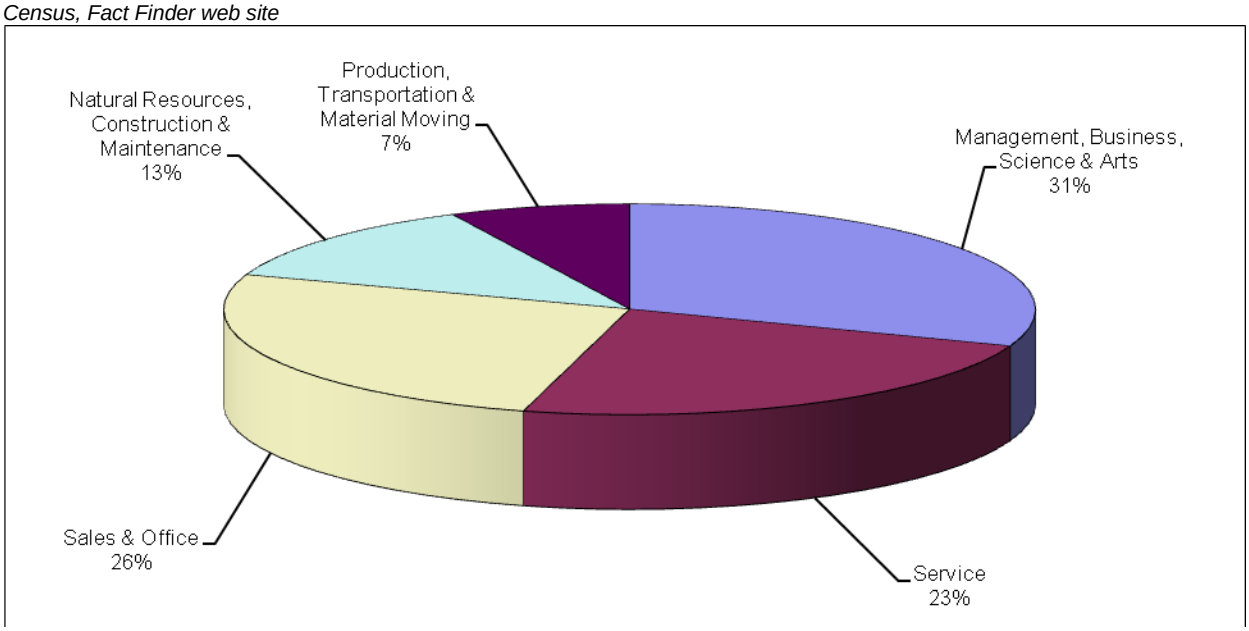

Figure 5-4. Occupations in the Planning Area

Census, Fact Finder web site

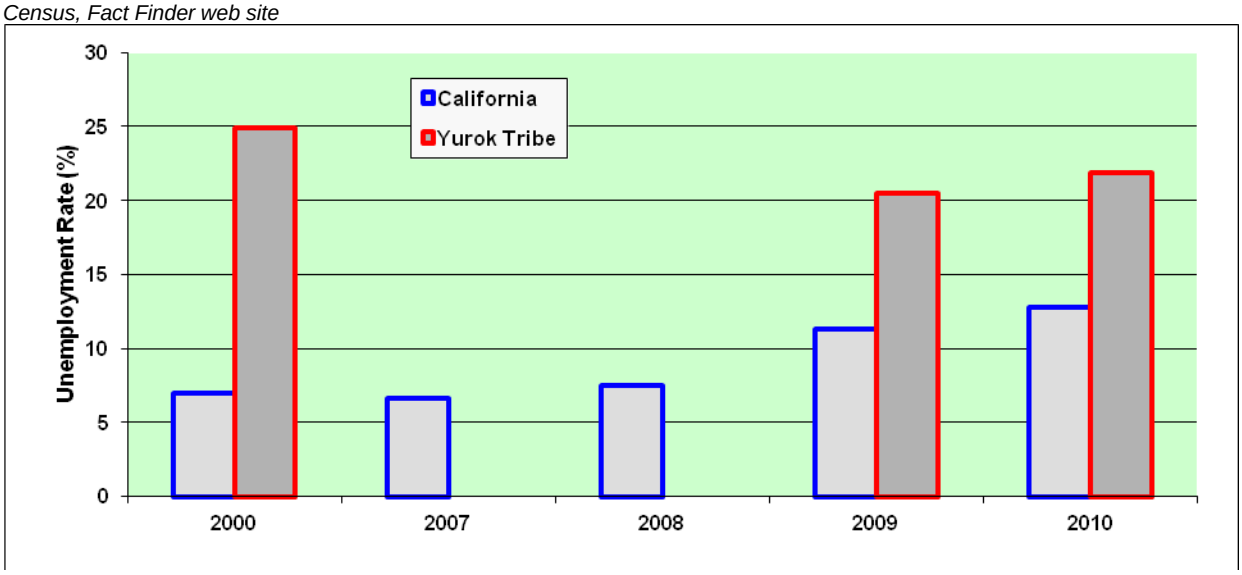

Figure 5-5. California and Yurok Tribe Unemployment Rate

5.2 DEVELOPMENT PROFILE

As a sovereign nation, decisions on land use are governed by Tribal Government, who maintain policy-making authority. Once complete, this plan, along with the safety element and Yurok Emergency Land Use Plan will be utilized to support land use in the future by providing vital information on the risk associated with natural hazards in the planning area. The Yurok Tribe will incorporate by reference the Hazard Mitigation Plan in its comprehensive plan. This will assure that all future trends in development can be established with the benefits of the information on risk and vulnerability to natural hazards identified in this plan.

5.2.1 Land Use Principles

At 55,900 acres, the Yurok Reservation is the size of many cities or counties. However, without a tax base, gaming or other business revenues, the Yurok Tribe does not have the resources to construct essential community facilities, to install or replace eroding infrastructure, or to create sustainable economic development on the Reservation. While all of the Reservation is considered culturally sacred, there are specific areas which are particularly more significant, such as burial grounds and areas designated for archaeological preservation. These factors reduce the amount of land available for economic development and community facilities. Also of paramount concern is the fact that at present, over 70% of the reservation has no access to basic telephone or electrical services. This greatly enhances risk factors associated with response capabilities for emergency events.

The lack of electricity and inadequate telecommunications have been two of the most significant factors contributing to the slow growth of the Reservation. While the Tribe is actively seeking opportunities to remedy these deficiencies, it lacks funding to be able to fully address the issues. While portions of the Tribe are able to make advancements in growth and opportunities, the majority is unable to do so. The Tribe has recently begun development of a casino hotel, which is hoped to stimulate both the Reservation's economy and growth.

The Tribe has commenced development of land use regulations and guidelines. The Tribe makes it a point of practicing safe building development to protect its Tribal members. It is anticipated that within the lifecycle of this plan, the Tribe will have much of its land use regulations and guidelines in place. This

will be a significant factor for the Tribe in helping to reduce risk from its hazards of concern. At present, new buildings funded with Federal dollars are required to be built to minimal building code standards, but the development of regulatory guidelines which restrict or limit building in high-hazard areas, or requires a minimum amount of mitigation efforts, will greatly enhance the Tribe's resiliency.

5.2.2 Residential Development

Residential land use generally consists of single-family and multifamily dwellings, including manufactured housing, foster care facilities, group quarters, senior housing, assisted housing, and cooperative housing. According to Tribal GIS data, there are an estimated 812 single, residential buildings in the planning area, of which approximately 176 were vacant, primarily because they are for seasonal or recreational use. Of the occupied homes, over half are owner-occupied and 41 percent are rentals. Figure 5-6 categorizes the residential structures by type. Figure 5-7 categorizes them by year of construction. The year of construction is significant in determining the potential impact from various hazards due to construction standards in place at the time.

5.2.3 Non-Residential Development

As indicated, the Tribal boundary falls within both Humboldt and Del Norte Counties, and is primarily divided by an upper- and lower – reservation designation. At present, little construction is occurring within the region, due, in part, to the current economic downtrend, as well as the very limited infrastructure within 80% of the Reservation. The Tribe is diligently pursuing every avenue possible to obtain new and modify existing infrastructure to allow for expansion of the YR.

5.2.4 Critical Facilities and Infrastructure

Critical facilities and infrastructure are those that are essential to the health and welfare of the population. These become especially important after a hazard event. Critical facilities typically include police and fire stations, schools and emergency operations centers. Critical infrastructure can include the roads and bridges that provide ingress and egress and allow emergency vehicles access to those in need, and the utilities that provide water, electricity and communication services to the community. Also included are "Tier II" facilities and railroads, which hold or carry significant amounts of hazardous materials with a potential to impact public health and welfare in a hazard event. As defined for this hazard mitigation plan, critical facilities are local facilities in the public or private sector that provide essential products and services to the general public or are essential for use during public safety, emergency response and disaster recovery functions. Loss of a critical facility would result in a severe economic or catastrophic impact.

Critical facilities for the purposes of this planning effort include, but are not limited to the following:

- Tribal owned facilities such as department, agency, and administrative offices that provide essential services to the Yurok people
- Emergency response facilities needed for disaster response and recovery including, but not limited to public safety buildings, emergency services buildings, emergency operations centers and emergency supply storage facilities
- Medical and public health facilities used during emergency response such as medical clinics
- Facilities that may be used to house to shelter disaster victims such as schools, gymnasiums, churches

Census, Fact Finder web site

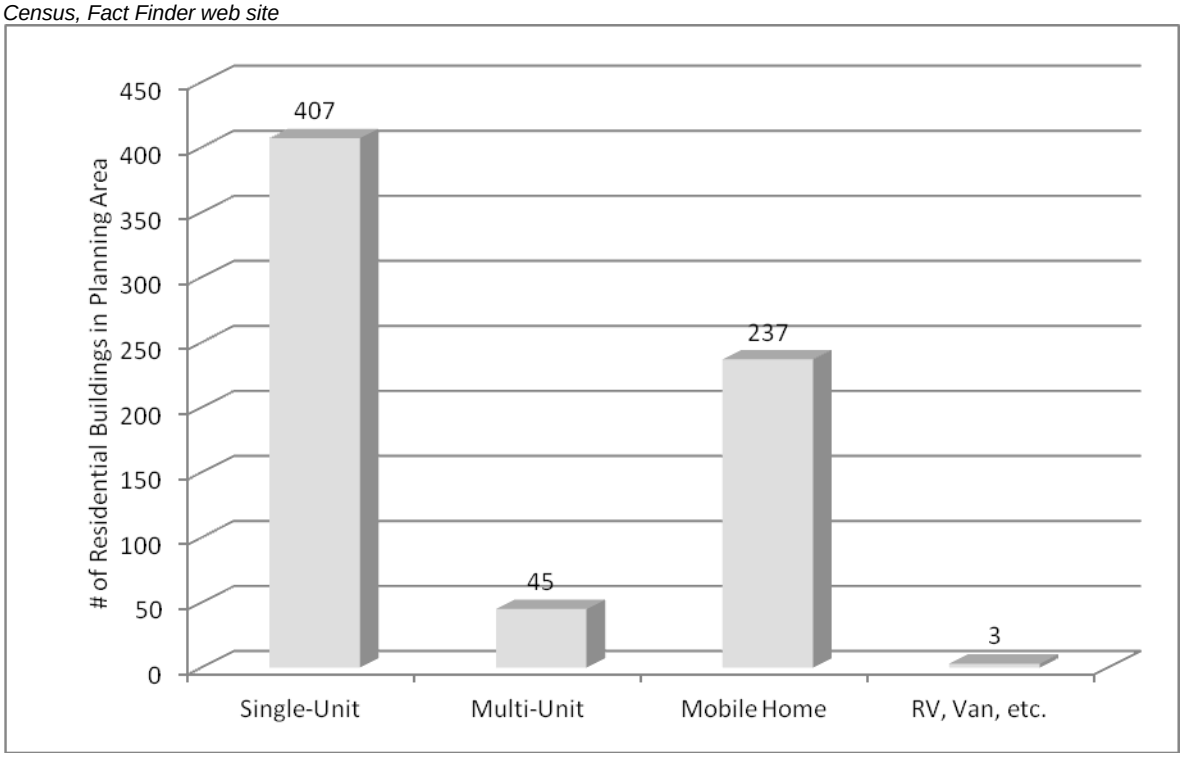

Figure 5-6. Housing Units

Census, Fact Finder web site

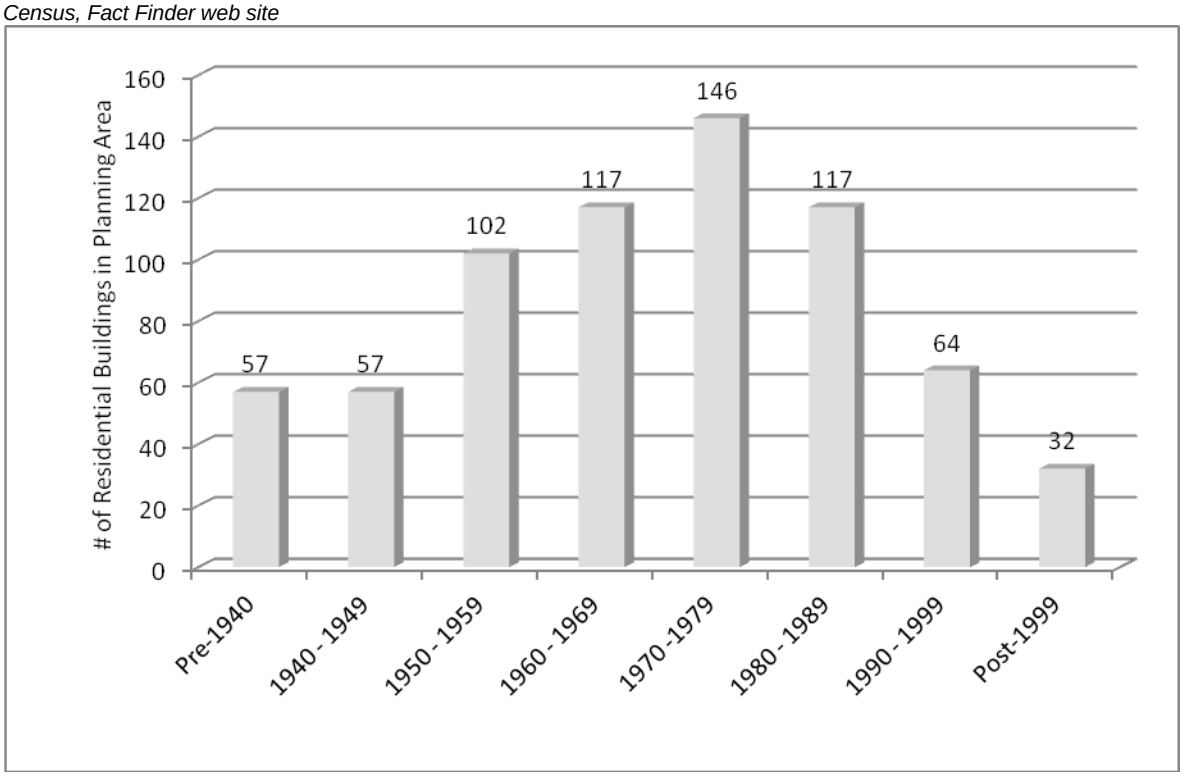

Figure 5-7. Year Housing Units Constructed

- Public and private utilities and infrastructure vital to maintaining or restoring normal services to the areas damaged by the disaster such as power lines, roads and highways, public works facilities, marinas and docks
- Community gathering places, including culturally significant areas, parks, community centers, and gymnasiums and meeting halls
- Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic, and/or water-reactive materials
- Cultural sites or facilities that are vitally important to maintaining the Tribe's cultural history, language, and traditions such as archaeological sites and artifact storage facilities.

A database of Tribal facilities within the Reservation was created to identify vulnerabilities to each hazard addressed by this plan. The risk assessment for each hazard discusses facilities with regard to that hazard. Figure 5-8 shows the location of Tribal facilities assessed by this plan. It should be noted that the number of facilities addressed include tribal members' residents and tribal facilities that fall outside of the existing tribal boundary, but for which the Tribe provides emergency response activities. Those properties and facilities are within the ancestral boundaries, and are part of the reason why the Tribe is attempting to gain ownership of those areas, as many tribal members and culturally sensitive areas fall within those boundaries.

5.3 RELEVANT REGULATIONS

Pertinent federal laws are described below. It should be noted that as a sovereign nation, the Tribe is not required to adhere to any local or state planning regulations; however, in an effort to be a good steward and neighbor, the Tribe does strive to plan in conjunction with state and local requirements. The Tribe must fulfill any federal regulations, such as those administered by HUD and EPA, as well as other federal agencies. This places a significant burden upon the Tribe as it is doubly impacted in its efforts when developing land use authority and other regulatory statutes.

5.3.1 Federal

Disaster Mitigation Act

The DMA is the current federal legislation addressing hazard mitigation planning. It emphasizes planning for disasters before they occur. It specifically addresses planning at the local level, requiring plans to be in place before Hazard Mitigation Grant Program funds are available to communities. This plan is designed to meet the requirements of DMA, improving eligibility for future hazard mitigation funds.

Endangered Species Act

The federal Endangered Species Act (ESA) was enacted in 1973 to conserve species facing depletion or extinction and the ecosystems that support them. The act sets forth a process for determining which species are threatened and endangered and requires the conservation of the critical habitat in which those species live. The ESA provides broad protection for species of fish, wildlife and plants that are listed as threatened or endangered. Provisions are made for listing species, as well as for recovery plans and the designation of critical habitat for listed species. The ESA outlines procedures for federal agencies to follow when taking actions that may jeopardize listed species and contains exceptions and exemptions. Criminal and civil penalties are provided for violations of the ESA.

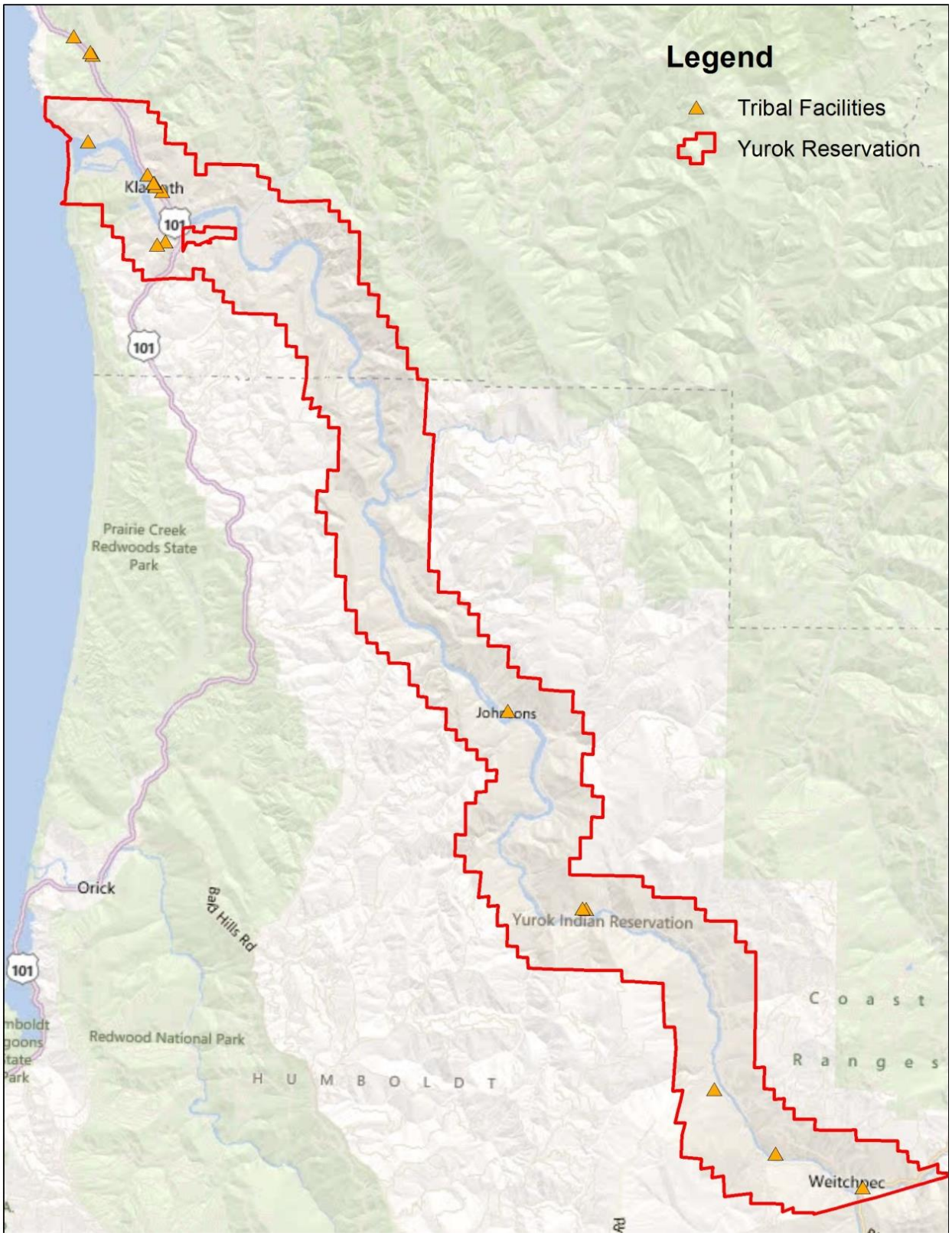

Figure 5-8. Tribal Facilities

Federal agencies must seek to conserve endangered and threatened species and use their authorities in furtherance of the ESA's purposes. The ESA defines three fundamental terms:

- **Endangered** means that a species of fish, animal or plant is "in danger of extinction throughout all or a significant portion of its range." (For salmon and other vertebrate species, this may include subspecies and distinct population segments.)
- **Threatened** means that a species "is likely to become endangered within the foreseeable future." Regulations may be less restrictive for threatened species than for endangered species.
- **Critical habitat** means "specific geographical areas that are…essential for the conservation and management of a listed species, whether occupied by the species or not."

Five sections of the ESA are of critical importance to understanding it:

- **Section 4: Listing of a Species**—The National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries) is responsible for listing marine species; the U.S. Fish and Wildlife Service is responsible for listing terrestrial and freshwater aquatic species. The agencies may initiate reviews for listings, or citizens may petition for them. A listing must be made "solely on the basis of the best scientific and commercial data available." After a listing has been proposed, agencies receive comment and conduct further scientific reviews for 12 to 18 months, after which they must decide if the listing is warranted. Economic impacts cannot be considered in this decision, but it may include an evaluation of the adequacy of local and state protections. Critical habitat for the species may be designated at the time of listing.
- **Section 7: Consultation**—Federal agencies, in protection of their fiduciary responsibilities to all Tribes, must ensure that any action which they authorize, fund, or carry out, which has the potential to impact any trust resource(s), is not likely to jeopardize or impact the continued existence of a listed or proposed species or adversely modify its critical habitat. This includes private and public actions that require a federal permit. Once a final listing is made, non-federal actions are subject to the same review, termed a "consultation." If the listing agency finds that an action will "take" a species, it must propose mitigation or "reasonable and prudent" alternatives to the action; if the proponent rejects these, the action cannot proceed.
- **Section 9: Prohibition of Take—**It is unlawful to "take" an endangered species, including killing or injuring it or modifying its habitat in a way that interferes with essential behavioral patterns, including breeding, feeding or sheltering.
- **Section 10: Permitted Take**—Through voluntary agreements with the federal government that provide protections to an endangered species, a non-federal applicant may commit a take that would otherwise be prohibited as long as it is incidental to an otherwise lawful activity (such as developing land or building a road). These agreements often take the form of a "Habitat Conservation Plan."
- **Section 11: Citizen Lawsuits**—Civil actions initiated by any citizen can require the listing agency to enforce the ESA's prohibition of taking or to meet the requirements of the consultation process.

With the listing of salmon and trout species as threatened or endangered, the ESA has impacted most of the Pacific Coast states. Although some of these areas have been more impacted by the ESA than others due to the known presence of listed species, the entire region has been impacted by mandates, programs and policies based on the presumption of the presence of listed species. Most West Coast jurisdictions must now take into account the impact of their programs on habitat.

Clean Air Act

The Yurok Tribe monitors air quality under its own Inherent Tribal Sovereignty under the Tribe's Approved Air Quality Ordinance and Smoke Management Plan. The Yurok Tribe Environmental Program-Air Quality Monitoring Program collects meteorological and particulate matter ($PM_{2.5}\mu g/m^3$) information reflecting air quality where people live, work and go to school on Tribal Lands. This system of monitoring serves multiple purposes for the Tribe and provides "real time" hourly data. This data can be used during wildfire events to assist local health and emergency officials to make decisions that affect the local community's health and safety. The data is shared via the Internet through a satellite link as a Remote Automated Weather Station (RAWS) or via the Yurok Tribes website www.yuroktribe.org.with the local California North Coast Unified Air Quality Management District, the local community, health officers, educational institutions and researchers to provide a more detailed accounting of air quality within the exterior Reservation boundaries as well as the adjacent areas affecting the Reservation. The meteorological data is also used by the (NIFC) National Interagency Fire Center in Boise, Idaho as part of their network to assess the threat of wildfires in Northern California.

Clean Water Act

The federal Clean Water Act (CWA) employs regulatory and non-regulatory tools to reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff. These tools are employed to achieve the broader goal of restoring and maintaining the chemical, physical, and biological integrity of the nation's surface waters so that they can support "the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water."

Evolution of CWA programs over the last decade has included a shift from a program-by-program, source-by-source, pollutant-by-pollutant approach to more holistic watershed-based strategies. Under the watershed approach, equal emphasis is placed on protecting healthy waters and restoring impaired ones. A full array of issues are addressed, not just those subject to CWA regulatory authority. Involvement of stakeholder groups in the development and implementation of strategies for achieving and maintaining water quality and other environmental goals is a hallmark of this approach.

The EPA recognizes that Indian Tribes face serious human health and environmental problems, and are working with the Indian Tribes to protect the health and environment of waters in Indian Country. Presently, the Yurok Tribe has undertaken several watershed restoration projects in its efforts to return the watersheds to a healthy state. The Tribe also has a Water Quality Control Plan which was approved by Tribal Council in 2004.

Water Quality Standards

Currently, the Yurok Tribe has not been delegated authority under Clean Water Act Section 303 (Water Quality Standards). However, in 2004, the Yurok Tribe adopted the Yurok Tribe Water Pollution Control Ordinance (WPCO) and Water Quality Control Plan (WQCP) for the Yurok Reservation by Resolution 04-46, which sets Tribally approved water quality standards for surface and ground waters within the Yurok Reservation. The WPCO and WQCP apply to all federal, state, county and Tribal government actions that have the potential to affect waters of the Yurok Reservation. The WPCO and WQCP prohibits certain activities and requires compliance with any water quality certification issued under the WPCO and WQCP. The WPCO authorizes YTEP to enforce its provisions. This reservation-wide jurisdiction over water quality is also consistent with the broad language of CWA section 106, which provides funding and guidance for Tribes to develop water pollution regulatory programs to protect water quality within the exterior boundaries of the reservation.

Presidential Disaster Declarations

Presidentially declared disasters are disaster events that cause more damage than state and local governments/resources can handle without federal assistance. There is not generally a specific dollar threshold that must be met. A Presidential Major Disaster Declaration puts into motion long-term federal recovery programs, some of which are matched by state programs, and designed to help disaster victims, businesses, and public entities. A Presidential Emergency Declaration can also be declared, but assistance is limited to specific emergency needs.

Non-FEMA Disaster Declarations

Unique to Tribes is the fact that disaster declarations can also be granted by other federal agencies other than FEMA, such as the Department of Housing and Urban Design and the Bureau of Indian Affairs. In such cases, similar to a Presidentially Declared event, funds are designated to help the Tribes recover from the impact of disaster events, and customarily carry a match requirement. Those funds are limited to specific needs, and are limited in nature.

5.3.2 State-Level Planning Initiatives

The Yurok Tribe must comply with all Federal regulations established, which many times are much more stringent than those regulations which state or local jurisdictions must address. This places a much heavier burden on the Tribe as they continue to grow and develop tribal lands. As a sovereign nation, the Tribe is not subject to state or local requirements; however, in the spirit of being a good neighbor and in partnership with the surrounding jurisdictions, the Tribe does consider its local communities in all of its planning initiatives. Some Tribal planning initiatives which the Tribe is undertaking also co-inside with the following state planning initiatives:

- California General Planning
- California Environmental Quality Act (Similar to NEPA)
- Assembly Bill 2140: General Plans: Safety Element
- Assembly Bill 32: The California Global Warming Solutions Act
- Senate Bill 97: Guidelines for Greenhouse Gas Emissions
- California State Building Code
- Standardized System – Emergency Management
- California State Hazard Mitigation Plan
- Governor's Executive Order S-13-08 – State Management of Climate Impacts from Sea-Level Rise

5.3.3 Tribal

Comprehensive Plan

The Tribe currently is in the process of developing its comprehensive plan, which is anticipated to be in force during the life cycle of this mitigation plan. Information contained within this document will be utilized in determining zoning and regulatory authority so as to reduce the impacts of disasters on Tribal members, while still taking into consideration the Tribe's ultimate goal of protecting its members, its cultural heritage, and the environment. Additionally, information from this plan will also be utilized with respect to funding opportunities as the Tribe continues to expand its land mass and tribal membership living on the Reservation.

Tribal Code

The Tribe does have a Tribal Code in place, the majority of which are civil related issues. At present, law enforcement utilizes either state or county code for enforcement activities. The Tribe is in the process of developing land use authority, which when completed will be adopted by Tribal Council.

Capability Assessment

The planning team performed an inventory and analysis of existing authorities and capabilities called a "capability assessment." A capability assessment creates an inventory of an agency's mission, programs and policies, and evaluates its capacity to carry them out. Table 5-1 summarizes the legal and regulatory capability of the Yurok Tribe. Table 5-2 summarizes the administrative and technical capability. Table 5-3 summarizes fiscal capability.

Emergency Management Capabilities

The Yurok Tribe Office of Emergency Services assists with hazards planning, grant writing, disaster relief training and NIMS compliance tracking. The Department has taken proactive steps to enhance the Reservation's capabilities with respect to emergency response and recovery efforts for both pre-and post-disaster efforts. Currently, the Tribe's Klamath office facility is designated as a Red Cross Shelter, providing protection and shelter for Tribal members when needed. This is a fully-operational facility, with kitchen and bathroom facilities, and has a back-up generator if needed. The development of this Hazards Mitigation Plan and Community Wildfire Protection Plan to help determine where priorities should be placed with respect to response and recovery efforts is a clear demonstration of the Tribe's efforts to enhance its emergency management capabilities.

The purpose of the Yurok Tribe's Office of Emergency Services is to provide:

- A leadership role in facilitating and coordinating a regional approach to emergency planning and response on the YR and surrounding communities;
- Guidance and coordination in the planning, mitigation, response and recovery of efforts of the YR before, during and after an emergency or disaster;
- Acquire, allocate and coordinate the appropriate resources in response to emergencies of disasters.

TABLE 5-1.
LEGAL AND REGULATORY CAPABILITY

REGULATORY TOOL (Codes, Ordinances, Plans, Policies, Procedures, Site Assessments, Studies)	County (C) Local (L), Tribal (T) State (S), Federal (F)	Mandate :No/Local (L) State (S)/Federal (F)	Potential Funding Source Y/N	Effect on Loss Reduction (X)			Hazards Impacted										Date of Adoption	Description
				Support	Facilitate	Hinder	Dam Failure/Safety	Drought	Earthquake	Flood	Landslide	Severe Winter Storm	Tsunami	Wildfire	Man-Made	Technological		
Housing and Municipal Facilities Relocation Study	T			X	X		X	X		X	X	X	X	X				IHS, BIA, Yurok Tribe
Hazardous Materials Site Assessment	T		Y	X	X										X		2011	CBRNE Plan
Soil Resource Reconnaissance & Drainfield Site Assessment and Preliminary Geotechnical Assessment	S	N	N	X	X				X		X	X	X		X			Includes various USGS data
Comprehensive Emergency Management Plan	T	N															2006	Under review
Highway/Roadway Safety Improvements Design Report	T	N		X	X		X	X	X	X	X	X	X	X				Supports capital funding of projects while incorporating evacuation planning prioritization
Engineering Report for Water System (Improvement)																		
Feasibility Study – Casino	T	N	N	X	X													

TABLE 5-1.
LEGAL AND REGULATORY CAPABILITY

REGULATORY TOOL (Codes, Ordinances, Plans, Policies, Procedures, Site Assessments, Studies)	County (C) Local (L), Tribal (T) State (S), Federal (F)	Mandate :No/Local (L) State (S)/Federal (F)	Potential Funding Source Y/N	Effect on Loss Reduction (X)			Hazards Impacted										Date of Adoption	Description
				Support	Facilitate	Hinder	Dam Failure/Safety	Drought	Earthquake	Flood	Landslide	Severe Winter Storm	Tsunami	Wildfire	Man-Made	Technological		
Trading Store (Business Plan)	T	N	N	X	X													Feasibility study conducted to determine placement and viability of Tribe's casino. Study included elements such as infrastructure review, economic outlook and tourism.
Tribal Codes (Civil)	T/F	Y	N	X	X		X	X	X	X	X	X	X	X				Currently in place, but the Tribe is also in the process of development of new, additional civil codes.
Tribal Code (Criminal)	S/F	N	Y	X	X									X	X	X		Provides enforcement against criminal acts, under county and state codes. The Tribe is currently in the process of becoming a federally recognized tribal police agency, but at present utilize local jurisdiction and state codes for enforcement.
Tribal Fishing and Hunting Ordinance	F/T																Treaties	The Tribe is granted authority under its treaty to utilize both current and ancestral boundaries as fishing grounds.

TABLE 5-1.
LEGAL AND REGULATORY CAPABILITY

REGULATORY TOOL (Codes, Ordinances, Plans, Policies, Procedures, Site Assessments, Studies)	County (C) Local (L), Tribal (T) State (S), Federal (F)	Mandate :No/Local (L) State (S)/Federal (F)	Potential Funding Source Y/N	Effect on Loss Reduction (X)			Hazards Impacted										Date of Adoption	Description
				Support	Facilitate	Hinder	Dam Failure/Safety	Drought	Earthquake	Flood	Landslide	Severe Winter Storm	Tsunami	Wildfire	Man-Made	Technological		
Land Use Code	T			X	X		X	X	X	X	X	X	X	X	X	X		Under development
Forest Practices Act	T/F	Y	Y	Y				X	X	X	X			X			1983 Federal	Covers tribal, private and state forest lands
Watershed Analysis	T/S	N	Y	X	X		X	X	X	X		X	X	X			Various studies in place	Extensive watershed analysis conducted Reservation wide
Habitat Conservation Plan	T/F																	Various plans address habitat conservation throughout the reservation
Scenic By-Ways Program	T/F		Y	Y	Y													2011 In process
Spill Prevention or Response Plan	T/S/C		Y	X	X		X		X	X				X	X	X	Varies by agency	CBRNE & Hazmat Response Plan; Environmental Dept. administers various hazmat and response initiatives
Emergency Response Plans	T		T	X	X		X	X	X	X	X		X				2006 forward	Varying in nature; some based on County plans; Tribe will review to determine accuracy based on HMP & CWPP

TABLE 5-1.
LEGAL AND REGULATORY CAPABILITY

REGULATORY TOOL (Codes, Ordinances, Plans, Policies, Procedures, Site Assessments, Studies)	County (C) Local (L), Tribal (T) State (S), Federal (F)	Mandate :No/Local (L) State (S)/Federal (F)	Potential Funding Source Y/N	Effect on Loss Reduction (X)			Hazards Impacted										Date of Adoption	Description
				Support	Facilitate	Hinder	Dam Failure/Safety	Drought	Earthquake	Flood	Landslide	Severe Winter Storm	Tsunami	Wildfire	Man-Made	Technological		
Building Codes	F/S/C	F/S	N	X	X				X			X						Mandated by federal funding; current IBC adopted by State administered
Growth Management Plan	T	N	N	X	X		X	X	X	X	X	X	X	X				Under current development; will utilize existing data from HMP and CWPP
Economic Development Plan	T	N	N	X													Various	Casino/Hotel; other plans to support efforts to enhance business
Cultural Resources Preservation Plan	T	N	Y	X	X		X	X	X	X	X	X	X	X	X	X	Several at various stages	Protected Document. Will be reviewed to determine areas of impact from hazard assessment.
Post Disaster Recovery Plan																		Strategy in plan for development during life-cycle of HMP.
Post Disaster Recovery Ordinance																		Strategy in HMP
COOP or COG																		Strategy in HMP

TABLE 5-1.
LEGAL AND REGULATORY CAPABILITY

REGULATORY TOOL (Codes, Ordinances, Plans, Policies, Procedures, Site Assessments, Studies)	County (C) Local (L), Tribal (T) State (S), Federal (F)	Mandate :No/Local (L) State (S)/Federal (F)	Potential Funding Source Y/N	Effect on Loss Reduction (X)			Hazards Impacted										Date of Adoption	Description
				Support	Facilitate	Hinder	Dam Failure/Safety	Drought	Earthquake	Flood	Landslide	Severe Winter Storm	Tsunami	Wildfire	Man-Made	Technological		
GIS Data	T	N	Y	X	X		X	X	X	X	X	X	X	X			Various	Significant GIS layers in place; HMGP funding will be sought to continue data-enhancement; GIS layers will be reviewed to incorporate new data discovered during HMP update process
Dam Safety Plans	F/S	Y	N	X	X		X		X	X		X					Unknown	Inundation studies by dam owners needs to be conducted; much of the data is old and updated analysis needs to be conducted. Strategy in plan exists for Tribe to work with dam owners for dam removal and new studies of potential impacts.
Air Quality Monitoring/Studies	F	Y	N	X	X									X			Various	EPA regulated standards – tribal enforcement
Water Quality Monitoring/Studies	F	Y	N	X	X		X			X		X	X	X			Various	EPA regulated standards – tribal enforcement

TABLE 5-1.
LEGAL AND REGULATORY CAPABILITY

REGULATORY TOOL (Codes, Ordinances, Plans, Policies, Procedures, Site Assessments, Studies)	County (C) Local (L), Tribal (T) State (S), Federal (F)	Mandate :No/Local (L) State (S)/Federal (F)	Potential Funding Source Y/N	Effect on Loss Reduction (X)			Hazards Impacted										Date of Adoption	Description
				Support	Facilitate	Hinder	Dam Failure/Safety	Drought	Earthquake	Flood	Landslide	Severe Winter Storm	Tsunami	Wildfire	Man-Made	Technological		
Transportation Plan	T	N	Y	X	X		X		X	X	X	X	X	X			2011	Transportation plan reviewed potential evacuation routes and impact from hazards on roadways. Plan assessed a number of significant issues related to the inferior federal and roadways on the reservation, and the negative impact on evacuation based on the current system in place.

TABLE 5-2.
ADMINISTRATIVE AND TECHNICAL CAPABILITY

Staff/Personnel Resources	Available?	Department/Agency/Position
Planners or engineers with knowledge of land development and land management practices	Y	Land Use Planners, Environmental Planners (various types), Water and Air Quality Planners
Engineers or professionals trained in building or infrastructure construction practices	N	While the Tribe abides by County/State building codes, at present, it does not possess the manpower to staff an individual to inspect or enforce specific levels of construction practices
Planners or engineers with an understanding of natural hazards	Y	Land Use Planners, Environmental Planners (various types), Water and Air Quality Planners
Staff with training in benefit/cost analysis	Y	The Tribe does have the ability to conduct benefit-cost analysis.
Floodplain manager	N	At present, the Tribe is not a member of the NFIP, nor does it currently intend to seek enrollment.
Surveyors	Y	Cadastral surveyors.
Personnel skilled or trained in GIS applications	Y	The Tribe has a robust GIS section, including trained personnel in the use of HAZUS and spatial analysis.
Scientist familiar with natural hazards in local area	Y	The Tribe has several departments which are specific to the impacts of natural hazards, including water/air quality monitoring, and environmental protection
Emergency Manager	Y	The Tribe has various public safety departments, including: a small volunteer fire department, law enforcement, public health and emergency management departments.
Grant Writers	Y	Several employees in various departments within Tribal Government are skilled grant writers.

TABLE 5-3. FISCAL CAPABILITY	
Financial Resources	Accessible or Eligible to Use?
1. Community Development Block Grants	Y
2. Capital Improvements Project Funding	Y
3. Authority to Levy Taxes for Specific Purposes	Y
4. User Fees For Water, Sewer, Gas or Electric Service	The Tribe does collect fees for water use from a small portion of users.
5. Impact Fees for Buyers or Developers of New Development/Homes (Not at present, but potentially may occur during life-cycle of HMP)	N
6. Incur Debt through General Obligation Bonds	N
7. Incur Debt through Special Tax Bonds	N
8. Incur Debt through Private Activity Bonds	N
9. Could Withhold Public Expenditures in Hazard-Prone Areas	N
10. State-Sponsored Grant Programs	Y
11. Bureau of Indian Affairs Sponsored Grant	Y
12. Indian Health Services Grant	Y
13. U.S. Dept. of Agriculture, Rural Development Agency	Y
14. U.S. Environmental Protection Agency	Y
15. U.S. Fire Administration	Y
16. Tribal Homeland Security Grants	Y
17. U.S. Army Corps of Engineers	Y
18. Stafford Act Grants	Y
19. Other	NA

During 2010-2012, the Tribe has developed or taken part in a number of exercises in an effort to enhance the preparedness of the Reservation, as follows:

- Two earthquake exercises which included an evacuation element for the Reservation. This has provided emergency management with the knowledge needed to plan for the evacuation of the Reservation with respect to those individuals requiring assistance during evacuation, as well as determining the most appropriate area in which to evacuate the Tribe. .
- A series of exercises with damn owner Pacific Power, which included inundation due to dam failure.

Additionally, the Tribe has also activated emergency response activities as a result of two tsunami threats (2010 and 2011), and hazardous materials incidents and issues occurring on the YR. The Tribe also has emergency capabilities with respect to firefighting and evacuation planning. Currently, the Public Safety Department is in the process of training personnel to serve within the Tribe's Emergency Operation's Center during disaster incidents. This will enable the Tribe to more quickly respond to incidents occurring on the Reservation, including those non-tribal members who reside within the planning area, as most

residents have come to rely on the Tribe for many of these services, given the remoteness to other service providers.

This mitigation plan will provide information with respect to safe harbors for evacuation purposes, and will further support preparedness by providing information with respect to the areas of impact from the hazards of concern.

In an effort to reduce the vulnerability of the population of the Reservation, by incorporating the findings of the Hazard Mitigation Plan, the Tribe will develop the Yurok Emergency Land Use Plan, which will incorporate areas of vulnerability and establish evacuation routes for use during incidents.

While many of these activities have been grant funded through various federal programs, policy development to enhance resilience of the Reservation have been funded through Tribal Discretionary Funds. Given the current economic condition of the Tribe, this demonstrates the Tribe's commitment to developing a robust and applicable *all hazards* emergency management program. During the life cycle of this plan, the Tribe intends to continue seeking funds to assist in the development of various response plans, an update to the Comprehensive Emergency Management Plan, a Continuity of Operation's Plan, and a Recovery Plan, which will further enhance the Tribe's resiliency to disasters.

During this plan development, FEMA announced legislation which will allow Tribes to go directly to FEMA for Disaster Declarations. In response to this, the Tribe will attempt to also develop a recovery framework, which will help establish protocols and procedures necessary to assist tribal members in the best way possible. This, again, will be dependent upon funding opportunities, but is something which the Tribe feels is very important.

PART 3 —
RISK ASSESSMENT

CHAPTER 6.
DAM FAILURE

6.1 GENERAL BACKGROUND

6.1.1 Causes of Dam Failure

Dam failures in the United States typically occur in one of four ways (see Figure 6-1):

- Overtopping of the primary dam structure, which accounts for 34 percent of all dam failures, can occur due to inadequate spillway design, settlement of the dam crest, blockage of spillways, and other factors.
- Foundation defects due to differential settlement, slides, slope instability, uplift pressures, and foundation seepage can also cause dam failure. These account for 30 percent of all dam failures.
- Failure due to piping and seepage accounts for 20 percent of all failures. These are caused by internal erosion due to piping and seepage, erosion along hydraulic structures such as spillways, erosion due to animal burrows, and cracks in the dam structure.
- Failure due to problems with conduits and valves, typically caused by the piping of embankment material into conduits through joints or cracks, constitutes 10 percent of all failures.

The remaining 6 percent of U.S. dam failures are due to miscellaneous causes. Many dam failures in the United States have been secondary results of other disasters. The prominent causes are earthquakes, landslides, extreme storms, massive snowmelt, equipment malfunction, structural damage, foundation failures, and sabotage. The most likely disaster-related causes of dam failure in the Yurok planning area are earthquake and soil failure.

Poor construction, lack of maintenance and repair, and deficient operational procedures are preventable or correctable by a program of regular inspections. Terrorism and vandalism are serious concerns that all operators of public facilities must plan for; these threats are under continuous review by public safety agencies.

DEFINITIONS

Dam—Any artificial barrier, together with appurtenant works, that does or may impound or divert water, and that either (a) is 25 feet or more in height from the natural bed of the stream or watercourse at the downstream toe of the barrier (or from the lowest elevation of the outside limit of the barrier if it is not across a stream channel or watercourse) to the maximum possible water storage elevation; or (b) has an impounding capacity of 50 acre-feet or more. (CA Water Code, Division 3.)

Dam Failure—An uncontrolled release of impounded water due to structural deficiencies in dam.

Emergency Action Plan—A document that identifies potential emergency conditions at a dam and specifies actions to be followed to minimize property damage and loss of life. The plan specifies actions the dam owner should take to alleviate problems at a dam. It contains procedures and information to assist the dam owner in issuing early warning and notification messages to responsible downstream emergency management authorities of the emergency situation. It also contains inundation maps to show emergency management authorities the critical areas for action in case of an emergency. (FEMA 64)

High Hazard Dam—Dams where failure or operational error will probably cause loss of human life. (FEMA 333)

Significant Hazard Dam—Dams where failure or operational error will result in no probable loss of human life but can cause economic loss, environmental damage or disruption of lifeline facilities, or can impact other concerns. Significant hazard dams are often located in rural or agricultural areas but could be located in areas with population and significant infrastructure. (FEMA 333)

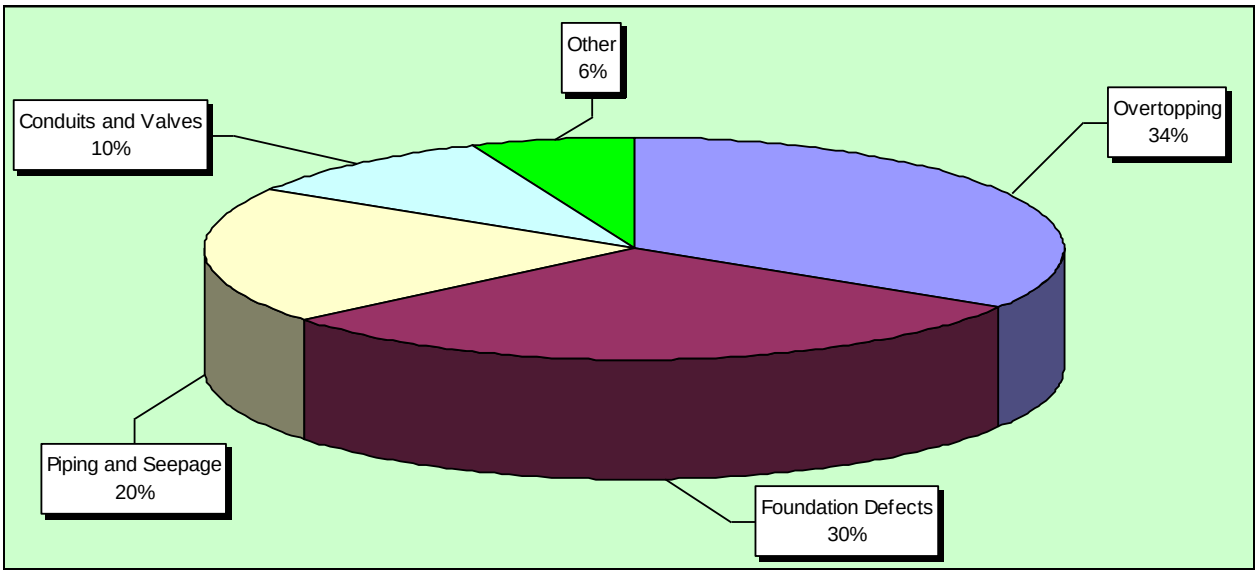

Figure 6-1. Historical Causes of Dam Failure

6.1.2 Dam Removal

The Yurok Tribe has been working for many years to have dams removed within the planning region due, in part, to the negligible power benefit but significant negative impact on water quality and fish passage. The Tribe maintains a number of programs to both enhance water quality and restore fish passage to its previous higher levels. Salmon runs have been significantly disrupted as a result of dams, and the negative impact will continue for many years after the dams have been removed. The Tribe will continue to work with dam owners in this regard.

6.1.3 Regulatory Oversight

The potential for catastrophic flooding due to dam failures led to passage of the National Dam Safety Act (Public Law 92-367). The National Dam Safety Program requires a periodic engineering analysis of every major dam in the country. The goal of this FEMA-monitored effort is to identify and mitigate the risk of dam failure so as to protect the lives and property of the public.

California Division of Safety of Dams

California's Division of Safety of Dams (a division of the Department of Water Resources) monitors the dam safety program at the state level. When a new dam is proposed, Division staff inspect the site. When an application is received, the Division reviews the plans to ensure that the dam is designed to meet minimum requirements and that the design is appropriate for known geologic conditions. After approval of the application, the Division inspects the construction to ensure that the work is done in accordance with the approved plans. After construction, the Division inspects each dam on an annual basis to ensure that it is performing as intended and is not developing problems. Roughly a third of these inspections include in-depth instrumentation reviews. The Division periodically reviews the stability of dams and their major appurtenances in light of improved design approaches and requirements, as well as new findings regarding earthquake hazards and hydrologic estimates in California (DWR Website, 2007).

U.S. Army Corps of Engineers Dam Safety Program

The U.S. Army Corps of Engineers is responsible for safety inspections of some federal and non-federal dams in the United States that meet the size and storage limitations specified in the National Dam Safety

Act. The Corps has inventoried dams; surveyed each state and federal agency's capabilities, practices and regulations regarding design, construction, operation and maintenance of the dams; and developed guidelines for inspection and evaluation of dam safety (U.S. Army Corps of Engineers, 1997).

Federal Energy Regulatory Commission Dam Safety Program

The Federal Energy Regulatory Commission (FERC) has the largest dam safety program in the United States. The FERC cooperates with a large number of federal and state agencies to ensure and promote dam safety and, more recently, homeland security. There are 3,036 dams that are part of regulated hydroelectric projects are in the FERC program. Two-thirds of these are more than 50 years old. As dams age, concern about their safety and integrity grows, so oversight and regular inspection are important. FERC staff inspects hydroelectric projects on an unscheduled basis to investigate the following:

- Potential dam safety problems
- Complaints about constructing and operating a project
- Safety concerns related to natural disasters
- Issues concerning compliance with the terms and conditions of a license.

Every five years, an independent consulting engineer, approved by the FERC, must inspect and evaluate projects with dams higher than 32.8 feet, or with a total storage capacity of more than 2,000 acre-feet.

FERC staff monitors and evaluates seismic research in geographic areas where there are concerns about seismic activity. This information is applied in investigating and performing structural analyses of hydroelectric projects in these areas. FERC staff also evaluates the effects of potential and actual large floods on the safety of dams. During and following floods, FERC staff visits dams and licensed projects, determines the extent of damage, if any, and directs any necessary studies or remedial measures the licensee must undertake. The FERC publication *Engineering Guidelines for the Evaluation of Hydropower Projects* guides the FERC engineering staff and licensees in evaluating dam safety. The publication is frequently revised to reflect current information and methodologies.

The FERC requires licensees to prepare emergency action plans and conducts training sessions on how to develop and test these plans. The plans outline an early warning system if there is an actual or potential sudden release of water from a dam due to failure. The plans include operational procedures that may be used, such as reducing reservoir levels and reducing downstream flows, as well as procedures for notifying affected residents and agencies responsible for emergency management. These plans are frequently updated and tested to ensure that everyone knows what to do in emergency situations.

6.2 HAZARD PROFILE

6.2.1 Past Events

According to the California State Hazard Mitigation Plan, there have been nine dam failures in the state since 1950, none of them in the planning area. Overtopping caused two of the failures, and the others were caused by seepage or leaks. One failure, the 1963 Baldwin Hills Dam Failure, resulted in three deaths because the leak turned into a washout. The historical record indicates that California has had about 45 failures of non-federal dams. The failures occurred for a variety of reasons, the most common being overtopping. Other reasons include shortcomings in the dams or an inadequate assessment of surrounding geomorphologic characteristics.

California's first notable dam failure was in 1883 in Sierra County, and the most recent failure was in 1965. The most catastrophic event was the failure of William Mulholland's St. Francis Dam, which failed

in 1928 and killed an estimated 450 people. San Francisquito Canyon, which was flooded in the event, was home to hundreds of transients who were not accounted for in the death estimate.

Specific to the Yurok Reservation, annually, water releases from the dams during the winter season causes flooding throughout areas of the Reservation. This flooding is not as a result of the impact from rain accumulation on the reservation, but as a result of the dams spilling water. Additionally, water from these release events sometimes include toxic allege, which pose a health risk to those living downstream of the spill, as well as fish and wildlife.

6.2.2 Location

Table 6-1 lists dams on the Klamath and Trinity Rivers and their tributaries, which could impact portions of the Yurok planning area if they were to fail. Figure 6-2 shows worst-case inundation areas based on a potential Domino Dam failure event on the Klamath River. The Domino Probable Maximum Flood event depicts the inundation area if multiple dams were to fail at the same time, including Iron Gate, Copco No 1, and Copco No 2. The total impact area is 7,000 acres for the Reservation. Because stream-side and river-front properties are often more heavily populated and more highly valued than other areas, the potential impact of dam failures to human life and land values in the planning area pose a considerable threat. In addition there could be a significant cultural impact due to the presence of cultural resources within the dam failure inundation areas, as well as impact to fish spawning and fish habitat.

TABLE 6-1.
DAMS WITH POTENTIAL IMPACT ON THE TRINITY AND KLAMATH RIVERS

Dam Name	County	Water Course	Owner	Year Built	Crest Elevation (feet)	Dam Type	Crest Length (feet)	Height (feet)	Storage Capacity (acre-feet)	Use[a]
Copco No. 1	Siskiyou	Klamath River	PacifiCorp	1922	2,613.0	Gravity	415	132	77,000	STO, DIV, POW
Copco No. 2	Siskiyou	Klamath River	PacifiCorp	1925	2,484.0	Gravity	148	37	55	DIV, POW
Iron Gate	Siskiyou	Klamath River	PacifiCorp	1962	2,343.0	Earth and Rock	745	188	58,000	STO, REG, POW
JC Boyle	Klamath, Oregon	Klamath River	PacifiCorp	1958	3,800.0	Earth	693	68	3,495	POW
Jones Ranch	Trinity	Tributary Trinity River	Eleanor Jones	1980	1,905.5	Earth	350	36	58	STO, REC
Lewiston	Trinity	Trinity	U.S. Bureau of Reclamation	1963	1,910.0	Earth	745	73	14,660	
Link River Diversion	Klamath, Oregon	Klamath/ Link River	U.S. Bureau of Reclamation	1928	4,145.0		435	22	735,000	DIV
Trinity	Trinity	Trinity River	U.S. Bureau of Reclamation	1962	2,395.0	Earth	2,450	458	2,447,650	MULTI, IRR, REC, POW

a. Use codes: DIV = Diversion; IRR = Irrigation; MULTI = Multi-purpose; POW = Power Generation; REC = Recreation; REG = Regulation; STO = Storage

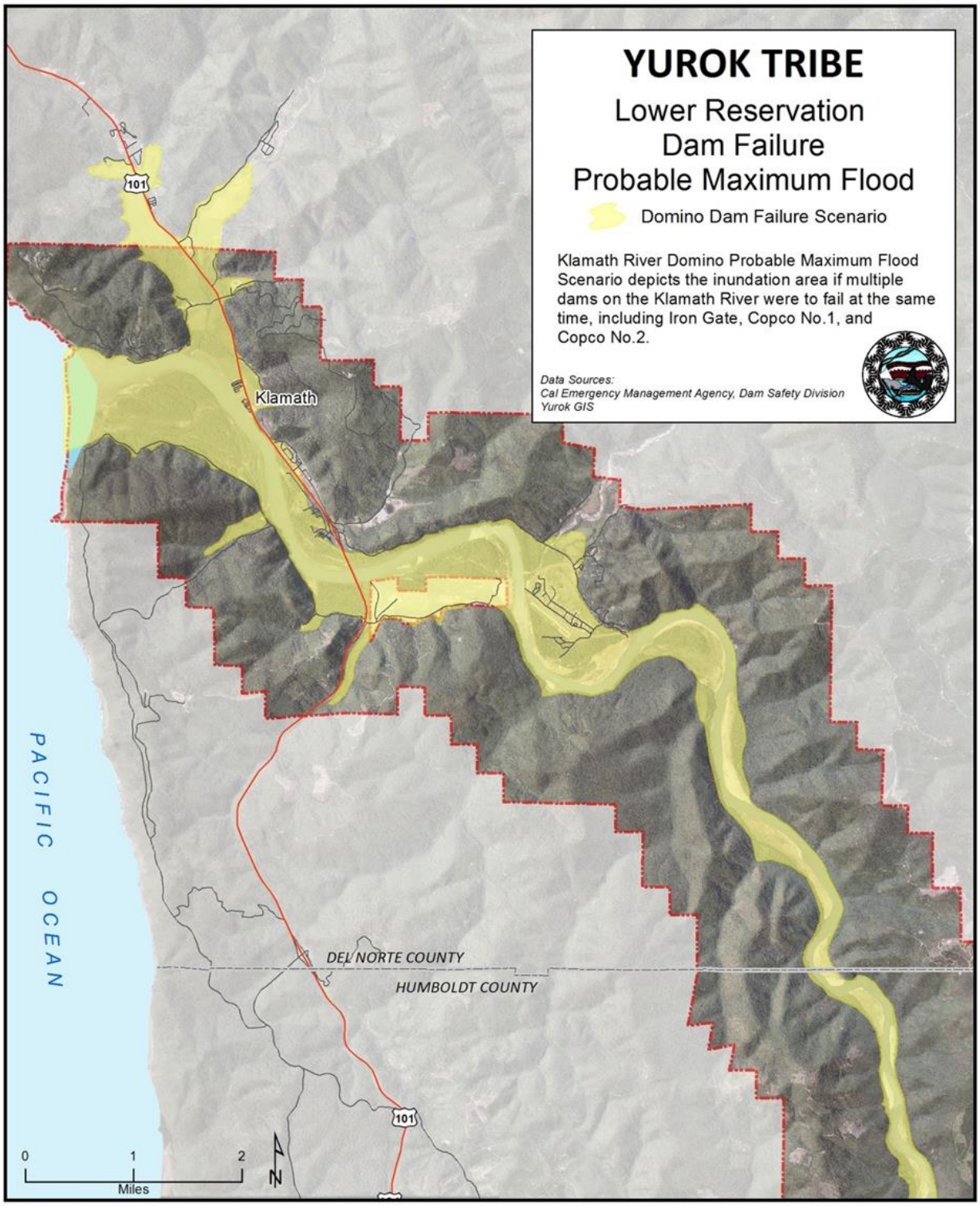

Figure 6-2. Lower Reservation Potential Dam Failure Inundation Area, Klamath River

While failure of any of the dams listed would have a significant negative impact on the Reservation, failure of the Lewiston and Trinity Dams in particular would cause complete devastation along the banks of the river on both the Hoopa and Yurok tribes, causing inundation twenty to thirty feet above normal river levels, resulting in water levels many times higher than the flood of record. It is estimated that such

events would occur within 12 hours of dam failure. Inundation mapping for the Trinity Dam was not available during the development of this plan. Failure of the Lewiston dam would destroy 90% of the structures within the inundation area, as only a few structures are situated on higher elevation, out of the inundation zone. Existing bridges, buildings and infrastructure would be non-existent.

6.2.3 Frequency

Dam failure events are infrequent and usually coincide with events that cause them, such as earthquakes, landslides and excessive rainfall and snowmelt. There is a "residual risk" associated with dams. Residual risk is the risk that remains after safeguards have been implemented. For dams, the residual risk is associated with events beyond those that the facility was designed to withstand. However, the probability of any type of dam failure is low in today's regulatory and dam safety oversight environment. However, while dam failure may be infrequent, the Tribe does annually experience flooding caused by dams releasing excess water during winter months.

6.2.4 Severity

Dam failure can be catastrophic to all life and property downstream. The U.S. Army Corps of Engineers developed the classification system shown in Table 6-2 for the hazard potential of dam failures. The Corps' hazard rating system is based only on the potential consequences of a dam failure; it does not take into account the probability of such failures.

TABLE 6-2.
CORPS OF ENGINEERS HAZARD POTENTIAL CLASSIFICATION

Hazard Category[a]	Direct Loss of Life[b]	Lifeline Losses[c]	Property Losses[d]	Environmental Losses[e]
Low	None (rural location, no permanent structures for human habitation)	No disruption of services (cosmetic or rapidly repairable damage)	Private agricultural lands, equipment, and isolated buildings	Minimal incremental damage
Significant	Rural location, only transient or day-use facilities	Disruption of essential facilities and access	Major public and private facilities	Major mitigation required
High	Certain (one or more) extensive residential, commercial, or industrial development	Disruption of essential facilities and access	Extensive public and private facilities	Extensive mitigation cost or impossible to mitigate

a. Categories are assigned to overall projects, not individual structures at a project.
b. Loss of life potential based on inundation mapping of area downstream of the project. Analyses of loss of life potential should take into account the population at risk, time of flood wave travel, and warning time.
c. Indirect threats to life caused by the interruption of lifeline services due to project failure or operational disruption; for example, loss of critical medical facilities or access to them.
d. Damage to project facilities and downstream property and indirect impact due to loss of project services, such as impact due to loss of a dam and navigation pool, or impact due to loss of water or power supply.
e. Environmental impact downstream caused by the incremental flood wave produced by the project failure, beyond what would normally be expected for the magnitude flood event under which the failure occurs.

Source: U.S. Army Corps of Engineers, 1995

6.2.5 Warning Time

Warning time for dam failure varies depending on the cause of the failure. In events of extreme precipitation or massive snowmelt, evacuations can be planned with sufficient time. In the event of a structural failure due to earthquake, there may be no warning time. A dam's structural type also affects warning time. Earthen dams do not tend to fail completely or instantaneously. Once a breach is initiated, discharging water erodes the breach until either the reservoir water is depleted or the breach resists further erosion. Concrete gravity dams also tend to have a partial breach as one or more monolith sections are forced apart by escaping water. The time of breach formation ranges from a few minutes to a few hours (U.S. Army Corps of Engineers, 1997). It is estimated that should a failure occur on the Trinity Dam, impact to both the Hoopa and Yurok Reservations would occur within 12 hours.

The Yurok Tribe has no established protocols for flood warning and response to imminent dam failure as these types of protocols are tied to the emergency action plans (EAPs) created by the dam owners. As of the writing of this plan, no inundation studies were available to the Tribe from the dam owners. More stringent requirements should be in place by the over-sight authority which requires the release of such information to the Tribe. However, as previously indicated, in an effort to prepare the Reservation for a potential dam breach, the Tribe has conducted a series of exercises with Pacific Power over the course of the last few years in their attempt to educate the Tribal members with respect to evacuation routes and evacuation planning.

6.3 SECONDARY HAZARDS

Dam failure can cause severe downstream flooding, depending on the magnitude of the failure. Other potential secondary hazards of dam failure are landslides around the reservoir perimeter, bank erosion on the rivers, and destruction of downstream habitat. In addition, on the Yurok Reservation, any impact to the bridges on the Reservation could lead to isolated islands of humanity, cutting off medical, emergency response and food supplies to residents. In addition, water supply and distribution lines above, and potentially below ground would be significantly impacted, as would power and communication lines. This is of significant concern because of the current lack of infrastructure brought to the Reservation by existing power companies. As approximately 70% of the reservation is currently without power and communication lines, impact to the existing infrastructure would be devastating to the Tribe.

6.4 CLIMATE CHANGE IMPACTS

Dams are designed partly based on assumptions about a river's flow behavior, expressed as hydrographs. Changes in weather patterns can have significant effects on the hydrograph used for the design of a dam. If the hygrograph changes, it is conceivable that the dam can lose some or all of its designed margin of safety, also known as freeboard. If freeboard is reduced, dam operators may be forced to release increased volumes earlier in a storm cycle in order to maintain the required margins of safety. Such early releases of increased volumes can increase flood potential downstream. Throughout the west, communities downstream of dams are already increases in stream flows from earlier releases from dams.

Dams are constructed with safety features known as "spillways." Spillways are put in place on dams as a safety measure in the event of the reservoir filling too quickly. Spillway overflow events, often referred to as "design failures," result in increased discharges downstream and increased flooding potential. Although climate change will not increase the probability of catastrophic dam failure, it may increase the probability of design failures.

6.5 EXPOSURE

GIS was used to assess exposure of dam failure. A building GIS layer was intersected with available dam inundation data, which has a level of accuracy acceptable for planning purposes. Dam inundation data was available for the Klamath River system. Where possible, data was enhanced using local, state and federal sources. In general, local communities that may be fully or partially affected by a dam failure are as follows:

- Copco No. 1, Copco No. 2 and Iron Gate Dams (Klamath River)
  - Orleans, Bluff Creek, Weitchpec, Martin's Ferry, Cappell Flat, Pecwan, Sregon, Johnson's, Wautec, Blue Creek, Ah-Pah, Klamath Glen, Tur-War Creek, Hoppel, Klamath and South Side Requa, Waukel Flats and Resighini.
- Lewiston and Trinity Dams (Trinity and Klamath Rivers)
  - Sandy Bar, China Flat, Willow Creek, Sugar Bowl, Hoopa Valley, Weitchpec, Martin's Ferry, Cappell Flat, Pecwan, Sregon, Johnsons, Wautec, Blue Creek, Ah-Pah, Klamath Glen, Tur-War, Hoppel, Klamath, South Side Requa (Klamath Beach Road), Waukel Flats, and Resighini.

6.5.1 Population

Population counts of those living in the dam inundation area were generated by analyzing the Reservation's total population and total households that intersect the inundation zone (both Tribal and non-Tribal). The methodology used to generate population estimates was determined by multiplying the average household size for the Yurok Reservation (3 persons per household) by the number of exposed residential buildings. Using this approach, it was estimated that the exposed population is 564 within the inundation area.

6.5.2 Property

Based on study area building data, it is estimated that there are 214 structures within the mapped Domino dam failure inundation areas in the planning area. The value of exposed buildings in the planning area was generated using GIS and is summarized in Table 6-3 and Table 6-4. This methodology estimated $56 million worth of building-and-contents exposure to dam failure inundation, representing 19 percent of the total assessed value of the planning area.

TABLE 6-3.
EXPOSURE AND VALUE OF STRUCTURES IN DOMINO DAM FAILURE INUNDATION AREAS

Number of Buildings Exposed	214
Value Exposed	
Structure	$33,550,664
Contents	$22,514,669
Total	$56,065,333
Exposed Value as % of Total Assessed Value	19.43%

TABLE 6-4.
FACILITIES IN DOMINO DAM FAILURE INUNDATION AREAS

Facility Type	Number in Planning Area
Tribal Facilities	5
Government Non-Tribal	5
Non Residential	16
Residential	188
Total	**214**

6.5.3 Environment

Reservoirs held behind dams affect many ecological aspects of a river. River topography and dynamics depend on a wide range of flows, but rivers below dams often experience long periods of very stable flow conditions or saw-tooth flow patterns caused by releases followed by no releases. Water releases from dams usually contain very little suspended sediment; this can lead to scouring of river beds and banks.

The environment would be exposed to a number of risks in the event of dam failure. The inundation could introduce many foreign elements into local waterways, resulting in destruction of downstream habitat, with detrimental effects on many species of animals, especially endangered species such as salmon.

6.6 VULNERABILITY

6.6.1 Population

Vulnerable populations are all populations downstream from dam failures that are incapable of escaping the area within the allowable time frame. This population includes the elderly and young who may be unable to get themselves out of the inundation area. The vulnerable population also includes those who would not have adequate warning from a television or radio emergency warning system. The Upriver communities have no public television or public radio coverage, severely impacting information sharing and alert and warning in that portion of the Reservation. In an effort to mitigate that impact, the Tribe has installed warning sirens which will help alert citizens.

6.6.2 Property

Vulnerable properties are those closest to the dam inundation area. These properties would experience the largest, most destructive surge of water. Low-lying areas are also vulnerable since they are where the dam waters would collect. Transportation routes are vulnerable to dam inundation and have the potential to be wiped out, creating isolation issues. This includes all roads, railroads and bridges in the path of the dam inundation. Those that are most vulnerable are those that are already in poor condition and would not be able to withstand a large water surge. Utilities such as overhead power lines, cable and phone lines could also be vulnerable. Loss of these utilities could create additional isolation issues for the inundation areas.

Loss estimations for the Domino dam failure hazard is not based on modeling utilizing damage functions. Instead, loss estimates were developed representing 30 percent, 50 percent and 80 percent of the assessed value of exposed structures. This allows emergency managers to select a range of economic impact based on an estimate of the percent of damage to the general building stock. Damage in excess of 50 percent is considered to be substantial by most building codes and typically requires total reconstruction of the structure. Table 6-5 shows the general building stock loss estimates in the mapped inundation zones.

TABLE 6-5. LOSS ESTIMATES FOR DAM FAILURE	
Building Count	214
Estimated Value	$56,065,333
30% Damage	$16,819,600
50% Damage	$28,032,667
80% Damage	$44,852,266

6.6.3 Environment

The environment would be vulnerable to a number of risks in the event of dam failure. The inundation could introduce foreign elements into local waterways, resulting in destruction of downstream habitat and detrimental effects on many species of animals, especially endangered species such as coho salmon. The extent of the vulnerability of the environment is the same as the exposure of the environment.

6.7 FUTURE TRENDS IN DEVELOPMENT

Land use in the planning area will be directed by general plans adopted under Tribal law. The safety elements of the general plans establish standards and plans for the protection of the community from hazards. Dam failure is currently not addressed as a standalone hazard in the safety elements, but flooding is. Most of the areas vulnerable to the more severe impacts from dam failure intersect mapped flood hazard areas. Flood-related policies in the general plan will help to reduce the risk associated with the dam failure hazard for all future development in the planning area. The Yurok Tribe is in the process of establishing formal policies regarding sound land use in identified hazard areas, as well as general guidelines with respect to land use.

6.8 SCENARIO

An earthquake in the region could lead to liquefaction of soils around a dam. This could occur without warning during any time of the day. A human-caused failure such as a terrorist attack also could trigger a catastrophic failure of a dam that impacts the planning area. While the probability of dam failure is very low, the probability of flooding associated with changes to dam operational parameters in response to climate change is higher. Dam designs and operations are developed based on hydrographs with historical record. If these hydrographs experience significant changes over time due to the impacts of climate change, the design and operations may no longer be valid for the changed condition. This could have significant impacts on dams that provide flood control. Specified release rates and impound thresholds may have to be changed. This would result in increased discharges downstream of these facilities, thus increasing the probability and severity of flooding. This is something which the Tribe is experiencing annually during the winter seasons as increased precipitation levels also increase the magnitude and frequency of the dams releasing or spilling excess water, flooding portions of the Reservation. Any of the scenarios referenced will curtail transportation on the Reservation, creating isolated islands of humanity. This has occurred many times previously on the Reservation, restricting access to medical care, food, and the ability of residents to travel to and from work. During the 1964 flood, a number of bridges along the Klamath River were damaged. At that time, a ferry was utilized by the Army Corps of Engineers to transport in excess of 100 cars per day.

6.9 ISSUES

The most significant issue associated with dam failure involves the properties and populations in the inundation zones. Flooding as a result of a dam failure would significantly impact these areas. There is often limited warning time for dam failure. These events are frequently associated with other natural hazard events such as earthquakes, landslides or severe weather, which limits their predictability and compounds the hazard. Important issues associated with dam failure hazards include the following:

- Federally regulated dams have an adequate level of oversight and sophistication in the development of emergency action plans for public notification in the unlikely event of failure. However, the protocol for notification of downstream citizens of imminent failure needs to be tied to local emergency response planning.
- Mapping for federally regulated dams is already required and available; however, mapping for non-federal-regulated dams that estimates inundation depths is needed to better assess the risk associated with dam failure from these facilities.
- Most dam failure mapping required at federal levels requires determination of the probable maximum flood. While the probable maximum flood represents a worst-case scenario, it is generally the event with the lowest probability of occurrence. For non-federal-regulated dams, mapping of dam failure scenarios that are less extreme than the probable maximum flood but have a higher probability of occurrence can be valuable to emergency managers and community officials downstream of these facilities. This type of mapping can illustrate areas potentially impacted by more frequent events to support emergency response and preparedness.
- The concept of residual risk associated with structural flood control projects should be considered in the design of capital projects and the application of land use regulations.
- Addressing security concerns and the need to inform the public of the risk associated with dam failure is a challenge for public officials.
- The lack of an existing up-to-date call out list and contact information provided to the Tribe by Pacific Corps and Bureau of Reclamation for use in the event of a dam failure would aid the Tribe greatly in the event of an incident occurring.

CHAPTER 7.
DROUGHT

7.1 GENERAL BACKGROUND

Drought is a prolonged period of dryness severe enough to reduce soil moisture, water and snow levels below the minimum necessary for sustaining plant, animal and economic systems. Droughts are a natural part of the climate cycle.

Drought can have a widespread impact on the environment and the economy, depending upon its severity, although it typically does not result in loss of life or damage to property, as do other natural disasters. The National Drought Mitigation Center uses three categories to describe likely drought impacts:

- Agricultural—Drought threatens crops that rely on natural precipitation.
- Water supply—Drought threatens supplies of water for irrigated crops and for communities.
- Fire hazard—Drought increases the threat of wildfires from dry conditions in forest and rangelands.

DEFINITIONS

Drought—The cumulative impacts of several dry years on water users. It can include deficiencies in surface and subsurface water supplies and generally impacts health, well being, and quality of life.

Hydrological Drought—Deficiencies in surface and subsurface water supplies.

Socioeconomic Drought—Drought impacts on health, well-being and quality of life.

7.1.1 Drought in California

Drought has impacted almost every county in California at one time or another, causing more than $2.6 million in damage. Droughts exceeding three years are relatively rare in northern California, the source of much of the state's water supply. The 1929-1934 drought established the criteria commonly used in designing storage capacity and yield for large northern California reservoirs. The driest single year in California's measured hydrologic history was 1977.

Past experience shows that drought impacts in California are felt first by those most dependent on annual rainfall: agencies fighting wild fires, ranchers engaged in dryland grazing, rural residents relying on wells in low-yield rock formations, or small water systems lacking a reliable water source. California's last major statewide drought was 1987-92. Southern California experienced dry years in the late 1990s/early 2000s, with water year 2002 setting records for the driest water year in Los Angeles and San Diego.

Most of California's precipitation comes from storms moving across the Pacific Ocean. The path followed by the storms is determined by the position of an atmospheric high pressure belt that normally shifts southward during the winter, allowing low pressure systems to move into the state. On average, 75 percent of California's annual precipitation occurs between November and March, with 50 percent occurring between December and February. If a persistent Pacific high pressure zone takes hold over California mid-winter, there is a tendency for the water year to be dry.

7.1.2 Additional Drought Impact on the Yurok Reservation

Of additional significance to the Yurok Tribe is the impact a drought can have on Salmon. Salmon runs can be disrupted for many years following drought conditions when river flows drop to dangerous levels.

Low flows also reduce the depth of the pools and coldwater refugia along the river, further reducing the salmon's ability to either migrate further upstream, or seek shelter in a coldwater, oxygenated environment. Low flows also dry up side springs, which provide additional refuge for salmonids. Likewise, the low flows prevent young fish from finding cover along the river's edge, and the related high temperatures, low oxygen levels and poor water quality have been lethal to fish. There have been several major fish kills of juvenile salmon due to low flows on the Reservation. Low water levels, which increase water temperatures, also increase the amount of blue/green algae, increasing health risk to individuals, fish and wildlife, and the environment in general.

Illegal diversion of water systems for cultivation of illegal marijuana operations has also increased drought impact. Low water leaves cause sediments to increase in above-ground water systems. Incidents such as this have caused issues with the Environmental Protection Agency, which has issued additional violation notices as a result of the low turbidity and increased sediments.

7.2 HAZARD PROFILE

Droughts originate from a deficiency of precipitation resulting from an unusual weather pattern. If the weather pattern lasts a short time (a few weeks or a couple months), the drought is considered short-term. If the weather pattern becomes entrenched and the precipitation deficits last for several months or years, the drought is considered to be long-term. It is possible for a region to experience a long-term circulation pattern that produces drought, and to have short-term changes in this long-term pattern that result in short-term wet spells. Likewise, it is possible for a long-term wet circulation pattern to be interrupted by short-term weather spells that result in short-term drought.

7.2.1 Past Events

The California Department of Water Resources has state hydrologic data back to the early 1900s (http://cdec.water.ca.gov/). The hydrologic data show multi-year droughts from 1912 to 1913, 1918 to 1920 and 1922 to 1924. Since then, three prolonged periods of drought occurred in California, all of which impacted the planning area to some degree:

- **1929 to 1934 Drought**—The 1929 to 1934 drought established the criteria for designing many large Northern California reservoirs. The Sacramento Valley runoff was 55 percent of average for the time period from 1901 to 1996, with only 9.8 million acre-feet received.
- **1975 to 1977 Drought**—California had one of its most severe droughts due to lack of rainfall during the winters of 1976 and 1977. 1977 was the driest period on record in California, with the previous winter recorded as the fourth driest in California's hydrological history. The cumulative impact led to widespread water shortages and severe water conservation measures throughout the state. Only 37 percent of the average Sacramento Valley runoff was received, with just 6.6 million acre-feet recorded. Over $2.6 billion in crop damage was recorded in 31 counties. A federal disaster declaration was declared in some counties. Water deliveries were required for domestic drinking water.
- **1987-1992 Drought**—California received precipitation well below average levels for four consecutive years. While the Central Coast was most affected, the Sierra Nevadas in Northern California and the Central Valley counties were also affected. During this drought, only 56 percent of average runoff for the Sacramento Valley was received, totaling just 10 million acre-feet. By February 1991, all 58 counties in California were suffering from drought conditions, and urban areas as well as rural and agricultural areas were impacted.

7.2.2 Location

The National Oceanic and Atmospheric Administration (NOAA) has developed several indices to measure drought impacts and severity and to map their extent and locations:

- The ***Palmer Crop Moisture Index*** measures short-term drought on a weekly scale and is used to quantify drought's impacts on agriculture during the growing season.
- The ***Palmer Z Index*** measures short-term drought on a monthly scale.
- The ***Palmer Drought Index (PDI)*** measures the duration and intensity of long-term drought-inducing circulation patterns. Long-term drought is cumulative, so the intensity of drought during a given month is dependent on the current weather patterns plus the cumulative patterns of previous months. Weather patterns can change quickly from a long-term drought pattern to a long-term wet pattern, and the PDI can respond fairly rapidly. Figure 7-1 shows this index as of March 2011.
- The hydrological impacts of drought (e.g., reservoir levels, groundwater levels, etc.) take longer to develop and it takes longer to recover from them. The ***Palmer Hydrological Drought Index (PHDI)***, another long-term index, was developed to quantify hydrological effects. The PHDI responds more slowly to changing conditions than the PDI. Figure 7-2 shows this index for June 2012.
- While the Palmer indices consider precipitation, evapotranspiration and runoff, the ***Standardized Precipitation Index (SPI)*** considers only precipitation. In the SPI, an index of zero indicates the median precipitation amount; the index is negative for drought and positive for wet conditions. The SPI is computed for time scales ranging from one month to 24 months. Figure 7-3 shows the 24-month SPI map for April 2009 through March 2011.

Figure 7-4 demonstrates a culmination of information, including the current situation, the extended outlook through October 2012 for the potential of impact from a drought situation, the long-term outlook, and the historical outlook from 1934. At present, no drought situation is anticipated in the area of the Yurok Reservation. While these maps demonstrate no immediate impact, climate change occurring within the region will undoubtedly change this analysis.

7.2.3 Frequency

According to the 2010 State of California Multi-Hazard Mitigation Plan, droughts exceeding three years are rare in Northern California, which is the source of much of the state's water supply. The state plan's list of droughts since 1972 shows only one drought affecting Humboldt and Del Norte Counties (in 2001). Review of state and federal data for declared drought disasters by county from 1950 through 2012 shows that no such droughts were declared in that time for Humboldt and Del Norte Counties.

While no actual droughts have been declared within the planning area, the increased number of illegal marijuana grow operations has continued to increase, causing significant water depletion and contributing to increased EPA violations. This water depletion is significant enough to reduce water levels to the point of increasing blue/green algae growth, which increases health issues, impacts fish and wildlife, and negatively impacts the general environment on the Reservation.

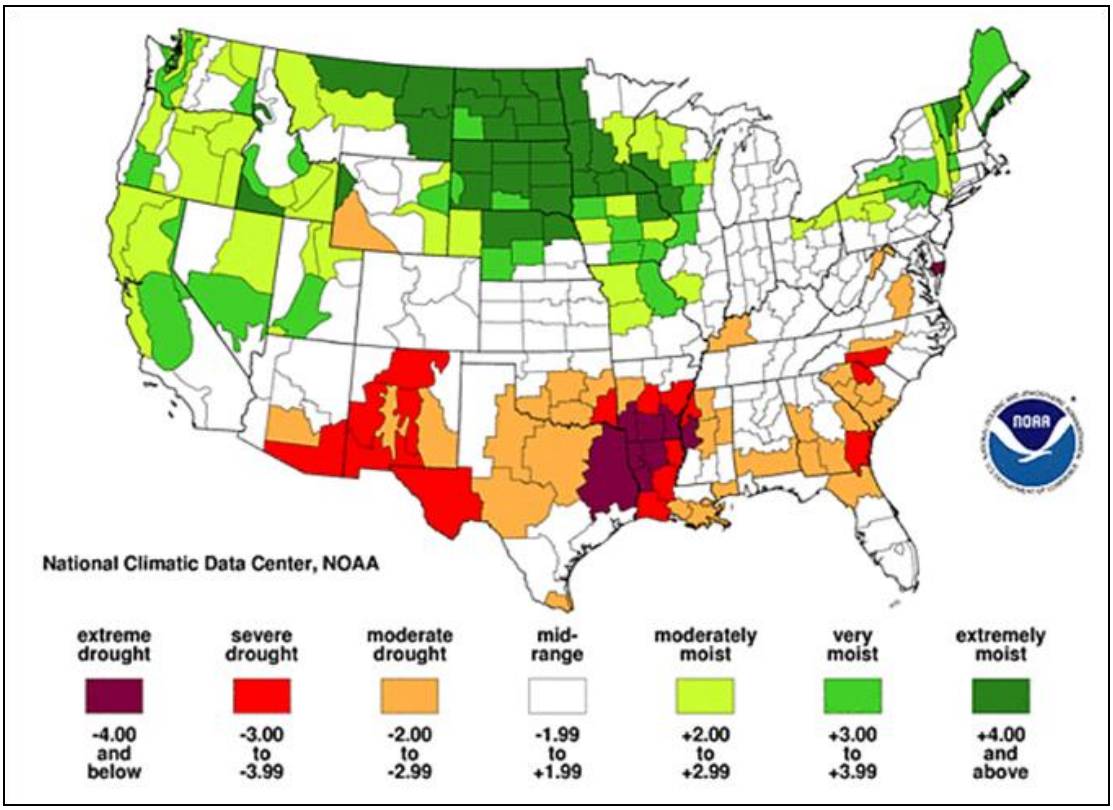

Figure 7-1. Palmer Drought Index Long-Term Drought Conditions (March 2011)

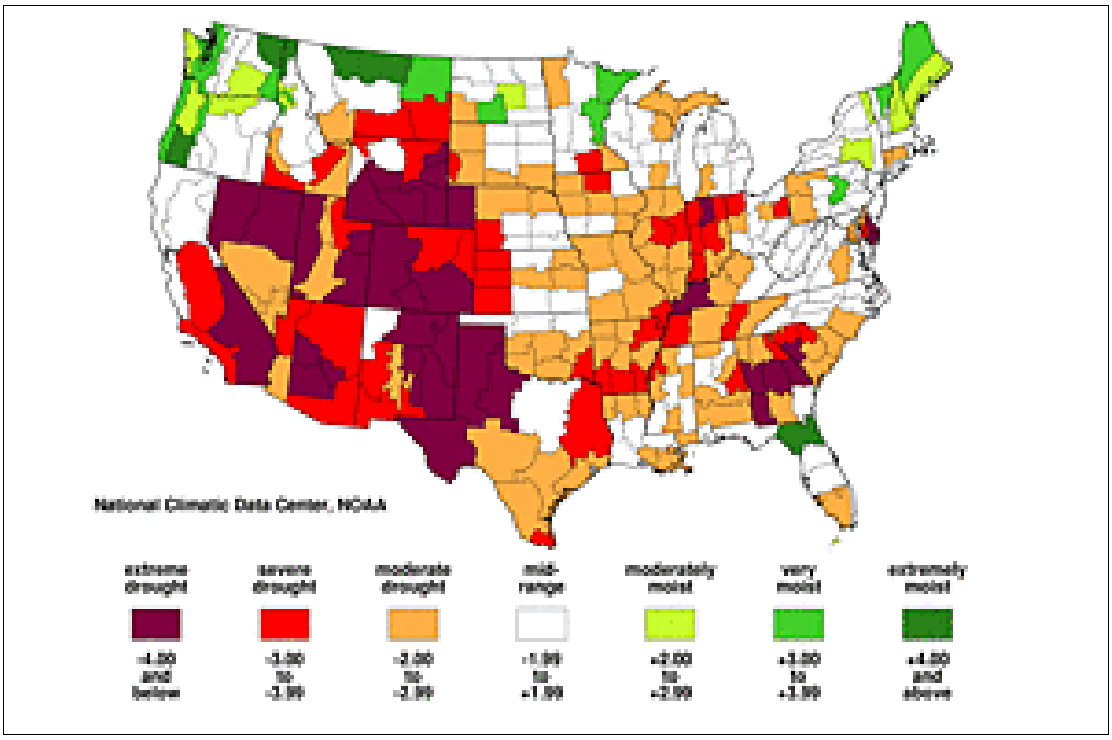

Figure 7-2. Palmer Hydrological Drought Index Long-Term Hydrologic Conditions (June 2012)

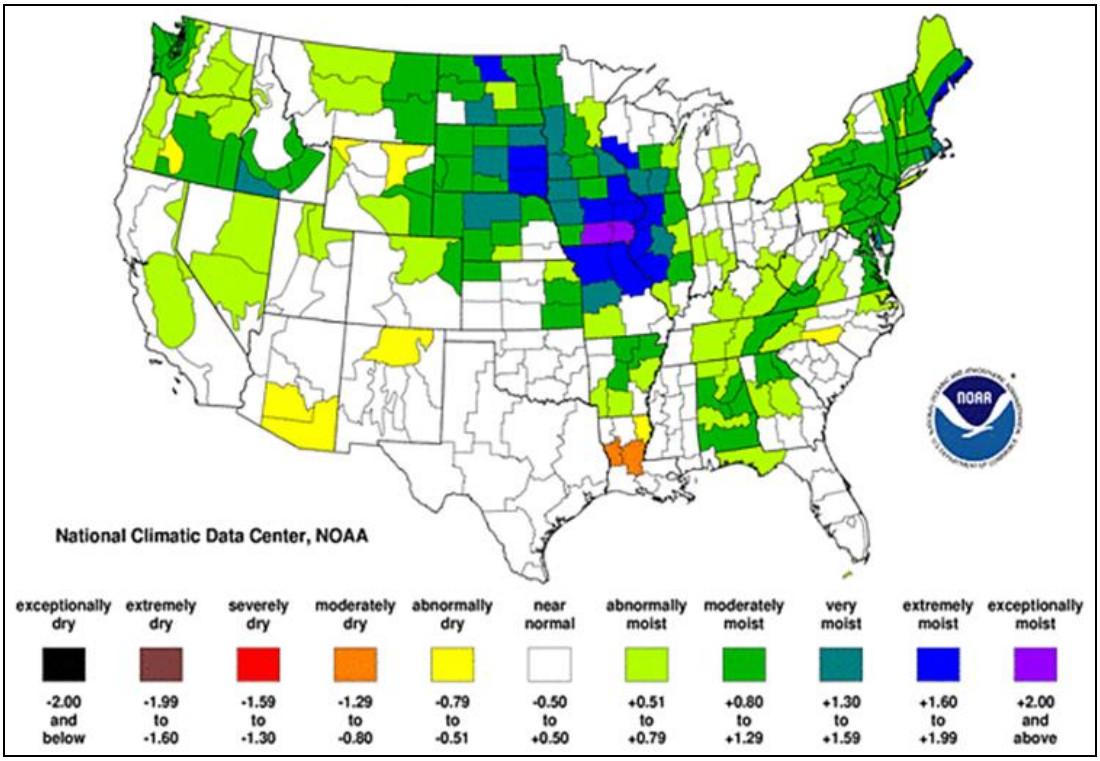

Figure 7-3. 24-Month Standardized Precipitation Index (April 2009—March 2011)

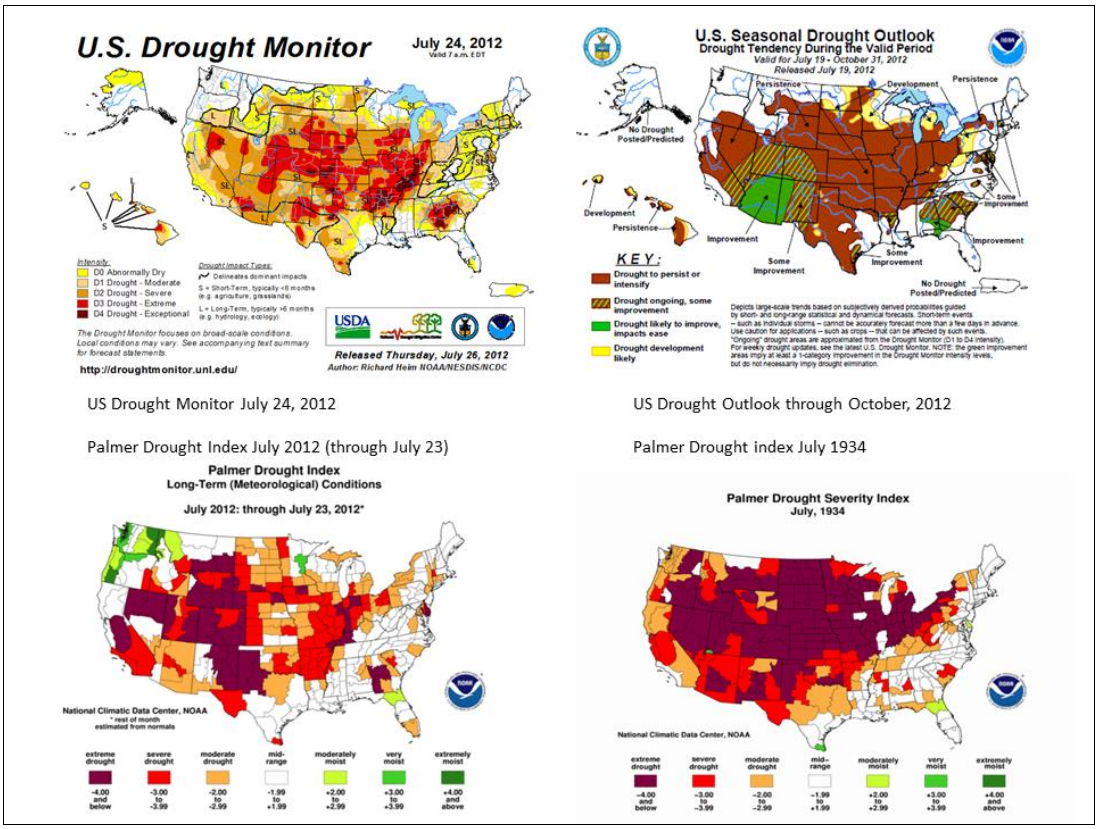

Figure 7-4. Palmer Index Drought Conditions (July 2012)

7.2.4 Severity

The severity of a drought depends on the degree of moisture deficiency, the duration, and the size and location of the affected area. The longer the duration of the drought and the larger the area impacted, the more severe the potential impacts. Droughts are not usually associated with direct impacts on people or property, but they can have significant impacts on agriculture, which can impact people indirectly. When measuring the severity of droughts, analysts typically look at economic impacts on a planning area.

Unlike most disasters, droughts normally occur slowly but last a long time. On average, the nationwide annual impacts of drought are greater than the impacts of any other natural hazard. They are estimated to be between $6 billion and $8 billion annually in the United States and occur primarily in the agriculture, transportation, recreation and tourism, forestry, and energy sectors. Social and environmental impacts are also significant, although it is difficult to put a precise cost on these impacts.

Drought affects groundwater sources, but generally not as quickly as surface water supplies, although groundwater supplies generally take longer to recover. Reduced precipitation during a drought means that groundwater supplies are not replenished at a normal rate. This can lead to a reduction in groundwater levels and problems such as reduced pumping capacity or wells going dry. Shallow wells are more susceptible than deep wells. Reduced replenishment of groundwater affects streams. Much of the flow in streams comes from groundwater, especially during the summer when there is less precipitation and after snowmelt ends. Reduced groundwater levels mean that even less water will enter streams when steam flows are lowest.

A drought directly or indirectly impacts all people in affected areas. A drought can result in farmers not being able to plant crops or the failure of planted crops. This results in loss of work for farm workers and those in related food processing jobs. Other water-dependent industries are commonly forced to shut down all or a portion of their facilities, resulting in further layoffs. A drought can harm recreational companies that use water (e.g., swimming pools, water parks, and river rafting companies) as well as landscape and nursery businesses because people will not invest in new plants if water is not available to sustain them.

7.2.5 Warning Time

Droughts are climatic patterns that occur over long periods of time. Only generalized warning can take place due to the numerous variables that scientists have not pieced together well enough to make accurate and precise predictions.

Empirical studies conducted over the past century have shown that meteorological drought is never the result of a single cause. It is the result of many causes, often synergistic in nature; these include global weather patterns that produce persistent, upper-level high-pressure systems along the West Coast with warm, dry air resulting in less precipitation.

Scientists at this time do not know how to predict drought more than a month in advance for most locations. Predicting drought depends on the ability to forecast precipitation and temperature. Anomalies of precipitation and temperature may last from several months to several decades. How long they last depends on interactions between the atmosphere and the oceans, soil moisture and land surface processes, topography, internal dynamics, and the accumulated influence of weather systems on the global scale.

7.3 SECONDARY HAZARDS

The secondary hazard most commonly associated with drought is wildfire. A prolonged lack of precipitation dries out vegetation, which becomes increasingly susceptible to ignition as the duration of the drought extends.

7.4 CLIMATE CHANGE IMPACTS

The long-term effects of climate change on regional water resources are unknown, but global water resources are already experiencing the following stresses without climate change:

- Growing populations
- Increased competition for available water
- Poor water quality
- Environmental claims
- Uncertain reserved water rights
- Groundwater overdraft
- Aging urban water infrastructure.

With a warmer climate, droughts could become more frequent, more severe, and longer-lasting. From 1987 to 1989, losses from drought in the U.S. totaled $39 billion (OTA, 1993). More frequent extreme events such as droughts could end up being more cause for concern than the long-term change in temperature and precipitation averages.

The best advice to water resource managers regarding climate change is to start addressing current stresses on water supplies and build flexibility and robustness into any system. Flexibility helps to ensure a quick response to changing conditions, and robustness helps people prepare for and survive the worst conditions. With this approach to planning, water system managers will be better able to adapt to the impacts of climate change.

7.5 EXPOSURE

All people, property and environments in the planning area would be exposed to some degree to the impacts of moderate to extreme drought conditions.

7.6 VULNERABILITY

Drought produces a complex web of impacts that spans many sectors of the economy and reaches well beyond the area experiencing physical drought. This complexity exists because water is integral to the ability to produce goods and provide services. Drought can affect a wide range of economic, environmental and social activities. The vulnerability of an activity to the effects of drought usually depends on its water demand, how the demand is met, and what water supplies are available to meet the demand.

7.6.1 Population

Many residents, particularly on the upper Reservation, rely entirely upon surface water systems for their domestic water supply. Community and individual water systems are particularly vulnerable during drought conditions, especially when additional water resources are depleted by illegal grow operations, which compounds the situation. The Yurok Tribe has limited ability to minimize the impacts on residents

and water consumers should several consecutive dry years occur. The potential for significant life or health impacts would be anticipated as a result of drought within the planning area, especially in light of the high fire dangers and lack of water supplies to fight fires that may erupt during a drought situation. In addition, elderly and young are more susceptible to heat, which is many times associated with drought conditions. As the Reservation has a fairly large population of elderly and young, the impact would be significant.

7.6.2 Property

While no structures will be directly affected by drought conditions, there is a significant increase of damage due to the increased vulnerability to wildfires, which are more likely following years of drought. Droughts can also have significant impacts on agriculture and landscapes, which could cause a financial burden to property owners.

7.6.3 Critical Facilities

Critical facilities as defined for this plan will continue to be operational during a drought. Critical facility elements such as landscaping may not be maintained due to limited resources, but the risk to the planning area's critical facilities inventory will be largely aesthetic. For example, when water conservation measures are in place, landscaped areas will not be watered and may die. These aesthetic impacts are not considered significant.

7.6.4 Environment

Environmental losses from drought are associated with damage to plants, fish loss, loss of spawning area, animals, wildlife habitat, and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Some of the effects are short-term and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent. It takes many years to recover from the loss of fish, especially when spawning areas are lost and eggs destroyed. Wildlife habitat may be degraded through the loss of wetlands, lakes and vegetation. However, many species will eventually recover from this temporary aberration. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity. Although environmental losses are difficult to quantify, growing public awareness and concern for environmental quality has forced public officials to focus greater attention and resources on these effects.

As indicated, Salmon runs can be disrupted for many years following drought conditions when river flows drop to dangerous levels as the low flows also reduce the depth of the pools and cold-water refugia along the river, reducing the salmon's ability to either migrate upstream or seek shelter in a cold-water, oxygenated environment.

7.6.5 Economic Impact

Economic impact will be largely associated with industries that use water or depend on water for their business. For example, recreational businesses could be impacted due to low levels in the river for fishing and touring. The harvesting of fish and other aquatic life for self-sustainment or commercial sale will have a significant impact on the Reservation. These types of industries represent a large portion of economic income on and near the Yurok Reservation, and could have significant impact on the planning area. Agricultural industries will also be impacted if water usage is restricted for irrigation, again impacting tribal members who are growing their own foods, and those growing agricultural crops for sale.

7.7 FUTURE TRENDS IN DEVELOPMENT

The Yurok Tribe has established plans that include policies dealing with issues of water supply and the protection of water resources. This plan provides the capability at the local level to protect future development from the impacts of drought. The Yurok Tribe reviewed its general plan under the capability assessment performed for this effort. Deficiencies identified by this review can be addressed by mitigation actions to increase the capability to deal with future trends in development.

7.8 SCENARIO

An extreme multiyear drought more intense than the 1977 drought could impact the region with little warning. Combinations of low precipitation and unusually high temperatures could occur over several consecutive years. Intensified by such conditions, extreme wildfires could break out throughout the planning area, increasing the need for water. Surrounding communities, also in drought conditions, could increase their demand for water supplies relied upon by the Yurok Tribe, causing social and political conflicts. If such conditions persisted for several years, the economy of the Yurok Tribe could experience setbacks, especially in water dependent industries.

7.9 ISSUES

The planning team has identified the following drought-related issues:

- Identification and development of alternative water supplies
- Utilization of groundwater recharge techniques to stabilize the groundwater supply
- The probability of increased drought frequencies and durations due to climate change
- The promotion of active water conservation even during non-drought periods.

CHAPTER 8.
EARTHQUAKE

8.1 GENERAL BACKGROUND

8.1.1 How Earthquakes Happen

An earthquake is the vibration of the earth's surface following a release of energy in the earth's crust. This energy can be generated by a sudden dislocation of the crust or by a volcanic eruption. Most destructive quakes are caused by dislocations of the crust. The crust may first bend and then, when the stress exceeds the strength of the rocks, break and snap to a new position. In the process of breaking, vibrations called "seismic waves" are generated. These waves travel outward from the source of the earthquake at varying speeds.

Earthquakes tend to reoccur along faults, which are zones of weakness in the crust. Even if a fault zone has recently experienced an earthquake, there is no guarantee that all the stress has been relieved. Another earthquake could still occur.

Geologists classify faults by their relative hazards. Active faults, which represent the highest hazard, are those that have ruptured to the ground surface during the Holocene period (about the last 11,000 years). Potentially active faults are those that displaced layers of rock from the Quaternary period (the last 1,800,000 years). Determining if a fault is "active" or "potentially active" depends on geologic evidence, which may not be available for every fault. Although there are probably still some unrecognized active faults, nearly all the movement between the two plates, and therefore the majority of the seismic hazards, are on the well-known active faults.

DEFINITIONS

Earthquake—The shaking of the ground caused by an abrupt shift of rock along a fracture in the earth or a contact zone between tectonic plates.

Epicenter—The point on the earth's surface directly above the hypocenter of an earthquake. The location of an earthquake is commonly described by the geographic position of its epicenter and by its focal depth.

Fault—A fracture in the earth's crust along which two blocks of the crust have slipped with respect to each other.

Focal Depth—The depth from the earth's surface to the hypocenter.

Hypocenter—The region underground where an earthquake's energy originates

Liquefaction—Loosely packed, water-logged sediments losing their strength in response to strong shaking, causing major damage during earthquakes.

Faults are more likely to have earthquakes on them if they have more rapid rates of movement, have had recent earthquakes along them, experience greater total displacements, and are aligned so that movement can relieve accumulating tectonic stresses. A direct relationship exists between a fault's length and location and its ability to generate damaging ground motion at a given site. In some areas, smaller, local faults produce lower magnitude quakes, but ground shaking can be strong, and damage can be significant as a result of the fault's proximity to the area. In contrast, large regional faults can generate great magnitudes but, because of their distance and depth, may result in only moderate shaking in the area.

California is seismically active because it sits on the boundary between three of the earth's tectonic plates. Most of the state—everything east of the San Andreas Fault—is on the North American Plate. Monterey, Santa Barbara, Los Angeles, and San Diego are on the Pacific Plate, which trends offshore at Cape Mendocino. North of Cape Mendocino, the offshore subducting Gorda Plate strongly influences seismicity of Humboldt and Del Norte counties. The area where the three tectonic plates intersect is

known as the Mendocino Triple Junction. The relative movement between the Gorda and North American plates is primarily a thrust subduction. California has thousands of recognized faults, hundreds of which have names, but only some of which are known to be active and pose significant hazards. North of Cape Mendocino, the Little Salmon and the Mad River fault zones are seismically important.

8.1.2 Earthquake Classifications

Earthquakes are typically classified in one of two ways: By the amount of energy released, measured as **magnitude**; or by the impact on people and structures, measured as **intensity**.

Magnitude

Currently the most commonly used magnitude scale is the moment magnitude (M_w) scale, with the follow classifications of magnitude:

- Great—$M_w \geq 8$
- Major—M_w = 7.0—7.9
- Strong—M_w = 6.0—6.9
- Moderate—M_w = 5.0—5.9
- Light—M_w = 4.0—4.9
- Minor—M_w = 3.0—3.9
- Micro—$M_w < 3$

Estimates of moment magnitude roughly match the local magnitude scale (ML) commonly called the Richter scale. One advantage of the moment magnitude scale is that, unlike other magnitude scales, it does not saturate at the upper end. That is, there is no value beyond which all large earthquakes have about the same magnitude. For this reason, moment magnitude is now the most often used estimate of large earthquake magnitudes.

Intensity

Currently the most commonly used intensity scale is the modified Mercalli intensity scale, with ratings defined as follows (USGS, 1989):

- I. Not felt except by a very few under especially favorable conditions
- II. Felt only by a few persons at rest, especially on upper floors of buildings.
- III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it is an earthquake. Standing cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
- IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like a heavy truck striking building. Standing cars rocked noticeably.
- V. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
- VI. Felt by all; many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.

- VII. Damage negligible in buildings of good design and construction; slight in well-built ordinary structures; considerable in poorly built or badly designed structures. Some chimneys broken.
- VIII. Damage slight in specially designed structures; considerable damage in ordinary buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
- IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
- X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
- XI. Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
- XII. Damage total. Lines of sight and level are distorted. Objects thrown into the air.

8.1.3 Ground Motion

Earthquake hazard assessment is also based on expected ground motion. This involves determining the annual probability that certain ground motion accelerations will be exceeded, then summing the annual probabilities over the time period of interest. The most commonly mapped ground motion parameters are the horizontal and vertical peak ground accelerations (PGA) for a given soil or rock type. Instruments called accelerographs record levels of ground motion due to earthquakes at stations throughout a region. These readings are recorded by state and federal agencies that monitor and predict seismic activity.

Maps of PGA values form the basis of seismic zone maps that are included in building codes such as the International Building Code. Building codes that include seismic provisions specify the horizontal force due to lateral acceleration that a building should be able to withstand during an earthquake. PGA values are directly related to these lateral forces that could damage “short period structures” (e.g. single-family dwellings). Longer period response components determine the lateral forces that damage larger structures with longer natural periods (apartment buildings, factories, high-rises, bridges). Table 8-1 lists damage potential and perceived shaking by PGA factors, compared to the Mercalli scale.

8.1.4 Effect of Soil Types

The impact of an earthquake on structures and infrastructure is largely a function of ground shaking, distance from the source of the quake, and liquefaction, a secondary effect of an earthquake in which soils lose their shear strength and flow or behave as liquid, thereby damaging structures that derive their support from the soil. Liquefaction generally occurs in soft, unconsolidated sedimentary soils. A program called the National Earthquake Hazard Reduction Program (NEHRP) creates maps based on soil characteristics to help identify locations subject to liquefaction. Table 8-2 summarizes NEHRP soil classifications. NEHRP Soils B and C typically can sustain ground shaking without much effect, dependent on the earthquake magnitude. The areas that are commonly most affected by ground shaking have NEHRP Soils D, E and F. In general, these areas are also most susceptible to liquefaction.

TABLE 8-1.
MERCALLI SCALE AND PEAK GROUND ACCELERATION COMPARISON

Modified Mercalli Scale	Perceived Shaking	Potential Structure Damage		Estimated PGA[a] (%g)
		Resistant Buildings	Vulnerable Buildings	
I	Not Felt	None	None	<0.17%
II-III	Weak	None	None	0.17%—1.4%
IV	Light	None	None	1.4%—3.9%
V	Moderate	Very Light	Light	3.9%—9.2%
VI	Strong	Light	Moderate	9.2%—18%
VII	Very Strong	Moderate	Moderate/Heavy	18%—34%
VIII	Severe	Moderate/Heavy	Heavy	34%—65%
IX	Violent	Heavy	Very Heavy	65%—124%
X—XII	Extreme	Very Heavy	Very Heavy	>124%

a. PGA measured in percent of g, where g is the acceleration of gravity
Sources: USGS, 2008; USGS, 2010

TABLE 8-2.
NEHRP SOIL CLASSIFICATION SYSTEM

NEHRP Soil Type	Description	Mean Shear Velocity to 30 m (m/s)
A	Hard Rock	1,500
B	Firm to Hard Rock	760-1,500
C	Dense Soil/Soft Rock	360-760
D	Stiff Soil	180-360
E	Soft Clays	< 180
F	Special Study Soils (liquefiable soils, sensitive clays, organic soils, soft clays >36 m thick)	

8.2 HAZARD PROFILE

The Reservation sits within both Humboldt and Del Norte Counties, both of which are located within the two highest of five seismic risk zones specified by the Uniform Building Code, and offshore Cape Mendocino has the highest concentration of earthquake events anywhere in the continental United States. Nine quaternary faults have been identified in the region that could impact the planning area.

Recent investigations have shown that the subducting Gorda Plate and the Juan de Fuca Plate form the "Cascadia Subduction Zone," which runs north offshore of Humboldt and Del Norte Counties, Oregon, and Washington, has moved in unison in a series of great earthquakes (magnitude 8 to 9) over the last 20,000 years, most recently about 300 years ago, with events occurring at 300- to 500-year intervals. The seismic setting has the potential to cause significant ground shaking, leading to the following hazards:

- A serious liquefaction and subsidence hazard, particularly around the muds and sands of Crescent City
- A near-shore tsunami striking the coast within 15 minutes of ground-shaking
- A significant landslide hazard countywide
- Surface fault rupture along the San Andreas, and possibly along the Little Salmon and Mad River fault zones, and other active or potentially active faults in the county.

8.2.1 Past Events

According to the California State Hazard Mitigation Plan, Del Norte County has been impacted by at least one recorded earthquake between 1950 and 2003 that caused sufficient damage for the state to proclaim a state of emergency: the Cape Mendocino Earthquake on April 25, 1992, which also warranted a Presidential disaster declaration (DR-943). Table 8-3 lists seismic events with a magnitude of 5.0 or larger that were felt within the planning area since 2000.

TABLE 8-3.
RECENT EARTHQUAKES MAGNITUDE 5.0 OR LARGER FELT IN HUMBOLDT AND DEL NORTE COUNTIES

		Epicenter Location		
Date	Magnitude	Distance	Direction	Nearest City
February 13, 2012	5.6	9 km	SW	Weitchpec, CA
February 4, 2010	5.9	80 km	WSW	Eureka, CA
January 10, 2010	6.5	50 km	WSW	Eureka, CA
October 26, 2008	4.9	65 km	SW	Eureka (Offshore Northern CA)
April 30, 2008	5.4	55 km	E	Eureka, CA
May 9, 2007	5.2	85 km	WSW	Eureka, CA (Offshore Northern CA)
February 26, 2007	5.4	51 km	W	Ferndale, CA
July 16, 2006	5.0	6 km	WNW	Punta Gorda, CA
March 25, 2006	5.0	3 km	WNW	Punta Gorda, CA
June 14, 2005	7.2	156 km	W	Trinidad, CA
August 15, 2003	5.3	121 km	WNW	Ferndale, CA
June 17, 2002	5.27	37 km	W	Eureka, CA
September 20, 2001	5.10	80 km	WNW	Punta Gorda, CA
January 13, 2001	5.19	92 km	WNW	Ferndale, CA
March 16, 2000	5.59	N/A	N/A	Offshore Punta Gorda, Point Mendocino

Source: Earthquake Catalogs, Northern California Earthquake Data Center, and USGS Data Center, 2012

8.2.2 Location

Identifying the extent and location of an earthquake is not as simple as it is for other hazards such as flood, landslide or wild fire. The impact of an earthquake is largely a function of the following components:

- Ground shaking (ground motion accelerations)
- Liquefaction (soil instability)
- Distance from the source (both horizontally and vertically).

Mapping that shows the impacts of these components was used to assess the risk of earthquakes within the planning area. While the impacts from each of these components can build upon each other during an earthquake event, the mapping looks at each component individually. The mapping used in this assessment is described below.

Shake Maps

A shake map is a representation of ground shaking produced by an earthquake. The information it presents is different from the earthquake magnitude and epicenter that are released after an earthquake because shake maps focus on the ground shaking resulting from the earthquake, rather than the parameters describing the earthquake source. An earthquake has only one magnitude and one epicenter, but it produces a range of ground shaking at sites throughout the region, depending on the distance from the earthquake, the rock and soil conditions at sites, and variations in the propagation of seismic waves from the earthquake due to complexities in the structure of the earth's crust. A shake map shows the extent and variation of ground shaking in a region immediately following significant earthquakes.

Ground motion and intensity maps are derived from peak ground motion amplitudes recorded on seismic sensors (accelerometers), with interpolation based on estimated amplitudes where data are lacking, and site amplification corrections. Color-coded instrumental intensity maps are derived from empirical relations between peak ground motions and Modified Mercalli intensity. Two types of earthquake scenarios are typically generated from the data:

- A probabilistic seismic hazard map shows the hazard from earthquakes that geologists and seismologists A probabilistic seismic hazard map shows the hazard from earthquakes that geologists and seismologists agree could occur. The maps are expressed in terms of probability of exceeding a certain ground motion, such as the 10-percent probability of exceedance in 50 years. This level of ground shaking has been used for designing buildings in high seismic areas. Figure 8-1 shows the estimated ground motion on the Reservation for the 100-year probabilistic earthquake; Figure 8-2 shows results for the 500-year earthquake.
- Earthquake scenario maps describe the expected ground motions and effects of hypothetical large earthquakes for a region. Maps of these scenarios can be used to support all phases of emergency management. One scenario was chosen for this plan:
  - 2011 Cascadia Scenario—A Magnitude 9.0 event with an epicenter off the coast of Oregon, 60 miles west/northwest of Tillamook. See Figure 8-3.

NEHRP Soil Maps

NEHRP soil types define the locations that will be significantly impacted by an earthquake. NEHRP Soils B and C typically can sustain low-magnitude ground shaking without much effect. The areas that are most commonly affected by ground shaking have NEHRP Soils D, E and F. Figure 8-4 shows NEHRP soil classifications for the Yurok Reservation.

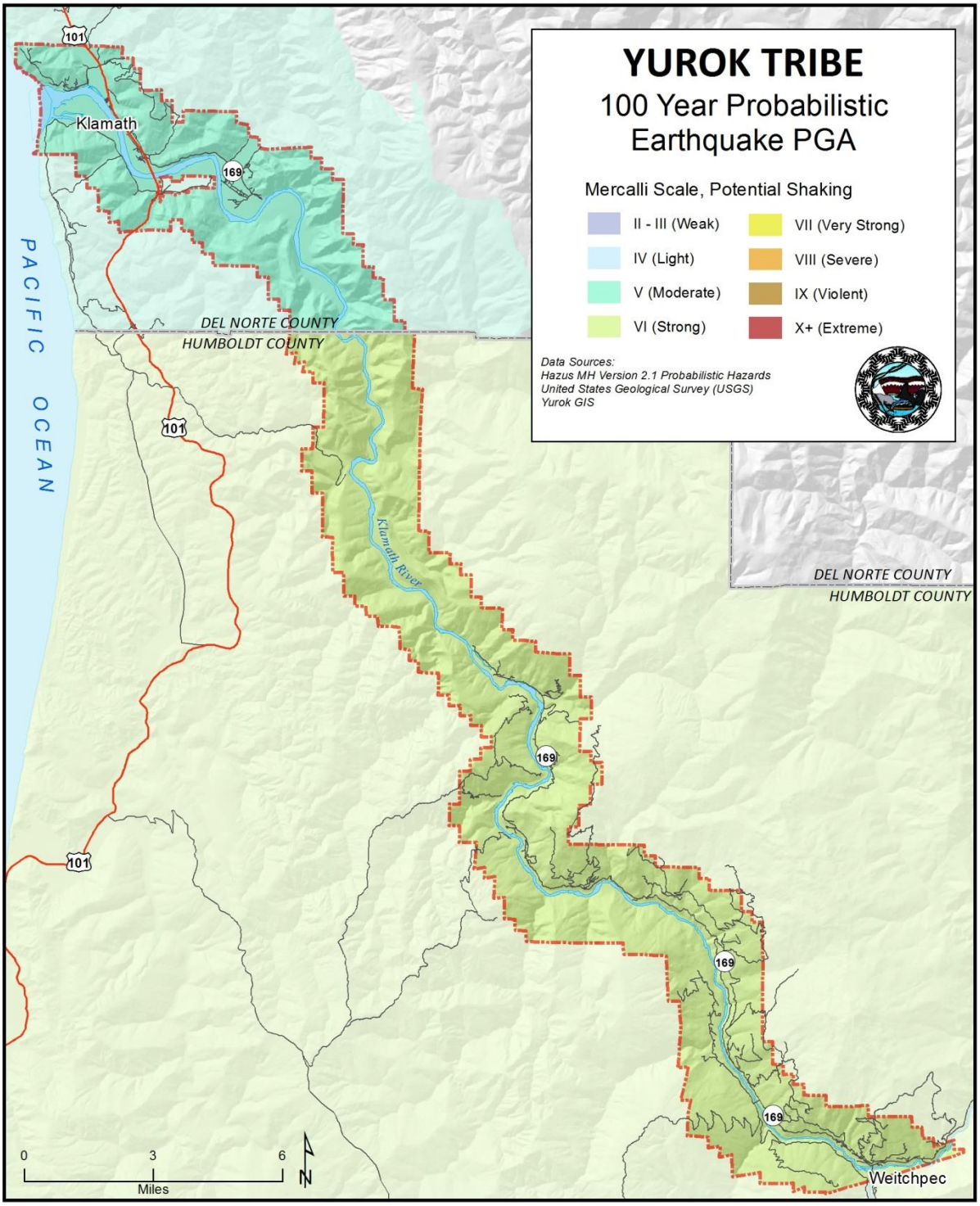

Figure 8-1. 100-Year Probabilistic Ground Motion Map for The Yurok Reservation

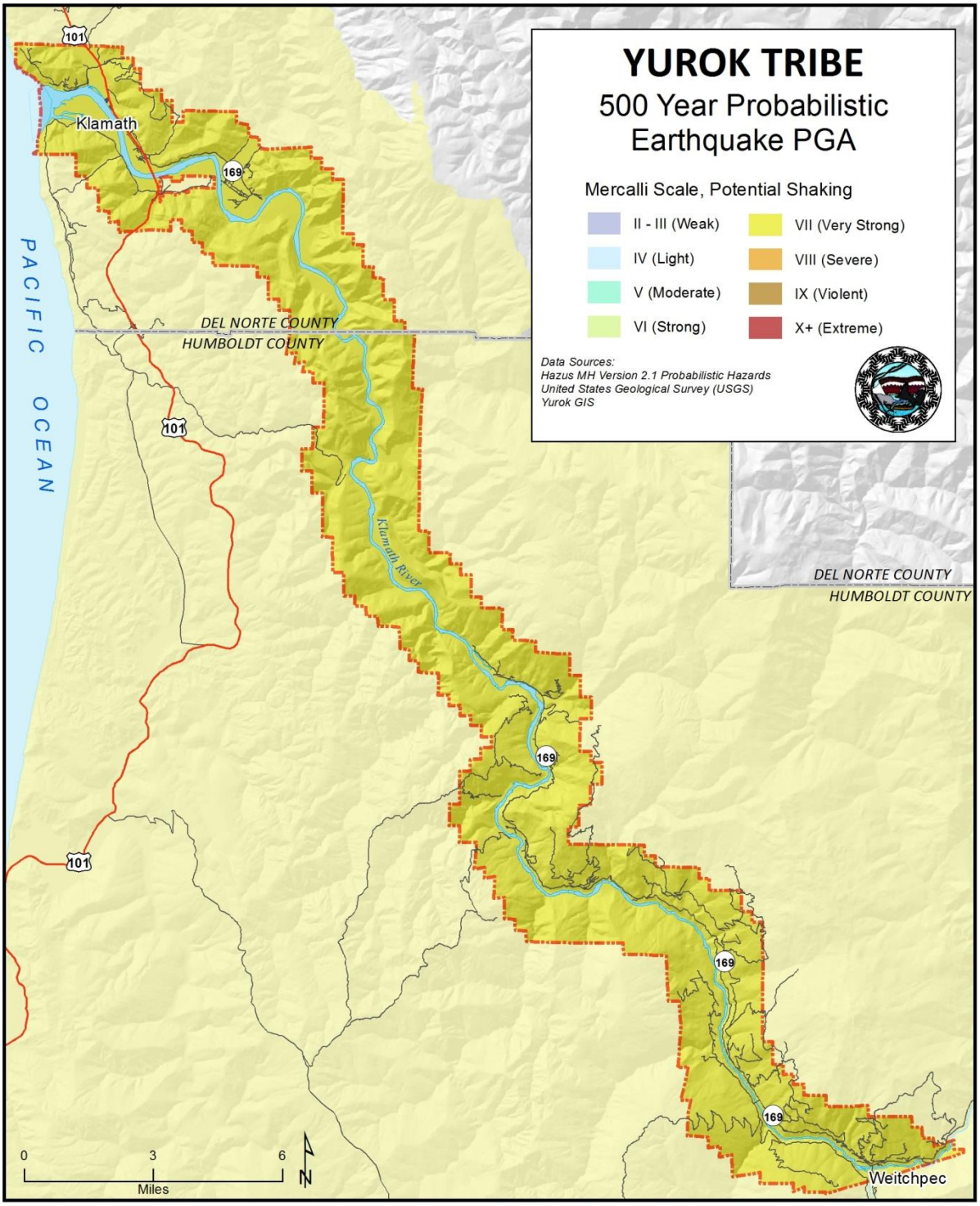

Figure 8-2. 500-Year Probabilistic Ground Motion Map for the Yurok Reservation

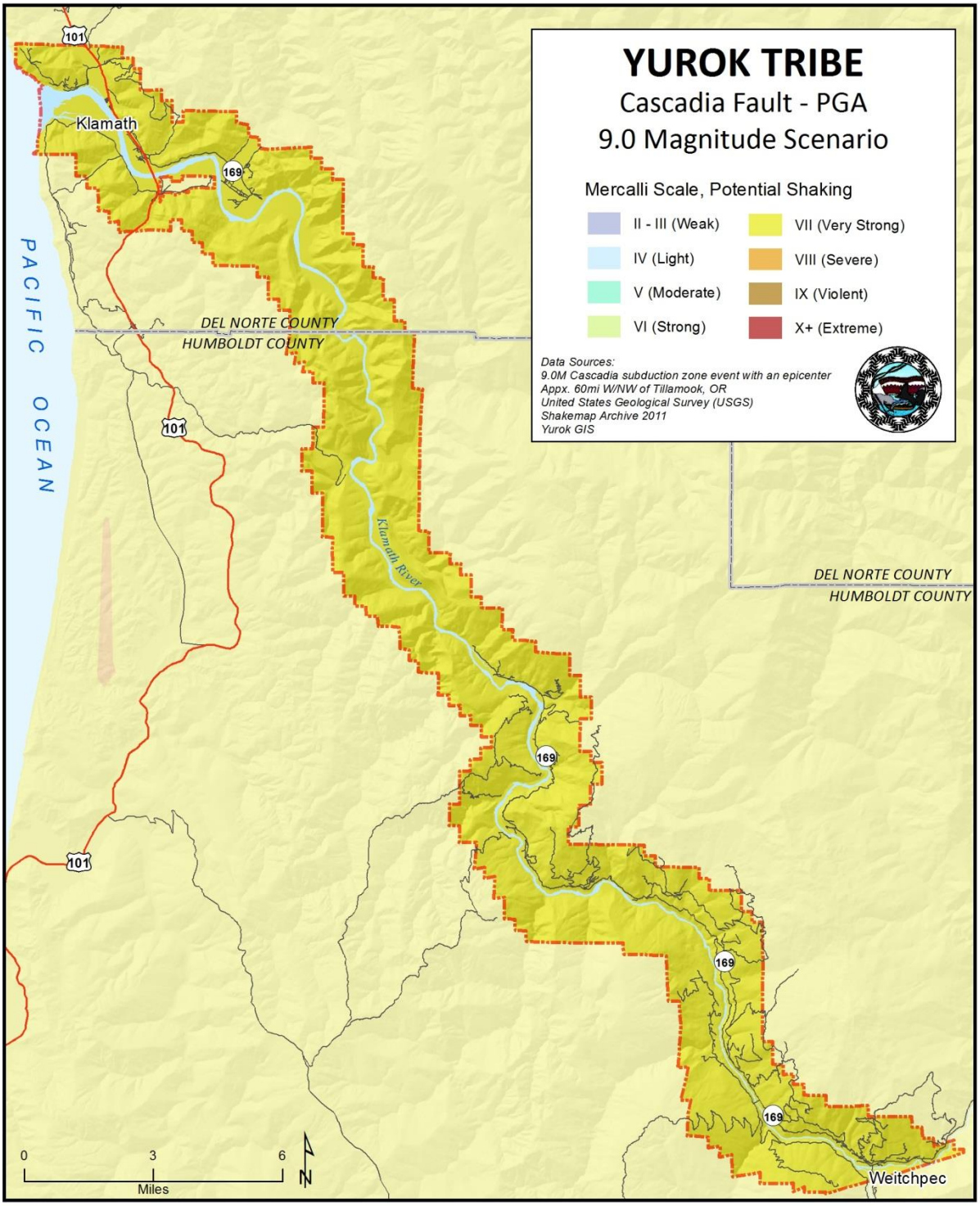

Figure 8-3. Cascadia 9.0M Scenario Event Ground Motion for the Yurok Reservation

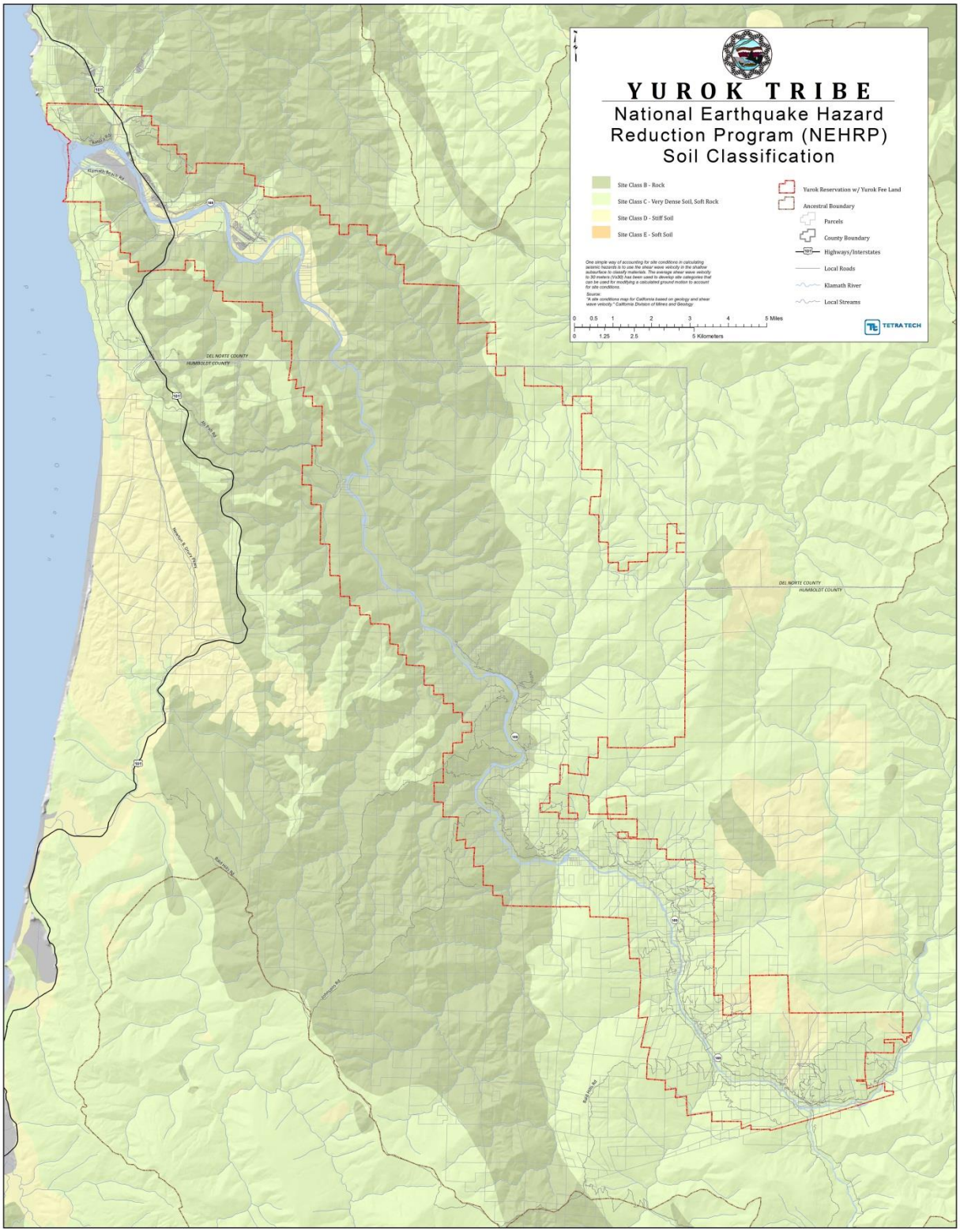

Figure 8-4. NEHRP Soil Classifications for the Yurok Reservation

8.2.3 Frequency

According the California State Hazard Mitigation Plan, earthquakes large enough to cause moderate damage to structures—those of Magnitude 5.5 or larger—occur three to four times a year statewide. Strong earthquakes of Magnitude 6 to 6.9 strike on an average of once every two to three years. Major earthquakes (Magnitude 7 to 7.9) occur in California about once every 10 years. The planning area is susceptible to regular earthquake activity, as evidenced by the 15 seismic events with a magnitude of 5.0 or higher experienced from 2000 through 2012 (see Table 8-3).

8.2.4 Severity

Earthquakes can last from a few seconds to over five minutes; they may also occur as a series of tremors over several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties generally result from falling objects and debris, because the shocks shake, damage or demolish buildings and other structures. Disruption of communications, electrical power supplies and gas, sewer and water lines should be expected. Earthquakes may trigger fires, dam failures, landslides or releases of hazardous material, compounding their disastrous effects.

Small, local faults produce lower magnitude quakes, but ground shaking can be strong and damage can be significant in areas close to the fault. In contrast, large regional faults can generate earthquakes of great magnitudes but, because of their distance and depth, they may result in only moderate shaking in an area.

Past events suggest that earthquakes typical for the planning area would cause light to moderate damage. However, severity can increase based on soil type and proximity to the hypocenter of the event. There are soft soils in the area that have a high degree of vulnerability to earthquakes.

The USGS has created ground motion maps based on current information about several fault zones. These maps show the PGA that has a certain probability (2 percent or 10 percent) of being exceeded in a 50-year period. The PGA is measured in numbers of g's (the acceleration associated with gravity). Figure 8-5 shows the PGAs with a 10-percent exceedance chance in 50 years in the planning area vicinity.

Magnitude is related to the amount of seismic energy released at the hypocenter of an earthquake. It is determined by the amplitude of the earthquake waves recorded on instruments. Whereas intensity varies depending on location with respect to the earthquake epicenter, magnitude is represented by a single, instrumentally determined value for each earthquake event.

In simplistic terms, the severity of an earthquake event can be measured in the following terms:

- How hard did the ground shake?
- How did the ground move? (Horizontally or vertically)
- How stable was the soil?
- What is the fragility of the built environment in the area of impact?

8.2.5 Warning Time

There is currently no reliable way to predict the day or month that an earthquake will occur at any given location. Research is being done with warning systems that use the low energy waves that precede major earthquakes. These potential warning systems give approximately 40 seconds notice that a major earthquake is about to occur. The warning time is very short but it could allow for someone to get under a desk, step away from a hazardous material they are working with, or shut down a computer system.

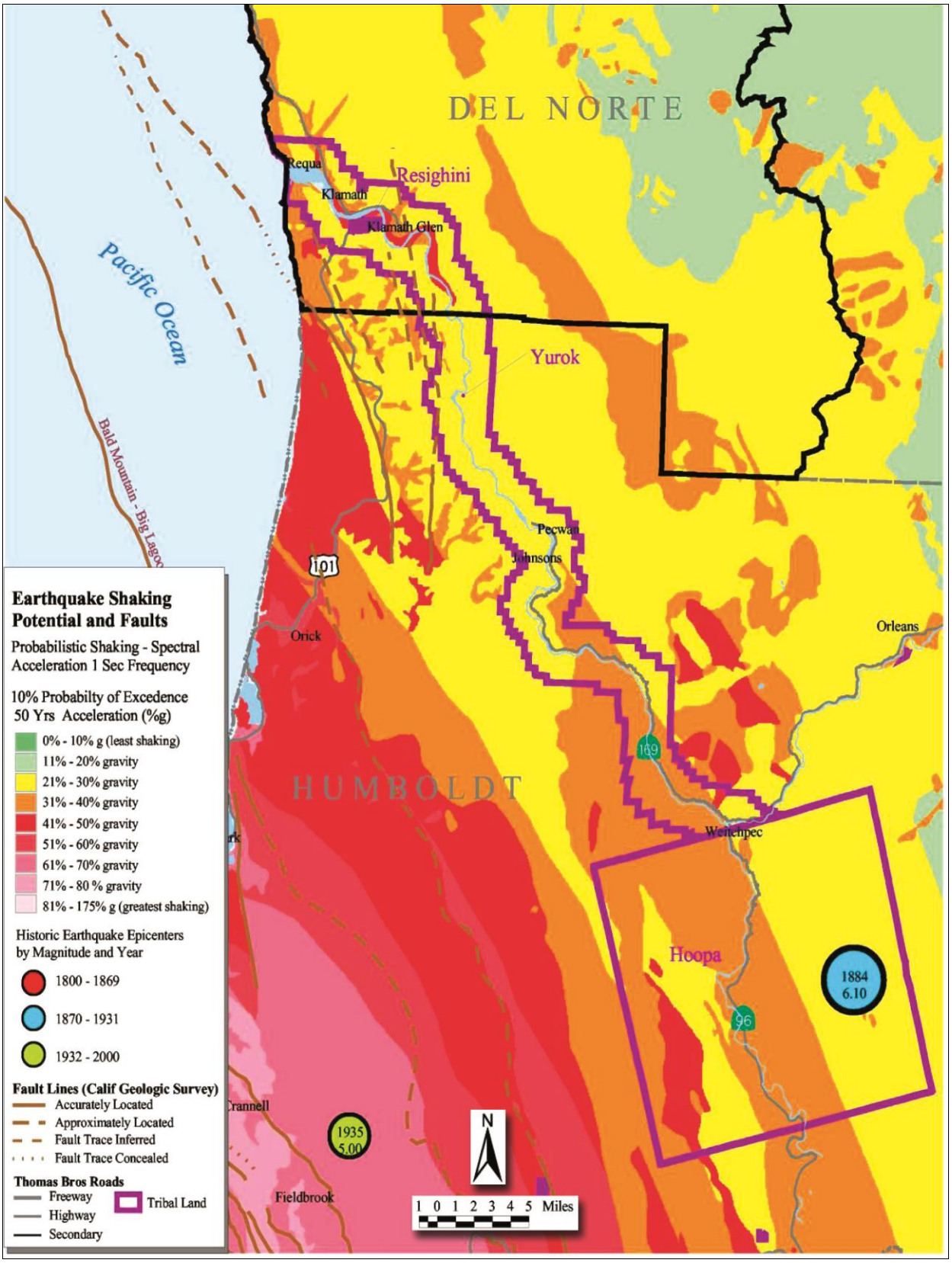

Figure 8-5. PGA with 2-Percent Probability of Exceedance in 50 Years, Planning Area Vicinity

8.3 SECONDARY HAZARDS

Earthquakes can cause large and sometimes disastrous landslides, mudslides and tsunamis. River valleys are vulnerable to slope failure, often as a result of loss of cohesion in clay-rich soils. Soil liquefaction occurs when water-saturated sands, silts or gravelly soils are shaken so violently that the individual grains lose contact with one another and float freely in the water, turning the ground into a pudding-like liquid. Building and road foundations lose load-bearing strength and may sink into what was previously solid ground. Unless properly secured, hazardous materials can be released, causing significant damage to the environment and people. Earthen dams and levees are highly susceptible to seismic events and the impacts of their eventual failures can be considered secondary risks for earthquakes.

8.4 CLIMATE CHANGE IMPACTS

The impacts of global climate change on earthquake probability are unknown. Some scientists say that melting glaciers could induce tectonic activity. As ice melts and water runs off, tremendous amounts of weight are shifted on the earth's crust. As newly freed crust returns to its original, pre-glacier shape, it could cause seismic plates to slip and stimulate volcanic activity according to research into prehistoric earthquakes and volcanic activity. NASA and USGS scientists found that retreating glaciers in southern Alaska may be opening the way for future earthquakes (NASA, 2004).

Secondary impacts of earthquakes could be magnified by climate change. Soils saturated by repetitive storms could experience liquefaction during seismic activity due to the increased saturation. Dams storing increased volumes of water due to changes in the hydrograph could fail during seismic events. There are currently no models available to estimate these impacts.

8.5 EXPOSURE

8.5.1 Population

The entire population of the planning area is potentially exposed to direct and indirect impacts from earthquakes. The degree of exposure is dependent on many factors, including the age and construction type of the structures people live in, the soil type their homes are constructed on, their proximity to fault location, etc. Whether directly impacted or indirectly impact, the entire population will have to deal with the consequences of earthquakes to some degree. Business interruption could keep people from working, road closures could isolate populations, and loss of functions of utilities could impact populations that suffered no direct damage from an event itself.

8.5.2 Property

There are approximately 892 buildings in the planning area, with a total assessed value of $288 million. Since all structures in the planning area are susceptible to earthquake impacts to varying degrees, this total represents the reservation-wide property exposure to seismic events. Most of the buildings (91 percent) are residential.

8.5.3 Critical Facilities and Infrastructure

All critical facilities in the planning area are exposed to the earthquake hazard. Hazardous materials releases can occur during an earthquake from fixed facilities or transportation-related incidents. Transportation corridors can be disrupted during an earthquake, leading to the release of materials to the surrounding environment. Facilities holding hazardous materials are of particular concern because of possible isolation of neighborhoods surrounding them. During an earthquake, structures storing these materials could rupture and leak into the surrounding area or an adjacent waterway, having a disastrous effect on the environment.

8.5.4 Environment

Secondary hazards associated with earthquakes will likely have some of the most damaging effects on the environment. Earthquake-induced landslides can significantly impact surrounding habitat. It is also possible for streams to be rerouted after an earthquake. This can change the water quality, possibly damaging habitat and feeding areas. There is a possibility of streams fed by groundwater drying up because of changes in underlying geology.

8.6 VULNERABILITY

Earthquake vulnerability data was generated using a Level 2 HAZUS-MH analysis. Once the location and size of a hypothetical earthquake are identified, HAZUS-MH estimates the intensity of the ground shaking, the number of buildings damaged, the number of casualties, the damage to transportation systems and utilities, the number of people displaced from their homes, and the estimated cost of repair and clean up.

8.6.1 Population

The most vulnerable populations to a disaster incident are the young and elderly residents. Both of these age groups represent a fairly high percentage of the tribal membership. Isolation of the Reservation due to an earthquake incident causing a landslide or otherwise restricting access is of considerable concern. Likewise, with both the high rate of unemployment and income levels below state average, households may lack the financial resources to improve their homes to make them more resistant to earthquakes, and also lack the financial resources to be self-sustaining for any length of time with respect to food, water and medications.

8.6.2 Property

Property losses were estimated through the Level 2 HAZUS-MH user defined facility analysis for the 100-year and 500-year earthquakes and the one scenario event. A summary of the property-related loss results is as follows:

- For a 100-year probabilistic earthquake, the estimated damage potential is $3 million, or 1 percent of the total value for the planning area.
- For a 500-year earthquake, the estimated damage potential is $24.9 million, or 8.6 percent of the total value for the planning area.
- For a 9.0-magnitude event on the Cascadia Fault, the estimated damage potential is $32.5 million, or 11.2 percent of the total value for the planning area.

Table 8-4 shows the results for potential building loss.

TABLE 8-4.
ESTIMATED EARTHQUAKE-CAUSED BUILDING ECONOMIC DAMAGE

	Building Economic Impact
100-Year Earthquake	$3,073,579
500-Year Earthquake	$24,879,396
Cascadia 9.0M Scenario	$32,544,488

8.6.3 Critical Facilities and Infrastructure

There is an extensive system of twenty-four (24) bridges on the Reservation. Several bridges are constructed of wood. All of these bridges are subject to failure during an earthquake or flood. While there is no record of a complete bridge failure on the Reservation from an earthquake, most bridges on the Reservation were built before 1970 and do not meet increased Caltrans design standards intended to prevent collapse under a maximum credible earthquake. Liquefaction may result in sinking, tilt, distortion or destruction of bridges.

Level of Damage

HAZUS-MH classifies the vulnerability of buildings to earthquake damage in five categories: no damage, slight damage, moderate damage, extensive damage, or complete damage. The model was used to assign a vulnerability category to each facility in the planning area. The analysis was performed for the 100-year, 500-year, and Cascadia earthquake events. Table 8-5, Table 8-6, and Table 8-7 summarizes the results.

TABLE 8-5.
ESTIMATED DAMAGE TO FACILITIES FROM 100-YEAR EARTHQUAKE

Category	No Damage	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage
Tribal Facility	90.08%	8.40%	1.41%	0.09%	0.00%
Government Non-Tribal	90.83%	7.81%	1.26%	0.08%	0.00%
Non Residential	89.55%	8.81%	1.52%	0.10%	0.00%
Residential	89.13%	8.77%	1.92%	0.15%	0.00%
Average	**89.90%**	**8.45%**	**1.53%**	**0.11%**	**0.00%**

TABLE 8-6.
ESTIMATED DAMAGE TO FACILITIES FROM 500-YEAR EARTHQUAKE

Category	No Damage	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage
Tribal Facility	50.39%	31.79%	14.62%	2.55%	0.62%
Government Non-Tribal	52.21%	31.17%	13.77%	2.31%	0.51%
Non Residential	49.23%	32.18%	15.17%	2.71%	0.68%
Residential	46.92%	30.83%	16.94%	4.43%	0.86%
Average	**47.21%**	**30.92%**	**16.74%**	**4.26%**	**0.84%**

TABLE 8-7.
ESTIMATED DAMAGE TO FACILITIES FROM CASCADIA EARTHQUAKE

Category	No Damage	Slight Damage	Moderate Damage	Extensive Damage	Complete Damage
Tribal Facility	28.98%	49.95%	16.74%	0.42%	3.88%
Government Non-Tribal	28.45%	50.45%	16.65%	0.41%	4.02%
Non Residential	24.07%	51.81%	19.36%	0.51%	4.23%
Residential	27.67%	46.57%	19.37%	2.34%	4.02%
Average	**27.53%**	**46.97%**	**19.26%**	**2.18%**	**4.03%**

8.6.4 Environment

The environment vulnerable to earthquake hazard is the same as the environment exposed to the hazard.

8.7 FUTURE TRENDS IN DEVELOPMENT

Land use in the planning area will be directed by general plans adopted under California's General Planning Law. The safety elements of the general plans establish standards and plans for the protection of the community from hazards. The information in this plan provides a tool to ensure that there is no increase in exposure in areas of high seismic risk. Development in the planning area will be regulated through building standards and performance measures so that the degree of risk will be reduced. The geologic hazard portions of the planning area are heavily regulated under California's General Planning Law. The International Building Code establishes provisions to address seismic risk.

8.8 SCENARIO

With the abundance of fault exposure in California, the potential scenarios for earthquake activity are many. An earthquake does not have to occur within the planning area to have a significant impact on the people, property and economy of the planning area.

Any seismic activity of 6.0 or greater on faults within the planning area would have significant impacts throughout the planning area. Potential warning systems could give approximately 40 seconds notice that a major earthquake is about to occur. This would not provide adequate time for preparation. Earthquakes of this magnitude or higher would lead to massive structural failure of property on NEHRP C, D, E, and F soils. Levees and revetments built on these poor soils would likely fail, representing a loss of critical infrastructure. These events could cause secondary hazards, including landslides and mudslides that would further damage structures. River valley hydraulic-fill sediment areas are also vulnerable to slope failure, often as a result of loss of cohesion in clay-rich soils. Soil liquefaction would occur in water-saturated sands, silts or gravelly soils.

8.9 ISSUES

Important issues associated with an earthquake include but are not limited to the following:

- More information is needed on the exposure and performance of soft-story construction within the planning area.

- A large percent of the planning area's building stock was built prior to 1975, when seismic provisions became uniformly applied through building code applications. Pre-1975 building codes increase the risk associated to structural damage.
- Based on the modeling of critical facility performance performed for this plan, a high number of facilities in the planning area are expected to have complete or extensive damage from scenario events. These facilities are prime targets for structural retrofits.
- The Tribe should create or enhance continuity of operations plans using the information on risk and vulnerability contained in this plan.
- Geotechnical standards should be established that take into account the probable impacts from earthquakes in the design and construction of new or enhanced facilities.
- Earthquakes could trigger other natural hazard events such as dam failures and landslides, which could severely impact the planning area.
- A worst-case scenario would be the occurrence of a large seismic event during a flood or high-water event. Levee failures would happen at multiple locations, increasing the impacts of the individual events.

CHAPTER 9.
FLOOD

9.1 GENERAL BACKGROUND

A floodplain is the area adjacent to a river, creek or lake that becomes inundated during a flood. Floodplains may be broad, as when a river crosses an extensive flat landscape, or narrow, as when a river is confined in a canyon.

When floodwaters recede after a flood event, they leave behind layers of rock and mud. These gradually build up to create a new floor of the floodplain. Floodplains generally contain unconsolidated sediments (accumulations of sand, gravel, loam, silt, and/or clay), often extending below the bed of the stream. These sediments provide a natural filtering system, with water percolating back into the ground and replenishing groundwater. These are often important aquifers, the water drawn from them being filtered compared to the water in the stream. Fertile, flat reclaimed floodplain lands are commonly used for agriculture, commerce and residential development.

DEFINITIONS

Flood—The inundation of normally dry land resulting from the rising and overflowing of a body of water.

Floodplain—The land area along the sides of a river that becomes inundated with water during a flood.

100-Year Floodplain—The area flooded by a flood that has a 1-percent chance of being equaled or exceeded each year. This is a statistical average only; a 100-year flood can occur more than once in a short period of time. The 1-percent annual chance flood is the standard used by most federal and state agencies.

Return Period—The average number of years between occurrences of a hazard (equal to the inverse of the annual likelihood of occurrence).

Riparian Zone—The area along the banks of a natural watercourse.

Connections between a river and its floodplain are most apparent during and after major flood events. These areas form a complex physical and biological system that not only supports a variety of natural resources but also provides natural flood and erosion control. When a river is separated from its floodplain with levees and other flood control facilities, natural, built-in benefits can be lost, altered, or significantly reduced.

9.1.1 Measuring Floods and Floodplains

The frequency and severity of flooding are measured using a discharge probability, which is the probability that a certain river discharge (flow) level will be equaled or exceeded in a given year. Flood studies use historical records to determine the probability of occurrence for the different discharge levels. The flood frequency equals 100 divided by the discharge probability. For example, the 100-year discharge has a 1-percent chance of being equaled or exceeded in any given year. The “annual flood” is the greatest flood event expected to occur in a typical year. These measurements reflect statistical averages only; it is possible for two or more floods with a 100-year or higher recurrence interval to occur in a short time period. The same flood can have different recurrence intervals at different points on a river.

The extent of flooding associated with a 1-percent annual probability of occurrence (the base flood or 100-year flood) is used as the regulatory boundary by many agencies. Also referred to as the special flood hazard area (SFHA), this boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities. Many communities have maps that show the extent and likely depth of flooding for the base flood. Corresponding water-surface elevations describe the elevation of water that will result from a given discharge level, which is one of the most important factors used in estimating flood damage.

9.1.2 Floodplain Ecosystems

Floodplains can support ecosystems that are rich in plant and animal species. A floodplain can contain 100 or even 1,000 times as many species as a river. Wetting of the floodplain soil releases an immediate surge of nutrients: those left over from the last flood, and those that result from the rapid decomposition of organic matter that has accumulated since then. Microscopic organisms thrive and larger species enter a rapid breeding cycle. Opportunistic feeders (particularly birds) move in to take advantage. The production of nutrients peaks and falls away quickly, but the surge of new growth endures for some time. This makes floodplains valuable for agriculture. Species growing in floodplains are markedly different from those that grow outside floodplains. For instance, riparian trees (trees that grow in floodplains) tend to be very tolerant of root disturbance and very quick-growing compared to non-riparian trees.

9.1.3 Effects of Human Activities

Because they border water bodies, floodplains have historically been popular sites to establish settlements due to the sustenance they provide. Human activities tend to concentrate in floodplains for a number of reasons: water is readily available; land is fertile and suitable for farming; transportation by water is easily accessible; and land is flatter and easier to develop. But human activity in floodplains frequently interferes with the natural function of floodplains. It can affect the distribution and timing of drainage, thereby increasing flood problems. Human development can create local flooding problems by altering or confining drainage channels. This increases flood potential in two ways: it reduces the stream's capacity to contain flows, and it increases flow rates or velocities downstream during all stages of a flood event. Human activities can interface effectively with a floodplain as long as steps are taken to mitigate the activities' adverse impacts on floodplain functions.

9.1.4 Federal Flood Programs

National Flood Insurance Program

The NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in participating communities. For most participating communities, FEMA has prepared a detailed Flood Insurance Study (FIS). The study presents water surface elevations for floods of various magnitudes, including the 1-percent annual chance flood and the 0.2-percent annual chance flood (the 500-year flood). Base flood elevations and the boundaries of the 100- and 500-year floodplains are shown on Flood Insurance Rate Maps (FIRMs), which are the principle tool for identifying the extent and location of the flood hazard.

At the present time, FEMA has not completed a flood insurance study specific to the Yurok Reservation, and no FIRM maps are available specific to the Yurok boundary. While the Tribe does not participate in the NFIP program, Humboldt and Del Norte Counties do participate, and areas of the Yurok Reservation are represented within those county FIRMs.

The Tribe has determined that enrollment in the NFIP will have a negative impact on its membership, including on its cultural resources and historic properties. The Yurok People have lived in their ancestral territories for thousands of years, and land plats and those structures on the lands have been passed down from generation to generation – much longer than the existence of the NFIP.

Over the course of time, tribal members whose residences were in what the non-tribal governments considered to be the floodplain were moved to other areas of the Reservation. Because of the limited land mass and suitable terrain which makes up the current boundary of the Yurok Reservation, this relocation many times ended up being a considerable distance away from other family members and was not in proximity to the original life they knew. Within the Tribal community, most families stay within very

close proximity to one another, as tradition and cultural heritage provides. In many instances, multiple generations of families will live within one house so that the younger generations can care for the elderly, and so that the elderly can teach the younger generations the ways of the Yurok People. Because of the limited land mass and the remoteness of a large portion of the Reservation, as families were displaced as a result of flood events and moved to other areas of the Reservation, these families lost connectivity to one another. This, in essence, has caused many families to lose their ancestral knowledge of their family's heritage.

To support the requirements associated with the NFIP would only further harm the Yurok People. Many of the Tribal Members have received their land through their ancestral background, with property being handed down from one generation to the next. As such, while the properties may fall within the floodplain, it is not necessarily by choice that the Members live where they do. The lack of land on which to move is very limited on the Reservation. Much of the land lacks the infrastructure necessary to support development. Until such time as the Tribe is able to increase its land mass, Tribal Members will, in essence, be forced to choose between maintaining their cultural heritage and familial connections by electing to live in the floodplain, or move out of floodplain, potentially off the Reservation, and lose their cultural heritage and benefits of living on the Reservation.

9.2 HAZARD PROFILE

9.2.1 The Klamath River

The Klamath River has the largest river basin in the California north coast region. The river originates in Oregon and drains 12,120 square miles. The Klamath River is the second largest river in California, exceeded only by the Sacramento River. The major tributaries to the Klamath River are the Salmon, Scott, Shasta and Trinity Rivers. The lower 50 miles of the river are within the Yurok Reservation, including the river mouth at the Pacific Ocean (Figure 9-1). Floods in the Klamath basin are caused by either of two factors:

- Rain-based floods, which are the most damaging floods along the Klamath River. Practically all damaging flood events have occurred during the period of November through March. Usually these events have occurred from rainstorms of several days in duration. Based on USGS gage data near Klamath, the maximum recorded discharge of 557,000 cubic feet per second (cfs) occurred on December 3, 1964, with a river level of 55.3 feet.
- Snowmelt floods usually begin in March and have not typically caused the damage associated with rain floods. Due to the size of the Klamath River basin, a true "worst-case scenario" would be a rain-on-snow event. Such events are not typical for the region, but are possible in light of potential climate change.

9.2.2 Past Events

The lower and middle sections of the Klamath River are extremely vulnerable to flooding, and major floods have occurred in years where major flooding has also occurred in Northern California, particularly as a result of Pineapple Express storms that bring large amounts of warm rain to Northern California. Significant floods on the Klamath River have occurred in 1926–1927, 1955, 1964, 1997, and 2005, in several cases changing the course of the river. The 1964 Christmas flood was particularly devastating, with a high water reaching 55 feet (17 m), inundating the towns of Klamath and Klamath Glen, destroying most of the Highway 101 bridge crossing the river. The highway bridge was rebuilt in a different location, though entrances to the old bridge still stand.

The Klamath River has a long history of major flood events with catastrophic damage and loss of life. The following sections describe the most notable recorded flood events.

Source: US Army Corps of Engineers Digital Visual Library

Figure 9-1. Mouth of the Klamath River on the Pacific Ocean

1861-62 Flood

Torrential rains and high tides caused extensive losses at Fort Turwar and Wau-Kell, where most of the buildings were swept away.

1881 Flood

In January 1881, heavy rains caused the Klamath to rise to an unprecedented height. Houses were swept away and livestock drowned. The federal government attempted to relocate the Yurok Tribe to the Smith River Reservation and reclaim the Tribe's low-lying lands under the authority of the Swamp Act.

1890 Flood

Heavy rains in late January 1890 caused the Klamath to flood. Water inundated the Hunter Creek bottom to a depth of 10 feet in places. On the south side of the Klamath, Jim Regan's and William Norris' ranches suffered heavy damage. At Martins Ferry, the Klamath rose 100 feet and carried away the suspension bridge. At Turwar, it crested 3 feet higher than it did in 1881.

1955 Flood (DR 47)

During the third week of December 1955, more than 1,000 people on the Reservation were forced from their homes due to flooding. The Trinity River Bridge in Hoopa was swept away when a logjam occurred and logs pummeled against it. As the bridge traveled down the Klamath River, it took out two bridges at Wetichpec: Martin's Ferry Bridge and the bridge at Klamath. Pecwan School was washed away. Traffic over U.S. 101 south to Eureka was stopped by the high water when the south approach to the Douglas Bridge was washed away, and earth slides blocked U.S. 101. The communities of Klamath and Klamath Glen were evacuated. On December 22, only the second stories and roofs protruded above the floodwaters from many Klamath area homes. South of Crescent City, more than 300 flood refugees, most of whom had fled the Klamath Glen on the December 21, were huddled at the Arrow Mill. Another 300 had been evacuated and taken to the old radar site on Requa hill when high water blocked their movement up U.S. 101 to Crescent City. An equal number fled to the safety of the Simpson Mill near Klamath Glen. About 100 people were quartered at MacMillen's Ranch, just north of Klamath, while scores of tourists remained in their cars, cut off by slides on U.S. 101.

1964 Flood (DR 183)

The most devastating flood in modern times occurred during the Christmas season of 1964. Torrential warm rains caused by a combination of heavy snow pack in the Siskiyous caused rapid snow melts that sent the Klamath River surging. The 1964 flood put an end to the old town of Klamath forever as it swept away all of the downtown and a fairly new school, destroyed the U.S. 101 bridge and the Martin's Ferry Bridge and carried many homes out to sea. Over 98 percent of the town of Klamath and 60 percent of the homes in Klamath Glen were destroyed. Hundreds of people were driven from their homes as the Klamath flooded the flats and lowlands. Bulldozers were used to reopen the road into Klamath Glen, where several hundred people were marooned. Several people fled to the Simpson Mill. Several trailers were pulled onto high ground at the mill, but many others were swept into the Pacific Ocean. Boaters risked their lives on the Klamath to save persons stranded in and on their homes.

1995 Flood, Severe Winter Storm, Wind, Landslide (DR 1044)

January-March 1995. The 1995 storms were unique with respect to the breadth of unusually heavy precipitation statewide. "El Niño" conditions brought strong storms, producing floods that led to federal disaster declarations through most of the state. This storm system is recognized as the cause to one of our nation's "Billion Dollar Disasters." Frequent winter storms cause 20-70 inch rainfall and periodic flooding across much of CA, incurring over $3.0 (3.6) billion damage/costs and caused 27 deaths throughout the state.

1997 Flood (DR 1155)

Northern California was drenched by a series of rainstorms December 29, 1996, through January 4, 1997. A wet, warm weather system commonly referred to as a "pineapple express" brought a series of storms from the central Pacific that caused heavy, prolonged and unusually warm precipitation across the northern half of the state. The four-day storm at the end of December produced rainfall two to three times the monthly average. The unusually warm rain caused widespread snowmelt from an above-normal snow pack. These conditions caused widespread minor to record-breaking floods from central California to Oregon. Approximately three quarters of the area's residents were isolated by water. The Pacific Power Yurok Substation was 3 feet under water, shutting off power to Klamath residents for days. Both Humboldt and Del Norte Counties received both a Governor's Proclamation and a Presidential Declaration of Emergency.

December 2005 – January 2006 Floods (DR 1628)

Heavy rains from a series of storms caused the river to rise. The first flood occurred on December 29, 2005. The river crested at 40.52 feet in the early morning. A second flood, on January 1, 2006, caused extensive damage when the river crested at 47.12 feet. Del Norte County received both a Governor's Proclamation and a Presidential Declaration of Emergency. Along the Klamath River, U.S. 101 was closed temporarily after the December 29 event; more significant flooding from the January 1 event resulted in a complete shutdown of the highway. Seventeen structures were damaged by high waters, and 70 mobile homes were moved prior to the event in response to forecasted river levels.

9.2.3 Location

The flooding that has occurred in portions of the planning area has been documented by gage records, high water marks, damage surveys and personal accounts. This documentation was the basis for the September 26, 2008 FIRM generated by FEMA for Del Norte County and the July 19, 1982 FIRM generated by FEMA for Humboldt County. While portions of the Tribe are recognized within these studies, it should be noted that the Tribe does not support, nor adopt, the analysis as presented in the FIRM maps. For this planning effort, FEMA's HAZUS-MH software was used to develop and map the extent and location of the 100 Year flood hazard, as shown in Figure 9-2 and Figure 9-3.

Also of significance on the Yurok Reservation is flooding which occurs from unplanned water releases from the dams located near the Reservation. These releases occur with frequency on the Reservation with little or no warning, and adversely impact the Reservation and its members as many times these releases causes significant river rises, especially when the release of the water from the dams occur simultaneous with weather event of increased precipitation.

Additional Hazus runs were completed for specific creek beds to determine impact within the planning area. Specifically, the 100- and 500-year events were developed for Turwar, Pecwan and Pine Creeks, as shown on Figure 9-4 through Figure 9-9.

9.2.4 Frequency

Recent history has shown that Humboldt and Del Norte Counties can expect an average of one episode of minor river flooding each winter. Winter floods inundate most of the area's 100-year floodplain at intervals of 3 to 10 years. Large, damaging floods typically occur every 10 years.

9.2.5 Severity

The principal factors affecting flood damage are flood depth and velocity. The deeper and faster flood flows become, the more damage they can cause. Shallow flooding with high velocities can cause as much damage as deep flooding with slow velocity. This is especially true when a channel migrates over a broad floodplain, redirecting high velocity flows and transporting debris and sediment. Flood severity is often evaluated by examining peak discharges; Table 9-1 summarizes the greatest Klamath River flows recorded by USGS flow gauges.

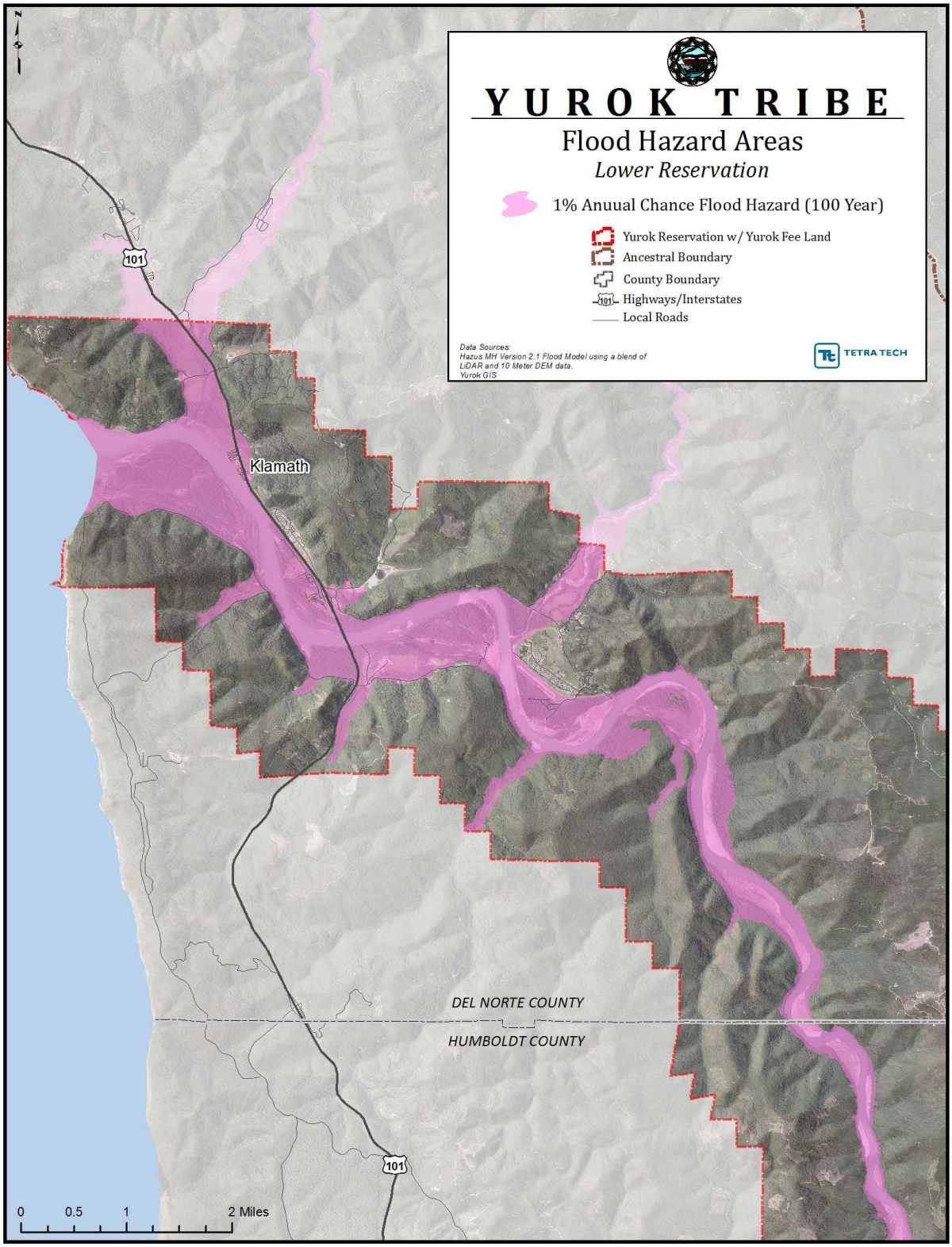

Figure 9-2. Lower Reservation Flood Hazard Area

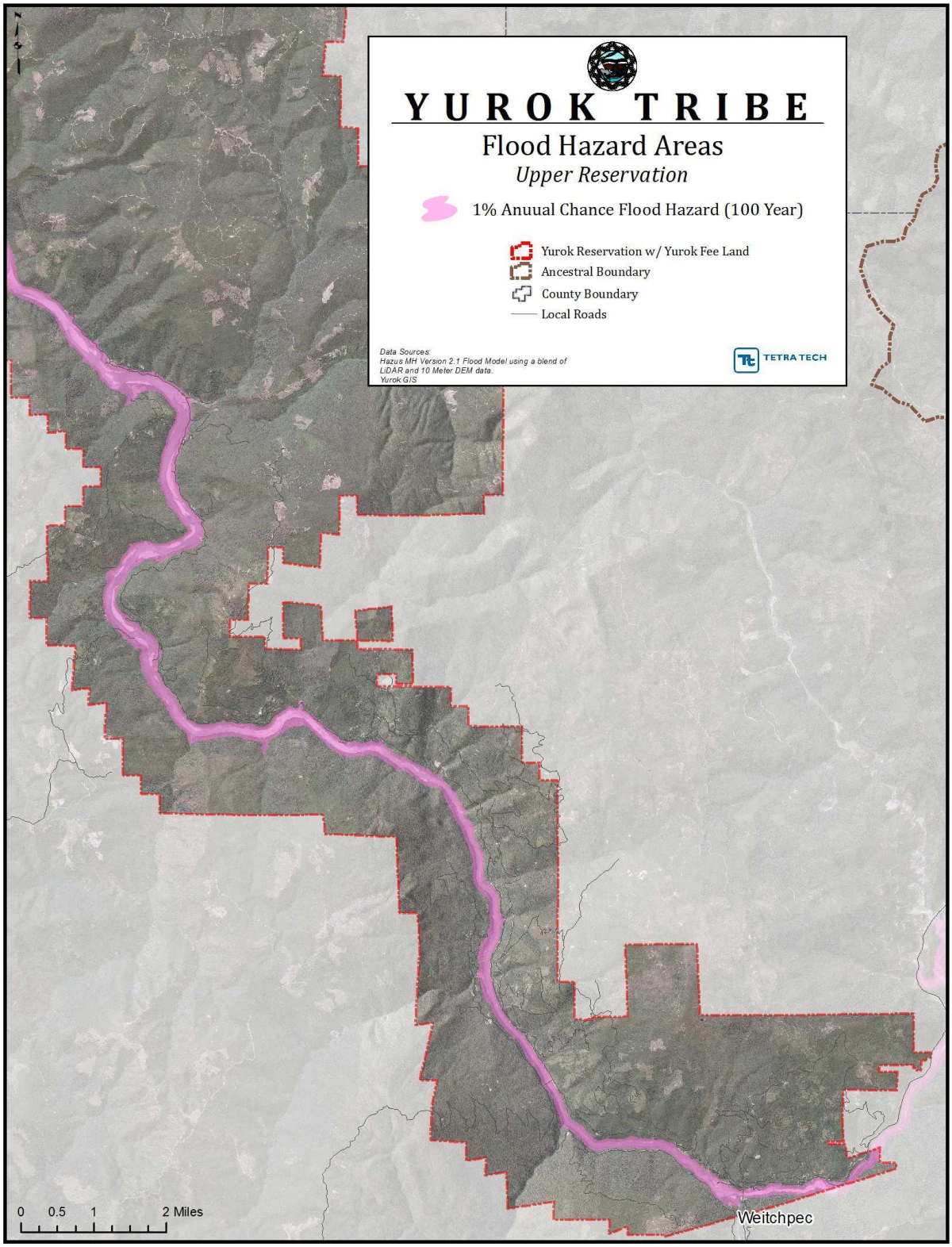

Figure 9-3. Upper Reservation Flood Hazard Area

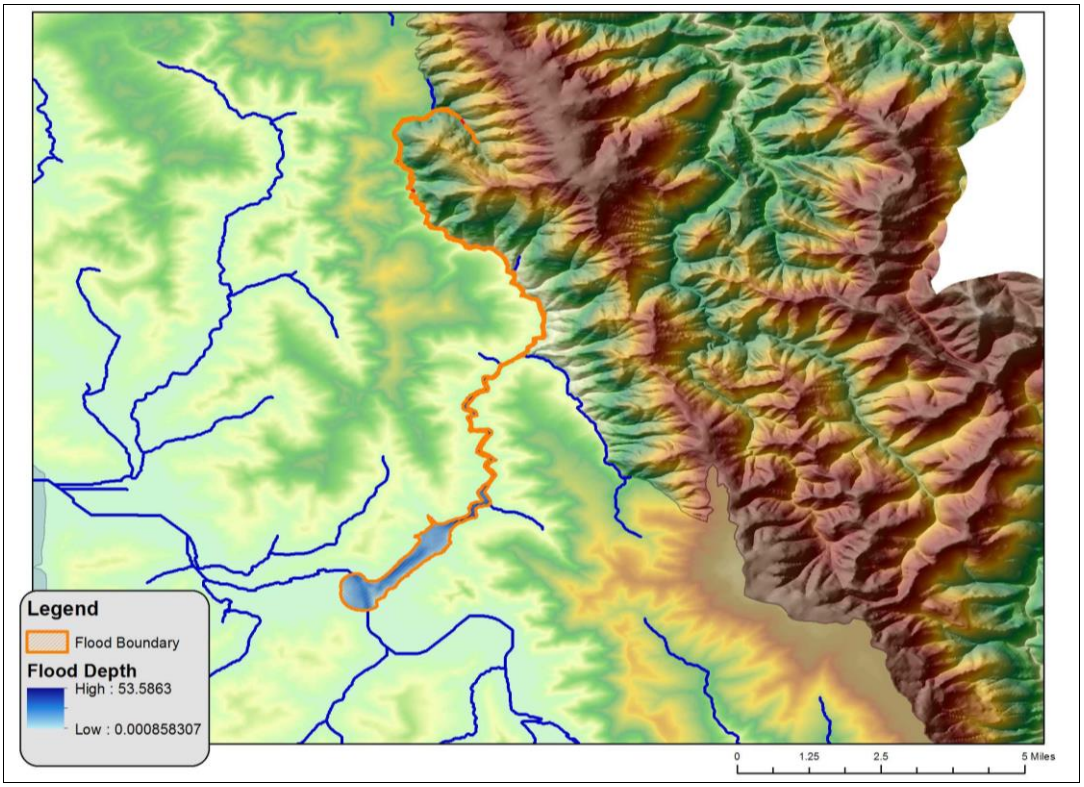

Figure 9-4. Turwar Creek 100-Year Flood Scenario

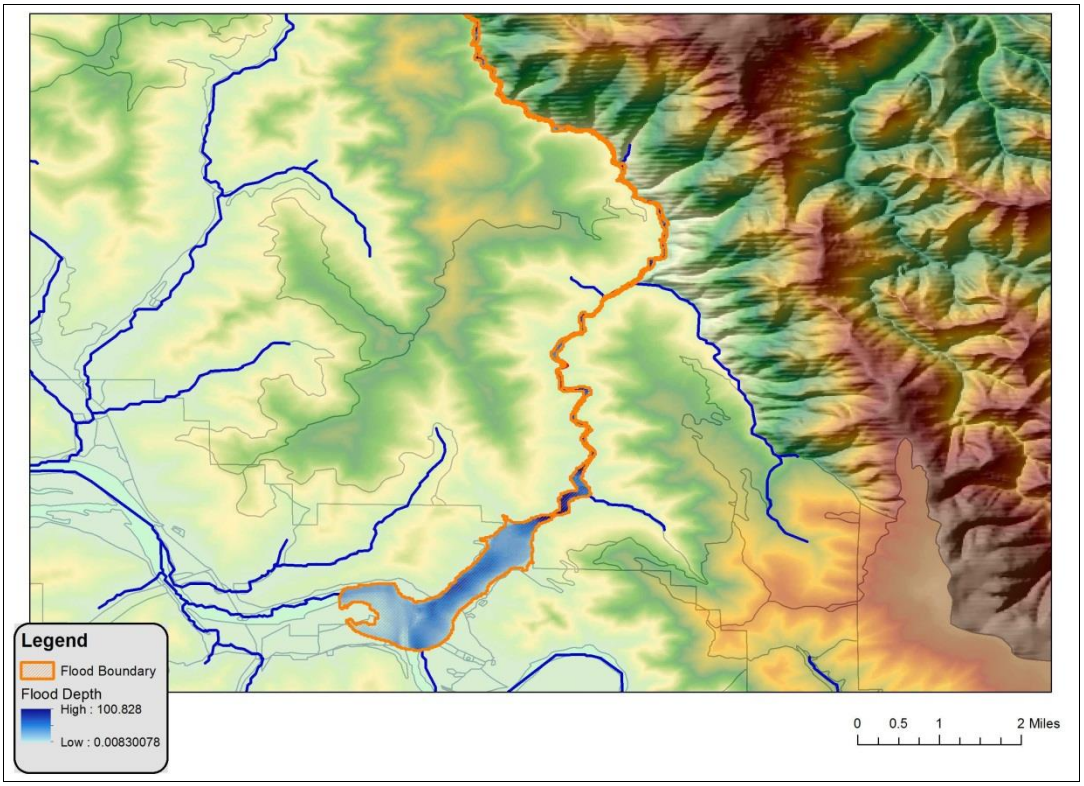

Figure 9-5. Turwar Creek 500-Year Flood Scenario

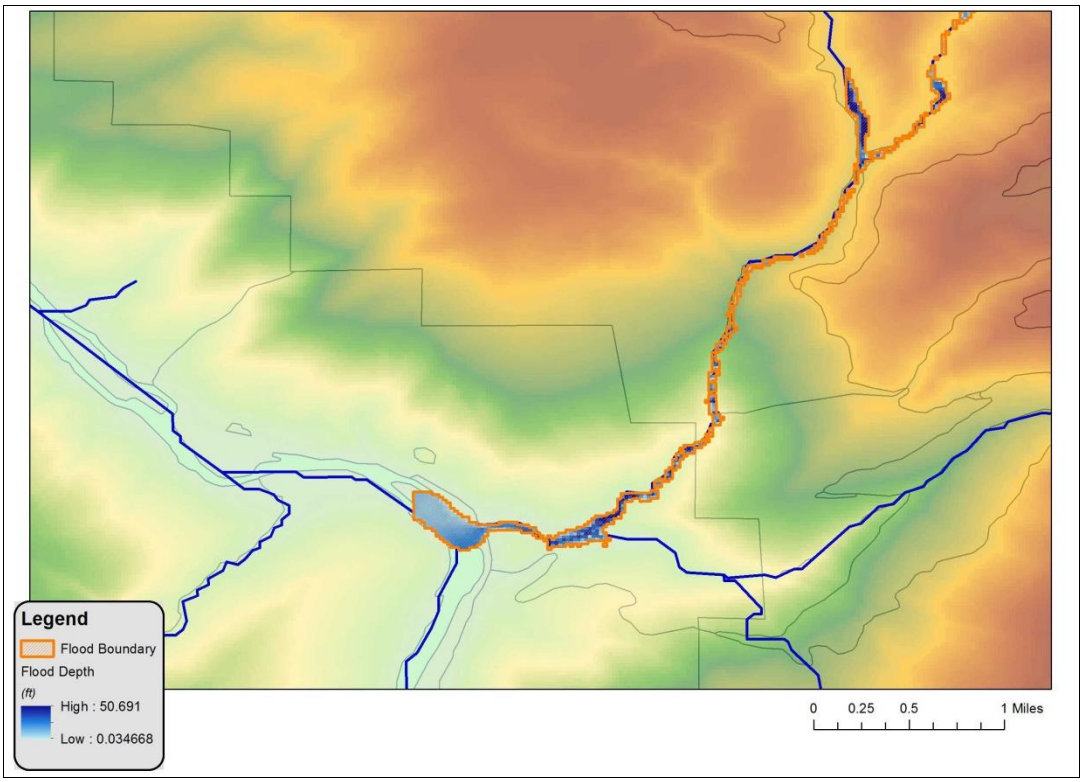

Figure 9-6. Pecwan Creek 100-Year Flood Scenario

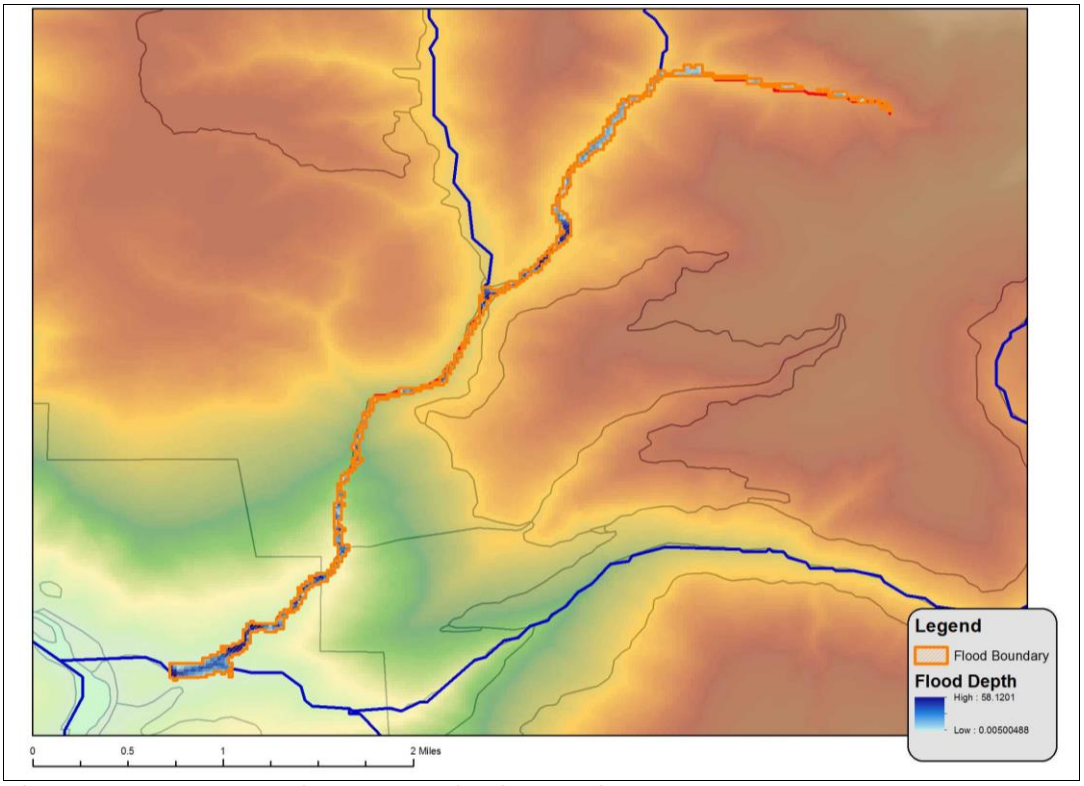

Figure 9-7. Pecwan Creek 500-Year Flood Scenario

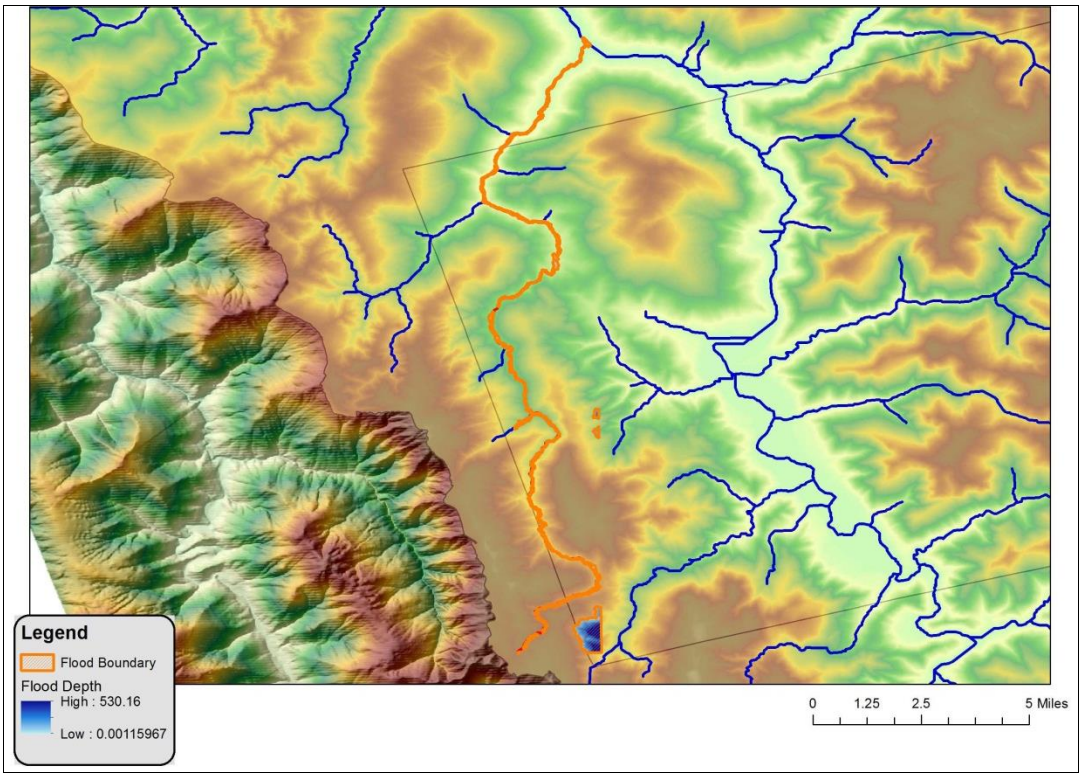

Figure 9-8. Pine Creek 100-Year Flood Scenario

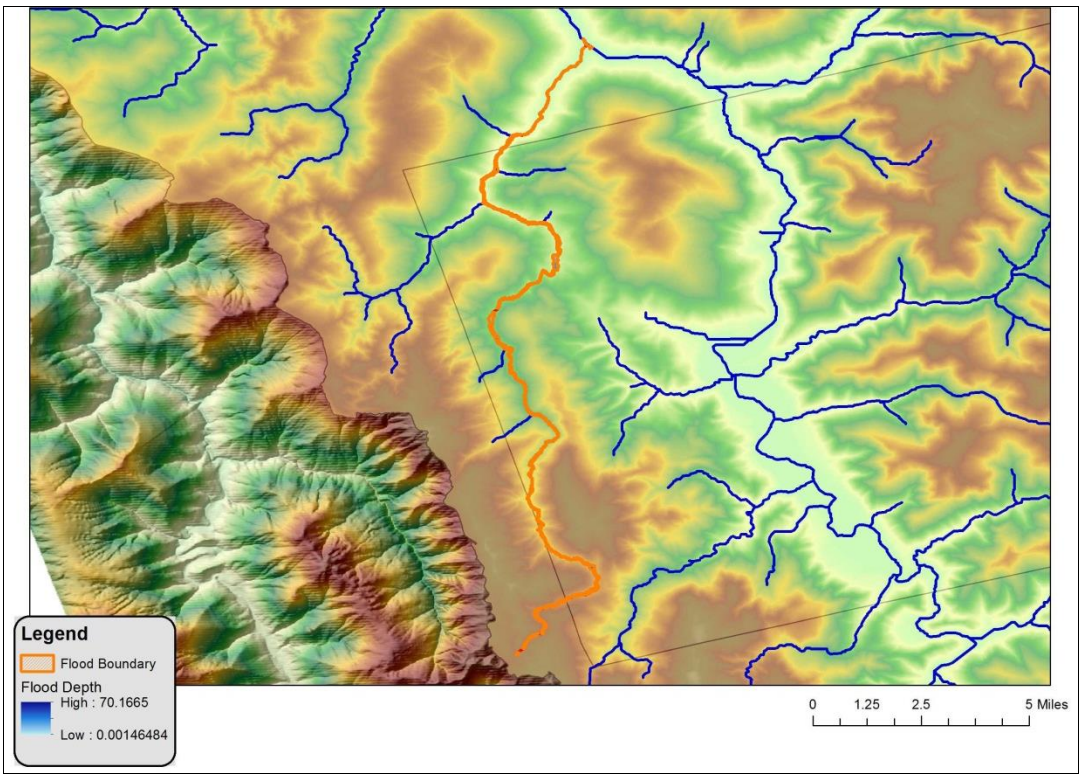

Figure 9-9. Pine Creek 500-Year Flood Scenario

TABLE 9-1.
HIGHEST RECORDED KLAMATH RIVER FLOWS

Date	River Level	River Flow
12/23/1964	61.29 feet	557,000 cfs
12/31/2005	47.12 feet	496,120 cfs
01/01/1997	43.80 feet	—
12/29/2005	40.52 feet	342,440 cfs
01/16/1974	38.90 feet	529,000 cfs
02/18/1986	36.76 feet	459,000 cfs
12/08/1861	36.50 feet	450,000 cfs
12/22/1955	35.80 feet	425,000 cfs
02/01/1890	35.80 feet	425,000 cfs
12/20/1981	34.20 feet	384,000 cfs
03/03/1972	33.70 feet	360,000 cfs
01/18/1971	32.90 feet	334,000 cfs
01/24/1970	32.80 feet	331,000 cfs
01/22/1972	32.50 feet	322,000 cfs
12/14/1977	32.10 feet	312,000 cfs

9.2.6 Warning Time

Due to the sequential pattern of meteorological conditions needed to cause serious flooding, it is unusual for a flood to occur without warning. Warning times for floods can be between 24 and 48 hours. Flash flooding can be less predictable, but potential hazard areas can be warned in advanced of potential flash flooding danger. Flooding is more likely to occur due to a rain storm when the soil is already wet and/or streams are already running high from recent previous rains (conditions already in place when a storm begins are called “antecedent conditions”).

On the Yurok Reservation, when any of the dams in the area spill water, it has the potential to cause flooding downstream on the Reservation. This is especially true when precipitation levels have been higher than normal due to a weather event in the area. The onset from dam releases are dependent upon the amount of water spilled. Presently, the dams are not required to notify the Tribe, and this has caused significant impact on the Reservation, as individuals become trapped due to impassable roadways and bridges, as well as flooding occurring within the residences.

9.3 SECONDARY HAZARDS

The most problematic secondary hazard for flooding is bank erosion and landslides, which in some cases can be more harmful than actual flooding. This is especially true in the upper courses of rivers with steep gradients, where floodwaters may pass quickly and without much damage, but scour the banks, edging properties closer to the floodplain or causing them to fall in. Flooding is also responsible for hazards such as landslides when high flows over-saturate soils on steep slopes, causing them to fail. Hazardous materials spills are also a secondary hazard of flooding if storage tanks rupture and spill into streams, rivers or storm sewers. As previously mentioned, the release of water from the dams also creates significant issues on the Reservation.

9.4 CLIMATE CHANGE IMPACTS

Use of historical hydrologic data has long been the standard of practice for designing and operating water supply and flood protection projects. For example historical data are used for flood forecasting models and to forecast snowmelt runoff for water supply. This method of forecasting assumes that the climate of the future will be similar to that of the period of historical record. However, the hydrologic record cannot be used to predict changes in frequency and severity of extreme climate events such as floods. Going forward, model calibration or statistical relation development must happen more frequently, new forecast-based tools must be developed, and a standard of practice that explicitly considers climate change must be adopted. Climate change is already impacting water resources, and resource managers have observed the following:

- Historical hydrologic patterns can no longer be solely relied upon to forecast the water future.
- Precipitation and runoff patterns are changing, increasing the uncertainty for water supply and quality, flood management and ecosystem functions.
- Extreme climatic events will become more frequent, necessitating improvement in flood protection, drought preparedness and emergency response.

The amount of snow is critical for water supply and environmental needs, but so is the timing of snowmelt runoff into rivers and streams. Rising snowlines caused by climate change will allow more mountain area to contribute to peak storm runoff. High frequency flood event s (e.g. 10 -year floods) in particular will likely increase with a changing climate. Along with reductions in the amount of the snowpack and accelerated snowmelt, scientists project greater storm intensity, resulting in more direct runoff and flooding. Changes in watershed vegetation and soil moisture conditions will likewise change runoff and recharge patterns. As stream flows and velocities change, erosion patterns will also change, altering channel shapes and depths, possibly increasing sedimentation behind dams, and affecting habitat and water quality. With potential increases in the frequency and intensity of wildfires due to climate change, there is potential for more floods following fire, which increase sediment loads and water quality impacts.

As hydrology changes, what is currently considered a 100-year flood may strike more often, leaving many communities at greater risk. Planners will need to factor a new level of safety into the design, operation, and regulation of flood protection facilities such as dams, floodways, bypass channels and levees, as well as the design of local sewers and storm drains.

In direct support of such issues, the Tribe’s Environmental Program has actively been working to determine the impacts of Climate Change on the Reservation as a whole. One area of focus has been on the issue of sea level rise, and how that element of climate change could potentially impact the planning area. Working with the Pacific Institute, through a project funded by the California Energy Commission’s Pacific Interest Energy Research Program, CalTrans and the California Ocean Protection Council, scenarios have been created to determine the impact of sea level rise in the areas of Requa, Ah Pah Ridge, and Klamath Glen. Figure 9-10, Figure 9-11 and Figure 9-12 depict the results of those scenarios.

The Environmental Program continues to work on climate change impacts on the Reservation. Beginning October 1, 2012, the Tribe received grant funding from the U.S. EPA to complete a vulnerability assessment, which will greatly enhance the knowledge base associated with potential impacts, allowing for the identification of community-based priorities for adaptation/mitigation planning efforts. Once completed, information from that study will greatly enhance those areas of impact within this document, and will assist in future land use development planning effort.

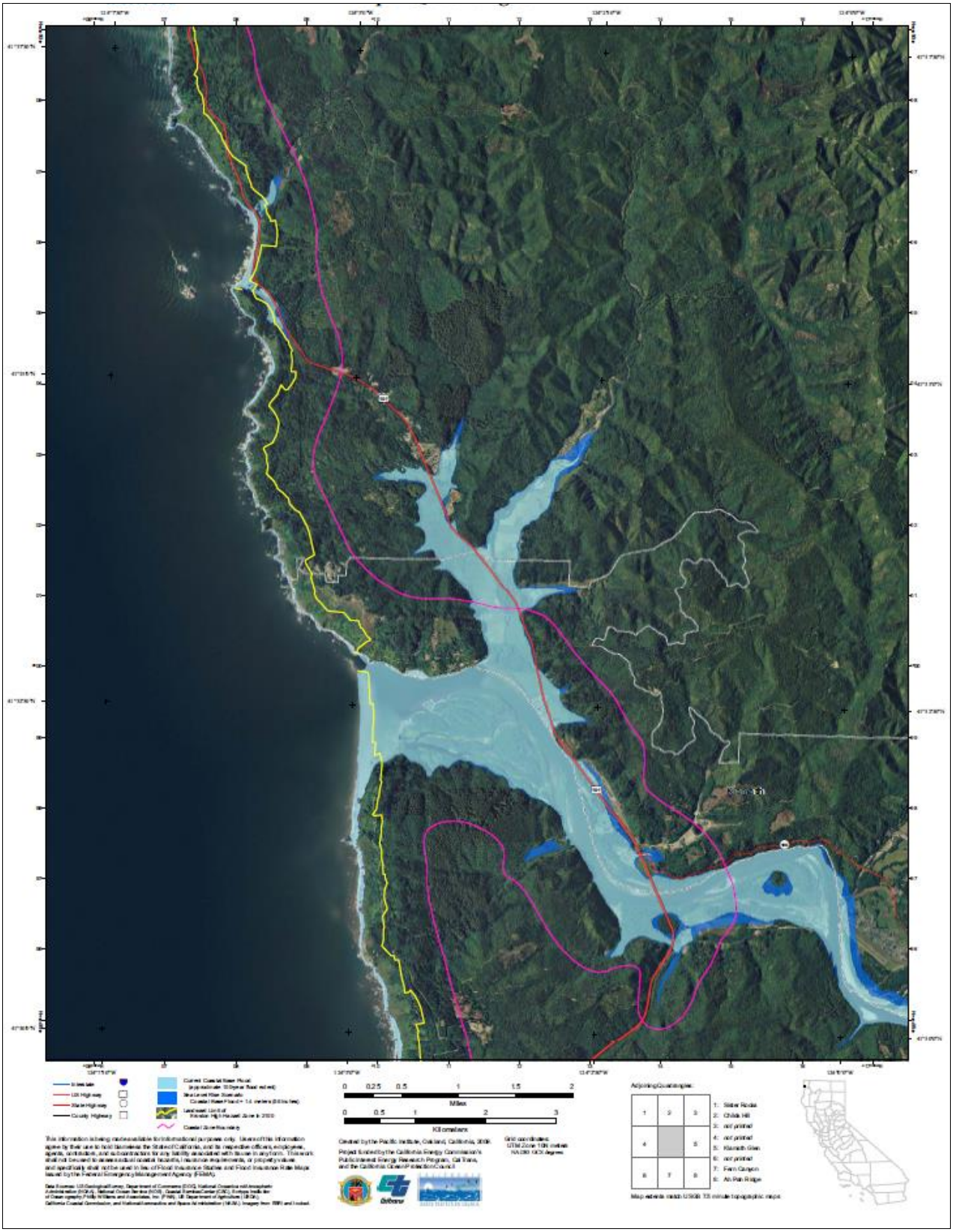

Figure 9-10. Flood Risk from Sea Level Rise in the Requa Area

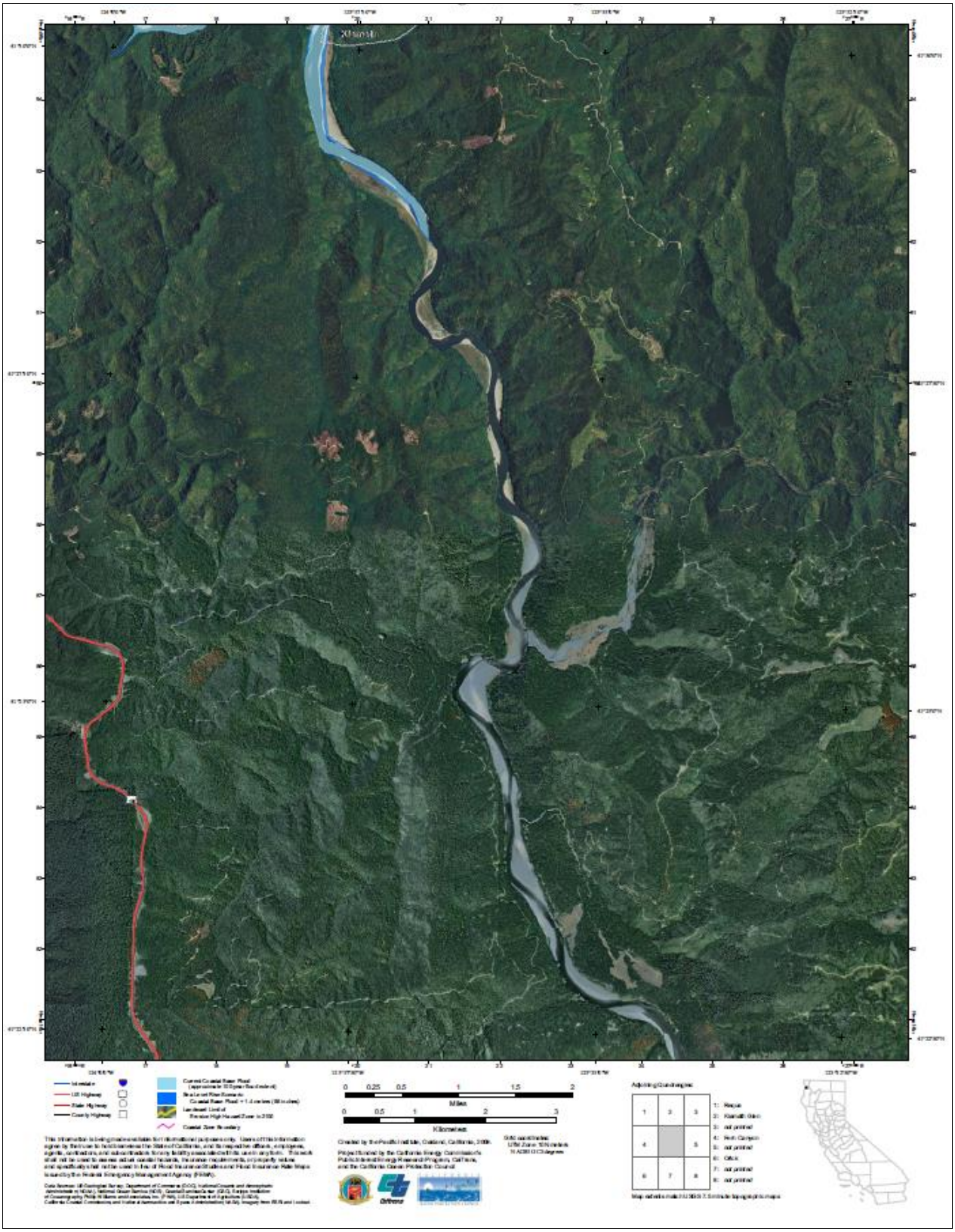

Figure 9-11. Flood Risk from Sea Level Rise in the Ah Pah Ridge Area

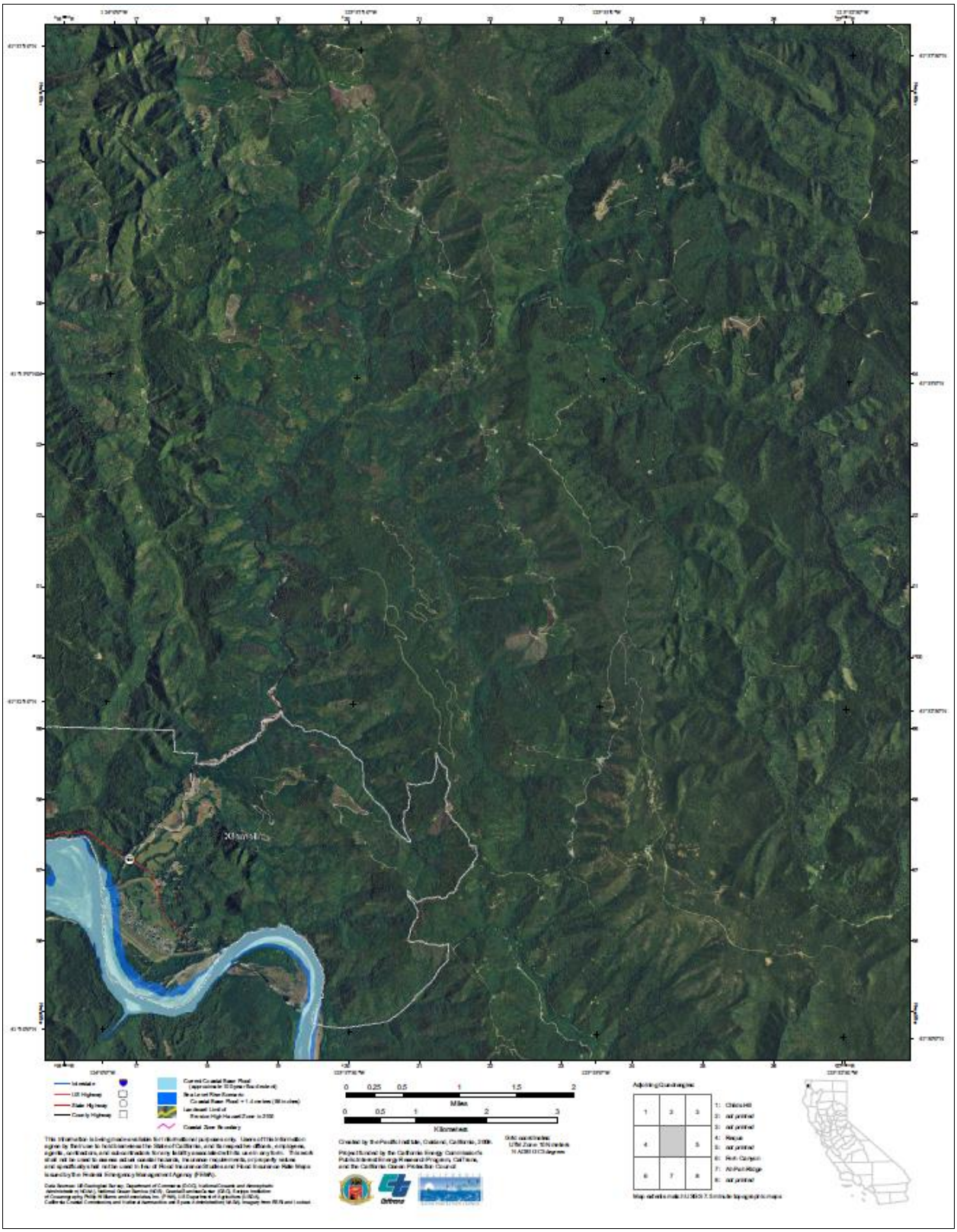

Figure 9-12. Flood Risk from Sea Level Rise in the Klamath Glen Area

9.5 EXPOSURE

The Level 2 HAZUS-MH protocol was used to assess the risk and vulnerability to flooding in the planning area. A user defined building specific model was developed, incorporating a HAZUS-generated 100-year floodplain, which has a level of accuracy acceptable for planning purposes. Where possible, the HAZUS-MH default data was enhanced using local GIS data from local, state and federal sources.

9.5.1 Population

Population counts of those living in the floodplain were generated by analyzing the Reservations total population and total households that intersect the 100-year floodplain (Tribal and Non-Tribal). The methodology used to generate population estimates was determined by multiplying the average household size for the Yurok Reservation (3 persons per household) by the number of exposed residential buildings. This number also reflects Tribal members who are within close proximity to the current Reservation Boundary, and for which the Tribe provides emergency services. These residences are not, at present, located on what is presently recognized by the federal government as the Reservation's boundary, but do fall within the Tribe ancestral boundary.

Using this approach, it was estimated that the exposed population is 378 within the 100-year floodplain (16 percent of the Tribes total population).

9.5.2 Property

Structures in the Floodplain

Table 9-2 summarizes the total area and number of structures in the floodplain. The HAZUS-MH model determined that there are 143 structures within the 100-year floodplain, 87 percent are residential structures.

TABLE 9-2.
AREA AND STRUCTURES IN THE FLOODPLAIN

	100-Year Floodplain
Area in Floodplain (acres)	7,437
Number of Structures in Floodplain	
Non-Tribal Government	1
Non-Single Family Residential	16
Single Family Residential	126
Total	**143**

Exposed Value

Table 9-3 summarizes the estimated value of exposed buildings in the planning area. This methodology estimated $41.3 million worth of building-and-contents exposure to the 100-year flood, representing 14.32% percent of the total assessed value of the planning area.

TABLE 9-3.
VALUE OF STRUCTURES IN THE FLOODPLAIN

	Estimated Flood Exposure			% of Total Assessed Value
	Structure	Contents	**Total**	
Government Non-Tribal	$355,000	$355,000	$710,000	5.21%
Non Residential	$3,102,062	$2,317,582	$5,419,644	23.81%
Single Family Residential	$23,458,225	$11,729,113	$35,187,338	17.39%
Total	**$26,915,287**	**$14,401,694**	**$41,316,981**	**14.32%**

9.5.3 Critical Facilities and Infrastructure

Tier II Facilities

Tier II facilities are those that use or store materials that can harm the environment if damaged by a flood. At present, businesses are not required to report hazardous materials to the Tribe. This is a significant issue for the Tribe, as it places a very high value on the protection of its environment, and during flood events, containers holding hazardous materials can rupture and leak into the surrounding area, having a disastrous effect on the environment as well as residents. The Tribe has a progressive environmental division, and has identified several Brownfield Sites on the Reservation which it monitors. For purposes of this planning effort, however, as businesses in the planning area are not required to report this information to the Tribe, but rather to the Counties and State, it is unclear how many Tier II hazardous material sites are presently in the 100-year floodplain and how many Tier II facilities are in the 500-year floodplain.

Utilities and Infrastructure

It is important to determine who may be at risk if infrastructure is damaged by flooding. Roads that are blocked or damaged can isolate residents and can prevent access throughout the planning area, including for emergency service providers needing to get to vulnerable populations or to make repairs. Bridges washed out or blocked by floods or debris also can cause isolation. Water and sewer systems can be flooded or backed up, causing health problems. Underground utilities can be damaged. Dikes can fail or be overtopped, inundating the land that they protect. The following sections describe specific types of critical infrastructure.

Roads

The major roads in the planning area that pass through the 100-year floodplain and are thus exposed to flooding are Highways 101, 96 and 169. Some of these roads are built above the flood level, and others function as levees to prevent flooding. Still, in severe flood events these roads can be blocked or damaged, preventing access to some areas.

Bridges

Flooding events can significantly impact road bridges, and there is an extensive system of twenty-four (24) bridges on the Reservation. These are important because often they provide the only ingress and egress to some neighborhoods. Several bridges are constructed of wood. During the 1955 and 1964 floods, several bridges on the Reservation failed due to prolonged battering from logs and debris. During the 1964 flood, a log jam on the Trinity Bridge in Hoopa caused the Trinity River Bridge to fail. As it

traveled from the Trinity River to the Klamath River, it destroyed every bridge on the Yurok Reservation, including two bridges in Weitchpec, Martin's Ferry Bridge and the Klamath Bridge, further isolating the Reservation community.

An analysis showed that there are 14 bridges that are in or cross over the 100-year floodplain.

Water and Sewer Infrastructure

Water and sewer systems can be affected by flooding. Floodwaters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from flood events, also causing localized urban flooding. Floodwaters can get into drinking water supplies, causing contamination. Sewer systems can be backed up, causing wastewater to spill into homes, neighborhoods, rivers and streams.

Levees

Levees have historically been used to control flooding in portions of the planning area. Many of the levees are older and were built under earlier flood management goals. Many of these older levees are exposed to scouring and failure due to old age and construction methods.

The Army Corps of Engineers built the Terwer Creek Erosion Klamath-Glen Levee in 1970, as a mitigation project following the devastating 1964 flood that destroyed over two hundred homes in the Klamath Glen Community. In 1995, the Army Corp of Engineers was required to correct a design error on the Klamath Glen Levee, and Congress appropriated funds for the necessary repairs.

There are three diesel-powered pumps that pump water at the levees during a flood. The Klamath-Glen levee withstood the 1997 and 2006 from floods, however, any period of sustained rains and flooding can cause concern with the levee overtopping or failing.

Residents behind the levee were evacuated during the 1997 flood when floodwaters were within a few feet of topping over the levee. During the 2006 flood, County workers were stationed in the Klamath-Glen area to ensure that the levee pumps did not fail. When flooding closed Terwer Bridge on U.S. Highway 169, fuel supplies to the pumps were sufficient to run the pumps for only three days. Had the floodwaters not subsided by the third day, an airlift of fuel supplies would have been necessary to keep the pumps working. Should the levee fail, several hundred residents would be flooded.

9.5.4 Environment

Flooding is a natural event, and floodplains provide many natural and beneficial functions. Nonetheless, with human development factored in, flooding can impact the environment in negative ways. Migrating fish can wash into roads or over dikes into flooded fields, with no possibility of escape. Pollution from roads, such as oil, and hazardous materials can wash into rivers and streams. During floods, these can settle onto normally dry soils, polluting them for agricultural uses. Human development such as bridge abutments and levees, and logjams from timber harvesting can increase stream bank erosion, causing rivers and streams to migrate into non-natural courses.

9.6 VULNERABILITY

Many of the areas exposed to flooding may not experience serious flooding or flood damage. This section describes vulnerabilities in terms of population, property, infrastructure and environment.

9.6.1 Population

A geographic analysis of demographics using the default HAZUS-MH Census Block inventory data identified populations vulnerable to the flood hazard. HAZUS estimated that a 100-year flood could displace up to 234 people, with 96 needing short-term shelter.

9.6.2 Property

HAZUS-MH calculates losses to structures from flooding by looking at depth of flooding and type of structure. Using historical flood insurance claim data, HAZUS-MH estimates the percentage of damage to structures and their contents by applying established damage functions to an inventory. For this analysis, local data on facilities was used instead of the default inventory data provided with HAZUS-MH. The analysis is summarized in Table 9-4 for the 100-flood event. It is estimated that there would be up to $10.8 million of flood loss from a 100-year flood event in the planning area. This represents 26 percent of the total exposure to the 100-year flood and 3.7 percent of the total assessed value for the reservation. On average, facilities received 27 percent damage to the structure and 38 percent damage to the contents during a 100-year flood event

TABLE 9-4.
LOSS ESTIMATES FOR FLOOD

	Structures Impacted[a]	Estimated Loss Associated with Flood			% of Total Assessed Value
		Structure	Contents	**Total**	
Government Non-Tribal	1	$38,797	$195,526	$234,324	1.72%
Non Residential	17	$596,420	$1,657,937	$2,254,357	9.90%
Residential	96	$5,240,818	$3,041,207	$8,282,025	4.09%
Total	**114**	**$5,876,035**	**$4,894,671**	**$10,770,706**	**3.73%**

a. Impacted structures are those structures with finished floor elevations below the flood event water surface elevation. These structures are the most likely to receive significant damage in a flood event.

9.6.3 Critical Facilities and Infrastructure

As defined earlier in this planning document, the Steering Committee elected to reference all facilities on the Reservation as critical facilities, due to the limited number of residential structures and the inability to re-build those structures due to both lack of funding and limited land mass. Therefore, all items previously defined in the above tables are to be considered critical facilities and infrastructure exposed to the flood risk.

9.6.4 Environment

The environment vulnerable to flood hazard is the same as the environment exposed to the hazard. Loss estimation platforms such as HAZUS-MH are not currently equipped to measure environmental impacts of flood hazards. The best gauge of vulnerability of the environment would be a review of damage from past flood events. Loss data that segregates damage to the environment was not available at the time of this plan. Capturing this data from future events could be beneficial in measuring the vulnerability of the environment for future updates.

9.7 FUTURE TRENDS

The planning area has experienced slow-to-moderate growth over the past 10 years. However, with the intended development of the Casino resulting in the potential increase in the job market, it is felt that Tribal members who currently live and work off of the Reservation will return home. The Yurok Tribe is optimistic that marginal, sustained growth will return to the planning area as the state and national economies strengthen, and as the Tribe is able to gather additional land mass in the surrounding area, such as those which were included in its ancestral boundaries. This increased land mass will allow for further expansion for the tribe, to include housing and business ventures.

The Yurok Tribe is equipped to handle future growth within flood hazard areas. Its general plan addresses frequently flooded areas in its safety elements. The Tribe has committed to linking its general plan to this hazard mitigation plan. This will create an opportunity for wise land use decisions as future growth impacts flood hazard areas.

9.8 SCENARIO

The primary water courses in the planning area have the potential to flood at irregular intervals, generally in response to a succession of intense winter rainstorms. Storm patterns of warm, moist air usually occur between early November and late March. A series of such weather events can cause severe flooding in the planning area. The worst-case scenario is a series of storms that flood numerous drainage basins in a short time, and the various dams in the area spilling additional water. This would overwhelm the response and floodplain management capability within the planning area. Major roads could be blocked, preventing critical access for many residents and critical functions. High in-channel flows could cause water courses to scour, possibly washing out roads and creating more isolation problems. In the case of multi-basin flooding, the Yurok Tribe would not be able to make repairs quickly enough to restore critical facilities and infrastructure to those areas of the Reservation which have infrastructure. Nor would they be able to provide emergency services to those areas experiencing isolation as a result of the flooding.

9.9 ISSUES

The planning team has identified the following flood-related issues relevant to the planning area:

- The accuracy of the existing flood hazard mapping produced by FEMA in reflecting the true flood risk within the planning area is questionable. This is most prevalent in areas protected by levees not accredited by the FEMA mapping process.
- The extent of the flood-protection currently provided by flood control facilities (dams, dikes and levees) is not known due to the lack of an established national policy on flood protection standards, and the lack of data and information provided to the Tribe with respect to areas of inundation.
- Older levees, such as the Klamath-Glen Levee, are subject to failure or do not meet current building practices for flood protection.
- The risk associated with the flood hazard overlaps the risk associated with other hazards such as earthquake, landslide and fishing losses. This provides an opportunity to seek mitigation alternatives with multiple objectives that can reduce risk for multiple hazards.
- Potential climate change could impact flood conditions in the planning area.
- More information is needed on flood risk to support the concept of risk-based analysis of capital projects.

- There needs to be a sustained effort to gather historical damage data, such as high water marks on structures and damage reports, to measure the cost-effectiveness of future mitigation projects.
- Ongoing flood hazard mitigation will require funding from multiple sources.
- There needs to be a coordinated hazard mitigation effort between the Tribe, jurisdictions and private businesses (including dam owners) affected by flood hazards in the planning area.
- Floodplain residents need to continue to be educated about flood preparedness and the resources available during and after floods.
- The concept of residual risk should be considered in the design of future capital flood control projects and should be communicated with residents living in the floodplain.

Existing floodplain-compatible uses such as agricultural and open space need to be maintained. There is constant pressure to convert these existing uses to more intense uses within the planning area during times of moderate to high growth. As the Tribe has very limited land mass, this is especially true as it has no other options because of the limited space available. Support by federal agencies to increase the Tribe's land mass back to its original ancestral lands is needed to allow the Tribe to continue to grow and expand in membership, reservation population and increased business opportunities.

CHAPTER 10.
LANDSLIDE

10.1 GENERAL BACKGROUND

A landslide is a mass of rock, earth or debris moving down a slope. Landslides may be minor or very large, and can move at slow to very high speeds. They can be initiated by storms, earthquakes, fires, volcanic eruptions or human modification of the land.

Mudslides (or mudflows or debris flows) are rivers of rock, earth, organic matter and other soil materials saturated with water. They develop in the soil overlying bedrock on sloping surfaces when water rapidly accumulates in the ground, such as during heavy rainfall or rapid snowmelt. Water pressure in the pore spaces of the material increases to the point that the internal strength of the soil is drastically weakened. The soil's reduced resistance can then easily be overcome by gravity, changing the earth into a flowing river of mud or "slurry." A debris flow or mudflow can move rapidly down slopes or through channels, and can strike with little or no warning at avalanche speeds. The slurry can travel miles from its source, growing as it descends, picking up trees, boulders, cars and anything else in its path. Although these slides behave as fluids, they pack many times the hydraulic force of water due to the mass of material included in them. Locally, they can be some of the most destructive events in nature.

DEFINITIONS

Landslide—The sliding movement of masses of loosened rock and soil down a slope. Such failures occur when the strength of the slope soils is exceeded by the pressure, such as weight or saturation, acting upon them.

Mass Movement—A collective term for landslides, debris flows, falls and sinkholes.

Mudslide (or Mudflow or Debris Flow)—A river of rock, earth, organic matter and other materials saturated with water.

All mass movements are caused by a combination of geological and climate conditions, as well as the encroaching influence of urbanization. Vulnerable natural conditions are affected by human residential, agricultural, commercial and industrial development and the infrastructure that supports it.

10.2 HAZARD PROFILE

Landslides are caused by one or a combination of the following factors: change in slope of the terrain, increased load on the land, shocks and vibrations, change in water content, groundwater movement, frost action, weathering of rocks, and removing or changing the type of vegetation covering slopes. In general, landslide hazard areas are where the land has characteristics that contribute to the risk of the downhill movement of material, such as the following:

- A slope greater than 33 percent
- A history of landslide activity or movement during the last 10,000 years
- Stream or wave activity, which has caused erosion, undercut a bank or cut into a bank to cause the surrounding land to be unstable
- The presence or potential for snow avalanches
- The presence of an alluvial fan, indicating vulnerability to the flow of debris or sediments
- The presence of impermeable soils, such as silt or clay, which are mixed with granular soils such as sand and gravel.

Flows and slides are commonly categorized by the form of initial ground failure. Figure 10-1 through Figure 10-4 show common types of slides. The most common is the shallow colluvial slide, occurring particularly in response to intense, short-duration storms. The largest and most destructive are deep-seated slides, although they are less common than other types.

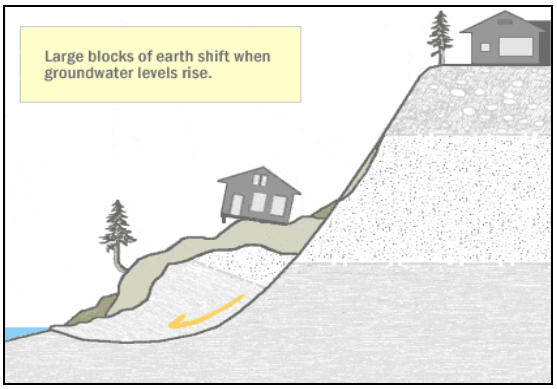

Figure 10-1. Deep Seated Slide

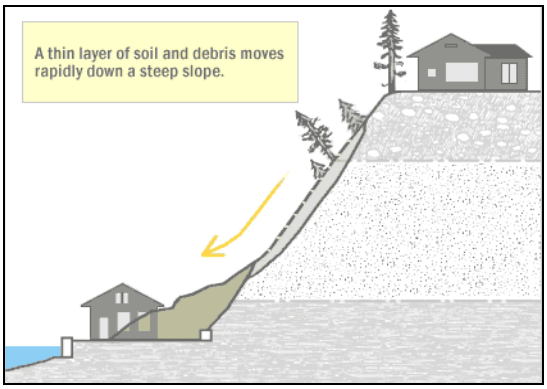

Figure 10-2. Shallow Colluvial Slide

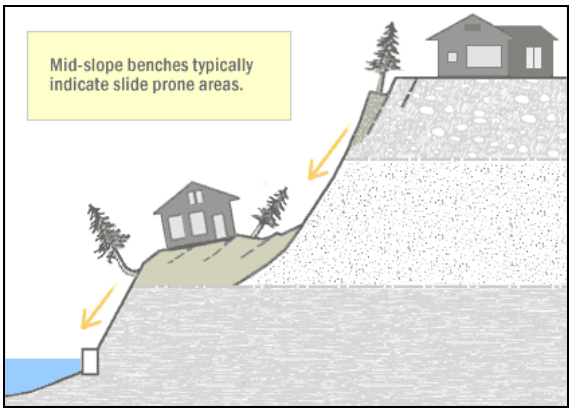

Figure 10-3. Bench Slide

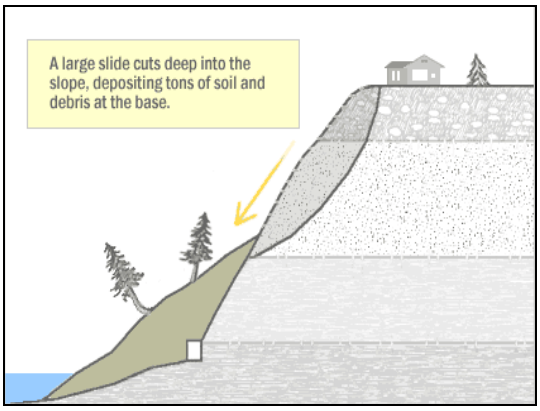

Figure 10-4. Large Slide

Slides and earth flows can pose serious hazard to property in hillside terrain. They tend to move slowly and thus rarely threaten life directly. When they move—in response to such changes as increased water content, earthquake shaking, addition of load, or removal of downslope support—they deform and tilt the ground surface. The result can be destruction of foundations, offset of roads, breaking of underground pipes, or overriding of downslope property and structures.

10.2.1 Past Events

Mudflows are common in the planning area during winter. Mudflows develop when water rapidly accumulates in the ground, such as during heavy rainfall or rapid snowmelt, changing the earth into a flowing river of mud that can flow rapidly down slopes or through channels. In the North Coast Ranges, landslides and soil slips are common due to the combination of sheared rocks, shallow soil profile development, steep slopes, and heavy seasonal precipitation. More than 90 percent of the Reservation is over 30% slope. Slopes are unstable and roadways are subject to soil slips, causing erosion of roadbeds and expensive road repairs. Historic Tribal records from 1948-1994 demonstrate extensive impacts from landslides during that time period.

TABLE 10-1.
LANDSLIDE AREAS OF IMPACT 1948-1994

Area	Number of Events
Ah Pah Main Stem	3
North Fork Ah Pah	3
Bear	20
Blue	14
Lower Blue	20
Blue West Fork	3
Cappell	10
Happow	19
Hunter	5
McGarvey	6
Omagar	13
Pecwan	11
Roach	4
Salt	4
Saugep	4
Terwer	16
Tully	4
Unnamed	27

TABLE 10-2.
ADDITIONAL LANDSLIDE AREAS OF IMPACT 1983-2006

Begin Date	Hazard Type	County	Injuries	Fatalities	Property Damage	Crop Damage
12/28/2005	Landslide	Del Norte	0.00	0.00	$13975000	$0
4/1/2006	Landslide	Del Norte	0.00	0.25	$3600000	$5000000
4/4/2006	Landslide	Del Norte	0.00	0.00	$2600000	$0
4/2/2006	Landslide	Del Norte	0.00	0.00	$2300000	$0
4/1/2006	Landslide	Del Norte	0.00	0.00	$1750000	$0
12/28/1992	Landslide—Winter Weather	Del Norte	0.00	0.00	$2778	$0
4/2/1983	Landslide—Severe Storm/Thunder Storm	Humboldt	0.00	0.00	$500000	$50000

Source: SHELDUS

10.2.2 Location

In the North Coast Ranges, landslides and soil slips are common due to the combination of sheared rocks, shallow soil profile development, steep slopes, and heavy seasonal precipitation. Also, the Lower Klamath has substantial amounts of Franciscan Complex rocks. Jurassic marine sediments are the predominant bedrock type in the Lower Trinity planning watershed. More than 90 percent of the Reservation has slopes at or greater than 30 percent grade. Slopes are unstable and roadways are subject to soil slips, causing erosion of roadbeds and expensive road repairs.

The best available predictor of where movement of slides and earth flows might occur is the location of past movements. Past landslides can be recognized by their distinctive topographic shapes, which can remain in place for thousands of years. Most landslides recognizable in this fashion range from a few acres to several square miles. Most show no evidence of recent movement and are not currently active. A small proportion of them may become active in any given year, with movements concentrated within all or part of the landslide masses or around their edges.

The recognition of ancient dormant mass movement sites is important in the identification of areas susceptible to flows and slides because they can be reactivated by earthquakes or by exceptionally wet weather. Also, because they consist of broken materials and frequently involve disruption of groundwater flow, these dormant sites are vulnerable to construction-triggered sliding. Figure 10-5 depicts landslide hazard areas in the Lower Klamath Watershed.

10.2.3 Frequency

Landslides are often triggered by other natural hazards such as earthquakes, heavy rain, floods or wildfires. The frequency of a landslide is related to the frequency of these triggering events. In Humboldt County, although landslides typically occur during and after major storms, they also occur naturally in average rainfall years in remote and non-human impacted areas. Recent major events occurred during the winter storms of 1963-64, 1982-83, 1992, 1998, 2005-06, each of which generated hundreds of slides. Figure 10-6 shows a road washout which occurred on the Reservation at Tectach Creek, which occurred in the Spring of 1999. This is but one example of such slides impacting the Reservation.

10.2.4 Severity

Landslides destroy property, infrastructure and transportation systems, and can take the lives of people. Slope failures in the United States result in an average of 25 lives lost per year and an annual cost to society of about $1.5 billion. The 2005-06 storms in Humboldt and Del Norte Counties caused millions of dollars in damage due to falls, slides, and mud and debris flows. This was about half of all damage caused by the storm. The landslides caused by the storm also caused tens of millions of dollars of damage to road infrastructure.

10.2.5 Warning Time

Mass movements can occur suddenly or slowly. The velocity of movement may range from a slow creep of inches per year to many feet per second, depending on slope angle, material and water content. Some methods used to monitor mass movements can provide an idea of the type of movement and the amount of time prior to failure. It is also possible to determine what areas are at risk during general time periods. Assessing the geology, vegetation and amount of predicted precipitation for an area can help in these predictions. However, there is no practical warning system for individual landslides. The current standard operating procedure is to monitor situations on a case-by-case basis, and respond after the event has occurred.

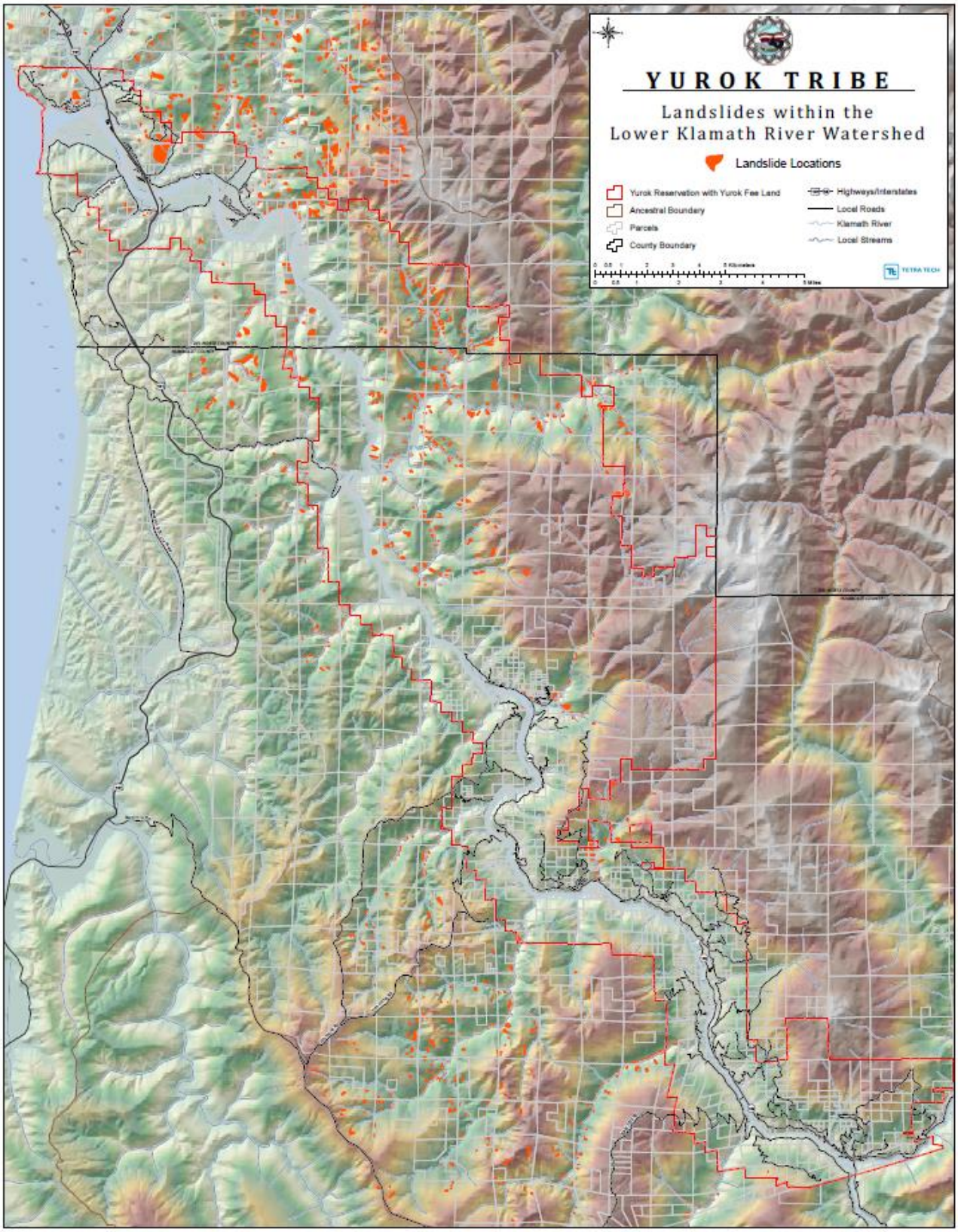

Figure 10-5. Landslide Hazard Areas in the Lower Klamath Watershed

Figure 10-6. Tectah Creek Road Washout, Spring 1999

Generally accepted warning signs for landslide activity include:

- Springs, seeps, or saturated ground in areas that have not typically been wet before
- New cracks or unusual bulges in the ground, street pavements or sidewalks
- Soil moving away from foundations
- Ancillary structures such as decks and patios tilting and/or moving relative to the main house
- Tilting or cracking of concrete floors and foundations
- Broken water lines and other underground utilities
- Leaning telephone poles, trees, retaining walls or fences
- Offset fence lines
- Sunken or down-dropped road beds
- Rapid increase in creek water levels, possibly accompanied by increased turbidity (soil content)

- Sudden decrease in creek water levels though rain is still falling or just recently stopped
- Sticking doors and windows, and visible open spaces indicating jambs and frames out of plumb
- A faint rumbling sound that increases in volume as the landslide nears
- Unusual sounds, such as trees cracking or boulders knocking together.

10.3 SECONDARY HAZARDS

Landslides can cause several types of secondary effects, such as blocking access to roads, which can isolate residents and businesses and delay commercial, public and private transportation. This could result in economic losses for businesses. Other potential problems resulting from landslides are power and communication failures. Vegetation or poles on slopes can be knocked over, resulting in possible losses to power and communication lines. Landslides also have the potential of destabilizing the foundation of structures, which may result in monetary loss for residents. They also can damage rivers or streams, potentially harming water quality, fisheries and spawning habitat.

10.4 CLIMATE CHANGE IMPACTS

Climate change may impact storm patterns, increasing the probability of more frequent, intense storms with varying duration. Increase in global temperature could affect the snowpack and its ability to hold and store water. Warming temperatures also could increase the occurrence and duration of droughts, which would increase the probability of wildfire, reducing the vegetation that helps to support steep slopes. All of these factors would increase the probability for landslide occurrences.

10.5 EXPOSURE

10.5.1 Population

Population could not be examined by landslide hazard area in the customary manner of using census block information because accurate census block information does not exist for the Reservation. The most significant factor for the reservation population is the potential landslide area cutting off ingress and egress, which has the potential to impact a large percentage of tribal members, as well as any outsiders who may be trapped on the reservation should a landslide occur.

10.5.2 Property

Currently, 21 structures on the Reservation are in a landslide prone area. Over 90 percent of the exposed structures are residential. There are a number of cultural resources that could be impacted by landslides. Those resources have been discussed during steering/planning team meetings, and strategies to address them will be developed separately from this document due to the sensitive nature of the cultural resources. The predominant land use on the reservation is single-family residences, which many times support multiple families. Table 10-3 shows the number and assessed value of structures exposed to the landslide risk.

10.5.3 Critical Facilities and Infrastructure

Table 10-4 summarizes the critical facilities exposed to the landslide hazard. No loss estimation of these facilities was performed due to the lack of established damage functions for the landslide hazard.

TABLE 10-3. EXPOSURE AND VALUE OF STRUCTURES IN LANDSLIDE RISK AREAS	
Number of Buildings Exposed	21
Value Exposed	
Structure	$3,911,991
Contents	$2,133,496
Total	**$6,045,487**
Exposed Value as % of Total Assessed Value	2.1%

TABLE 10-4. STRUCTURES EXPOSED TO LANDSLIDE RISK AREAS	
	Number of Exposed Structures in Risk Area
Government Non-Tribal	1
Non Residential	1
Single Family Residential	19
Total	**21**

A significant amount of infrastructure can be exposed to mass movements:

- **Roads**—Access to major roads is crucial to life-safety after a disaster event and to response and recovery operations. Landslides can block egress and ingress on roads, causing isolation for neighborhoods, traffic problems and delays for public and private transportation. This can result in economic losses for businesses.
- **Bridges**—Landslides can significantly impact road bridges. Mass movements can knock out bridge abutments or significantly weaken the soil supporting them, making them hazardous for use.
- **Power Lines**—Power lines are generally elevated above steep slopes; but the towers supporting them can be subject to landslides. A landslide could trigger failure of the soil underneath a tower, causing it to collapse and ripping down the lines. Power and communication failures due to landslides can create problems for vulnerable populations and businesses.
- **Water Systems—**Surface Water systems, intake systems, and above ground water lines and tanks are also at risk from landslides. Given the Tribe's limited infrastructure in place, coupled with the economic impact repair to damages sustained as a result of a landslide event would create, a significant issue would exist for the entire population living and doing business on the Reservation.

10.5.4 Environment

Environmental problems as a result of mass movements can be numerous. Landslides that fall into streams may significantly impact fish and wildlife habitat, as well as affecting water quality. Hillsides that provide wildlife habitat can be lost for prolong periods of time due to landslides.

10.6 VULNERABILITY

10.6.1 Population

Due to the nature of census block group data, it is difficult to determine demographics of populations vulnerable to mass movements. In general, all of the estimated residential buildings exposed to landslide hazard areas are considered to be vulnerable. Increasing population and the fact that many homes are built on view property atop or below bluffs and on steep slopes subject to mass movement, increases the number of lives endangered by this hazard.

10.6.2 Property

Although complete historical documentation of the landslide threat in the planning area is lacking, the landslides of 1997 and 2006 suggest a significant vulnerability to such hazards. The millions of dollars in damage attributable to mass movement during those storms affected private property and public infrastructure and facilities.

Loss estimations for the landslide hazard are not based on modeling utilizing damage functions, because no such damage functions have been generated. Instead, loss estimates were developed representing 10 percent, 30 percent and 50 percent of the assessed value of exposed structures. This allows emergency managers to select a range of economic impact based on an estimate of the percent of damage to the general building stock. Damage in excess of 50 percent is considered to be substantial by most building codes and typically requires total reconstruction of the structure. Table 10-5 shows the general building stock loss estimates in landslide risk areas.

TABLE 10-5.
LOSS ESTIMATES FOR LANDSLIDE

Exposed Value	$179,027,119
Estimated Loss Potential from Landslide	
10% Damage	$17,902,712
30% Damage	$53,708,136
50% Damage	$89,513,560

10.6.3 Critical Facilities and Infrastructure

There are 21 facilities exposed to the landslide hazard to some degree. A more in-depth analysis of the mitigation measures taken by these facilities to prevent damage from mass movements should be done to determine if they could withstand impacts of a mass movement.

Several types of infrastructure are exposed to mass movements, including transportation, water and sewer and power infrastructure. Highly susceptible areas of the planning area include mountain and coastal roads and transportation infrastructure. At this time, all infrastructure and transportation corridors identified as exposed to the landslide hazard are considered vulnerable until more information becomes available.

Roads critical to the Reservation which provide escape routes during hazard incidents include: US Highway 169 (running east to west, and is the only route in and out of the upper Reservation), Highway 101 (running north/south on the coastal area of the Reservation), Tulley Creek Road, Upper Cappell

Road, Lower Cappell Road, Bald Hills Road and Requa Road. As indicated, the transportation system on the Reservation is among the worst in the nation, and most of these roadways are susceptible to landslide hazards.

10.6.4 Environment

The environment vulnerable to landslide hazard is the same as the environment exposed to the hazard.

10.7 FUTURE TRENDS IN DEVELOPMENT

While experiencing low-to-minimal growth over the past 10 years, it is hoped that with new programs in place, such as the Scenic Byways Program, as well as development of new business opportunities being created with the development of the Tribe's Casino, that the population will again begin to climb more steadily. The Yurok Tribe is optimistic that marginal, sustained growth will return to the planning area as the state and national economies strengthen, and as the tribe is able to re-acquire additional land mass, allowing for the expansion of the Tribe.

The Yurok Tribe is equipped to handle future growth within landslide hazard areas. Its general plan addresses landslide risk areas in the safety elements. The Yurok Tribe has committed to linking its general plan to this hazard mitigation plan. This will create an opportunity for wise land use decisions as future growth impacts landslide hazard areas.

Additionally, the State of California has adopted the International Building Code (IBC) by reference in its California Building Standards Code. The IBC includes provisions for geotechnical analyses in steep slope areas that have soil types considered susceptible to landslide hazards. These provisions assure that new construction is built to standards that reduce the vulnerability to landslide risk. While the Tribe is not bound to adhere to California State Building Codes, the Tribe does build to IBC standards and codes on construction projects occurring on the Reservation in an effort to maintain the safety of all Tribal members and visitors to the Reservation.

10.8 SCENARIO

Major landslides in the planning area occur as a result of soil conditions that have been affected by severe storms, groundwater or human development. The worst-case scenario for landslide hazards in the planning area would generally correspond to a severe storm that had heavy rain and caused flooding. Landslides are most likely during late winter when the water table is high. After heavy rains from November to March, soils become saturated with water. As water seeps downward through upper soils that may consist of permeable sands and gravels and accumulates on impermeable silt, it will cause weakness and destabilization in the slope. A short intense storm could cause saturated soil to move, resulting in landslides. As rains continue, the groundwater table rises, adding to the weakening of the slope. Gravity, poor drainage, a rising groundwater table and poor soil exacerbate hazardous conditions.

Mass movements are becoming more of a concern as development moves outside of urban centers and into areas less developed in terms of infrastructure. As is the case on the Reservation, while most mass movements would be isolated events affecting specific areas, the impact of those mass movements have the potential to restrict ingress and egress to entire areas within the planning area. It is probable that private and public property, including infrastructure, will be affected. Mass movements could affect bridges that pass over landslide prone ravines and knock out rail service through the planning area. Road obstructions caused by mass movements would create isolation problems for residents and businesses in sparsely developed areas. Property owners exposed to steep slopes may suffer damage to property or structures. Landslides carrying vegetation such as shrubs and trees may cause a break in utility lines, cutting off power and communication access to residents. As utility lines, power and communication

systems are very limited, with as much as 80 percent of the reservation presently without power, this would be a devastating incident, and make impact not only the Tribe's ability to grow in the future, but also impact their ability to return to the levels before such an incident occurred.

Continued heavy rains and flooding will complicate the problem further. As emergency response resources are applied to problems with flooding, it is possible they will be unavailable to assist with landslides occurring all over the planning area.

10.9 ISSUES

Important issues associated with landslides in the planning area include the following:

- There are existing homes in landslide risk areas throughout the planning area. The degree of vulnerability of these structures depends on the codes and standards the structures were constructed to. Information to this level of detail is not currently available for all structures.
- Future development could lead to more homes in landslide risk areas.
- Mapping and assessment of landslide hazards are constantly evolving. As new data and science become available, assessments of landslide risk should be reevaluated.
- The impact of climate change on landslides is uncertain. If climate change impacts atmospheric conditions, then exposure to landslide risks is likely to increase.
- Landslides may cause negative environmental consequences, including water quality degradation, impact fish spawning, and destroy culturally sensitive areas.
- The risk associated with the landslide hazard overlaps the risk associated with other hazards such as earthquake, flood and wildfire. This provides an opportunity to seek mitigation alternatives with multiple objectives that can reduce risk for multiple hazards.

CHAPTER 11.
SEVERE WEATHER

11.1 GENERAL BACKGROUND

Severe weather refers to any dangerous meteorological phenomena with the potential to cause damage, serious social disruption, or loss of human life. It includes thunderstorms, downbursts, tornadoes, waterspouts, snowstorms, ice storms, and dust storms. Severe weather can be categorized into two groups: those that form over wide geographic areas are classified as general severe weather; those with a more limited geographic area are classified as localized severe weather. Severe weather, technically, is not the same as extreme weather, which refers to unusual weather events are at the extremes of the historical distribution for a given area.

11.2 HAZARD PROFILE

11.2.1 Overview

The Yurok Reservation experiences a predominantly marine climate on the coast; the inland climate possesses both continental and marine characteristics. On the coast, summers are cool and relatively dry; winters are mild, wet and cloudy. Two factors affect the climate:

- **Mountain ranges**—The coastal mountains affect rainfall. The first major release of rain occurs along the coast, and the second is along the west slopes of the Klamath Mountains.
- **Location and intensity of semi-permanent high- and low-pressure areas over the North Pacific Ocean**—During summer and fall, circulation of air around a high-pressure area over the North Pacific brings a prevailing westerly and northwesterly flow of comparatively dry, cool and stable air into the area. As the air moves inland, it becomes warmer and drier, resulting in a dry season. In the winter and spring, the high pressure resides further south while low pressure prevails in the Northeast Pacific. Circulation of air around both pressure centers brings a prevailing southwesterly and westerly flow of mild, moist air into the planning area. Condensation occurs as the air moves inland and rises along the windward mountain slopes. This results in a wet season beginning in late October or November, reaching a peak in winter, and decreasing by late spring.

DEFINITIONS

Freezing Rain—The result of rain occurring when the temperature is below the freezing point. The rain freezes on impact, resulting in a layer of glaze ice up to an inch thick. In a severe ice storm, an evergreen tree 60 feet high and 30 feet wide can be burdened with up to six tons of ice, creating a threat to power and telephone lines and transportation routes.

Severe Local Storm—"Microscale" atmospheric systems, including tornadoes, thunderstorms, windstorms, ice storms and snowstorms. These storms may cause a great deal of destruction and even death, but their impact is generally confined to a small area. Typical impacts are on transportation infrastructure and utilities.

Thunderstorm—A storm featuring heavy rains, strong winds, thunder and lightning, typically about 15 miles in diameter and lasting about 30 minutes. Hail and tornadoes are dangers associated with thunderstorms. Lightning is a threat to human life. Heavy rains over a small area in a short time can lead to flash flooding.

Tornado—Funnel clouds that generate winds up to 500 miles per hour. They can affect an area up to three-quarters of a mile wide, with a path of varying length. Tornadoes can come from lines of cumulonimbus clouds or from a single storm cloud. They are measured using the Fujita Scale, ranging from F0 to F5.

Windstorm—A storm featuring violent winds. Southwesterly winds are associated with strong storms moving onto the coast from the Pacific Ocean. Southern winds parallel to the coastal mountains are the strongest and most destructive winds. Windstorms tend to damage ridgelines that face into the winds.

Winter Storm—A storm with significant snowfall, ice, or freezing rain; the quantity of precipitation varies by elevation.

Precipitation

Measurable rainfall occurs on 118 days each year at the coast and on 190 days in the mountains. Thunderstorms occur up to 10 days each year over the lower elevations and up to 15 days in the mountains. Damaging hailstorms rarely occur. During July, August, and September, the driest months, two to four weeks can pass with only a few showers; however, in December and January, the wettest months, precipitation is frequently recorded on 20 to 25 days or more each month. Snowfall is light in the lower elevations and heavier in the mountains. During the wet season, rainfall is usually of light to moderate intensity and continuous over a long period rather than occurring in heavy downpours for brief periods; heavier intensities occur along the windward slopes of the mountains.

Temperature

Temperatures along the coastal ranges of the Reservation are mild, seldom rising above 76ºF. The average warmest month is September. The highest recorded temperature in Klamath was 99°F in 1964. Further inland, temperatures rise and are often very high from June through September when they can reach into the high 90s and low 100s. Temperatures have risen as high as 108ºF. Citizens in upriver communities are at even greater risk because they lack grid electricity, limiting their ability to have air conditioning.

On average, the coolest month is January. The lowest recorded temperature in Klamath was 17°F in 1972. Snow in the higher elevations of the Reservation is common during most winters. Bald Hills Road, the only direct connection between the upper and lower Reservation, is often closed during the winter due to snowstorms. In the higher elevations, US 101 and 299 are often difficult to travel during winter snowstorms. This makes it more difficult for residents to obtain vital goods and services and medical care.

Wind

The coastal range of the Reservation is subject to high winds that form off the Pacific Ocean. Winds can reach 80 miles per hour, knocking out power and falling trees. During the winter of 2005/2006, windstorms caused power failures and falling trees on numerous occasions.

The strongest winds are generally from the south or southwest and occur during the winter and spring. In interior valleys, wind velocities reach 40 to 50 mph each winter, and 75 to 90 mph a few times every 50 years. The highest summer and lowest winter temperatures generally occur during periods of easterly winds. During most of the year, the prevailing wind is from the southwest or west. The frequency of northeasterly winds is greatest in the fall and winter. Wind velocities ranging from five to 10 knots can be expected 60 to 80 percent of the time; 10 to 15 knots, 30 to 45 percent of the time; and 20 knots or higher, two to 15 percent of the time. The highest wind velocities are from the southwest or west and are frequently associated with rapidly moving weather systems. Extreme wind velocities on the coast can be expected to reach 50 mph at least once in two years; 60 to 70 mph once in 50 years; and 80 mph once in 100 years. The highest wind gust recorded in Eureka was 69 mph on January 31, 1981.

Tornadoes

There have been six reported tornadoes in the Del Norte County since 1958, and one in Humboldt County, as designated in Table 11-1. Most of these tornadoes occurred at least 20 miles to the north or south of the Reservation and resulted in only minimal damage. The magnitude of tornadoes in the local area has been between a Gale Tornadoes (F0) and a Moderate Tornadoes (F1). A Gale Tornadoes, with winds of 40-72 mph, causes light damage with possible damage to chimneys; breaks twigs and branches off tress; pushes over shallow-rooted trees; damages signboards; some windows broken; and hurricane winds. Moderate tornadoes have hurricane wind speeds of 73-112 M.P.H. and can peel surfaces off roofs; push mobile homes off their foundations, overturn and demolish outbuildings, push autos off the roads; and snap off trees and branches.

TABLE 11-1.
PAST TORNADO EVENTS IMPACTING PLANNING AREA

County	Date	Time	Length	Width	Magnitude	Damages
Del Norte	01/10/1958	0445	1 mile	60 yards	F0	$0.0
Del Norte	05/13/1960	1500	0 miles	Unknown	F0	$0.0
Del Norte	12/11/1992	1315	0 miles	23 yards	F1	$3,000
Del Norte	12/30/1992	0330	0 miles	23 yards	F1	$25,000
Del Norte	01/20/1996	1130	0 miles	30 yards	F0	$2,000
Del Norte	01/20/1996	1200	0 miles	20 yards	F0	$1,000
Humboldt	03/29/1958	1340	Unknown	Unknown	F2	$3,000

Source: National Weather Service Tornado Project

11.2.2 Past Severe Weather Events

Table 11-2 summarizes severe weather events in the planning area since 1990, as recorded by the National Oceanic and Atmospheric Administration (NOAA). Some extreme events are described in the sections below.

Severe Winter Storms

January 27, 1998 – February 28, 1998

A series of severe "El Nino" winter storms caused damage throughout the Reservation. Humboldt County received both a Governor's Proclamation and a Presidential Declaration.

Winter of 2003-2004

During the winter of 2003-2004, Humboldt County received 30.9 inches of snow. More than 13 inches of snow fell from February 1 – 6. A little over 12 inches of snow fell in December, and about 6 inches fell in January. Some residents who were not accustomed to high levels of snow were trapped in remote areas of the Reservation. One death occurred from exposure when a non-resident tried to walk from his trapped vehicle along a snow-covered rural road.

December 17, 2005 – January 3, 2006

A brief storm period in early December and a much more prolonged wet and stormy period from December 17, 2005 through January 2, 2006 brought extreme rainfall to northern California. Initially, generally dry antecedent soil moisture conditions and the spacing between storms of mid to late December allowed the Klamath River to rise and fall with only minor consequences. However, river flows rose higher with each passing storm. A large storm on December 28 and an even wetter New Year's Eve storm caused the Klamath River to rise well above flood stage. During the 48-hour period ending on New Year's Day, rain amounts generally ranged from 3 to 6 inches. For the 10-day period ending January 3, 2006, amounts generally ranged from 6 to 12 inches. The heavy rains posed a major problem for area transportation, with several road closures due to rock and mudslides.

TABLE 11-2.
PAST SEVERE WEATHER EVENTS IMPACTING PLANNING AREA

Date	Type	Deaths or Injuries	Property Damage
12/20/1990	Winter Storm	1	86,206.9
Description: Occurred in Humboldt County Portion of Reservation			
2/14/1992	Winter Storm, Flooding	0	9,090.91
Description: Occurred in Humboldt County Portion of Reservation			
12/31/1992	Winter Storm	0	27,777.78
Description: Occurred in Humboldt County Portion of Reservation			
12/11/1993	Winter Storm	0	3,448.28
Description: Occurred in Humboldt County Portion of Reservation			
1/06/1993	Winter Storm	0	111,111
Description: Occurred in Humboldt County Portion of Reservation			
1/08/1993	Winter Storm	0	8,333
Description: Occurred in Humboldt County Portion of Reservation			
1/13/1993	Winter Storm	1	357,143
Description: Occurred in Humboldt County Portion of Reservation			
1/15/1993	Winter Storm	0	100,000
Description: Occurred in Humboldt County Portion of Reservation			
1/19/1993	Winter Storm	1	31,250
Description: Occurred in Humboldt County Portion of Reservation			
3/1/1995	Severe Storm/Thunder Storm, Wind, Flooding	0	11,241,379.31 (Agricultural)
Description: Occurred in Del Norte County Portion of Reservation			
3/9/1995	Severe Storm/Thunder Storm, Wind, Flooding	0	1,000,000.00
Description: Occurred in Del Norte County Portion of Reservation			
12/8/1995	Wind, Winter Weather	2	6,000,000 500,000 (Crop Damage)
Description: Occurred in both Del Norte & Humboldt Counties			
12/11/1995	Wind	0	2,400,000
Description: Occurred in both Del Norte & Humboldt Counties			
8/13/1992	Excessive Heat	1	Unknown
Description: Occurred in both Del Norte & Humboldt Counties			

11.2.3 Location

Severe weather events have the potential to happen anywhere in the planning area. Communities in low-lying areas next to streams or lakes are more susceptible to flooding. Wind events are most damaging to areas that are heavily wooded. The distribution of average weather conditions over the planning area is shown on Figure 11-1 through Figure 11-4.

11.2.4 Frequency

The planning area can expect to experience exposure to some type of severe weather event at least annually.

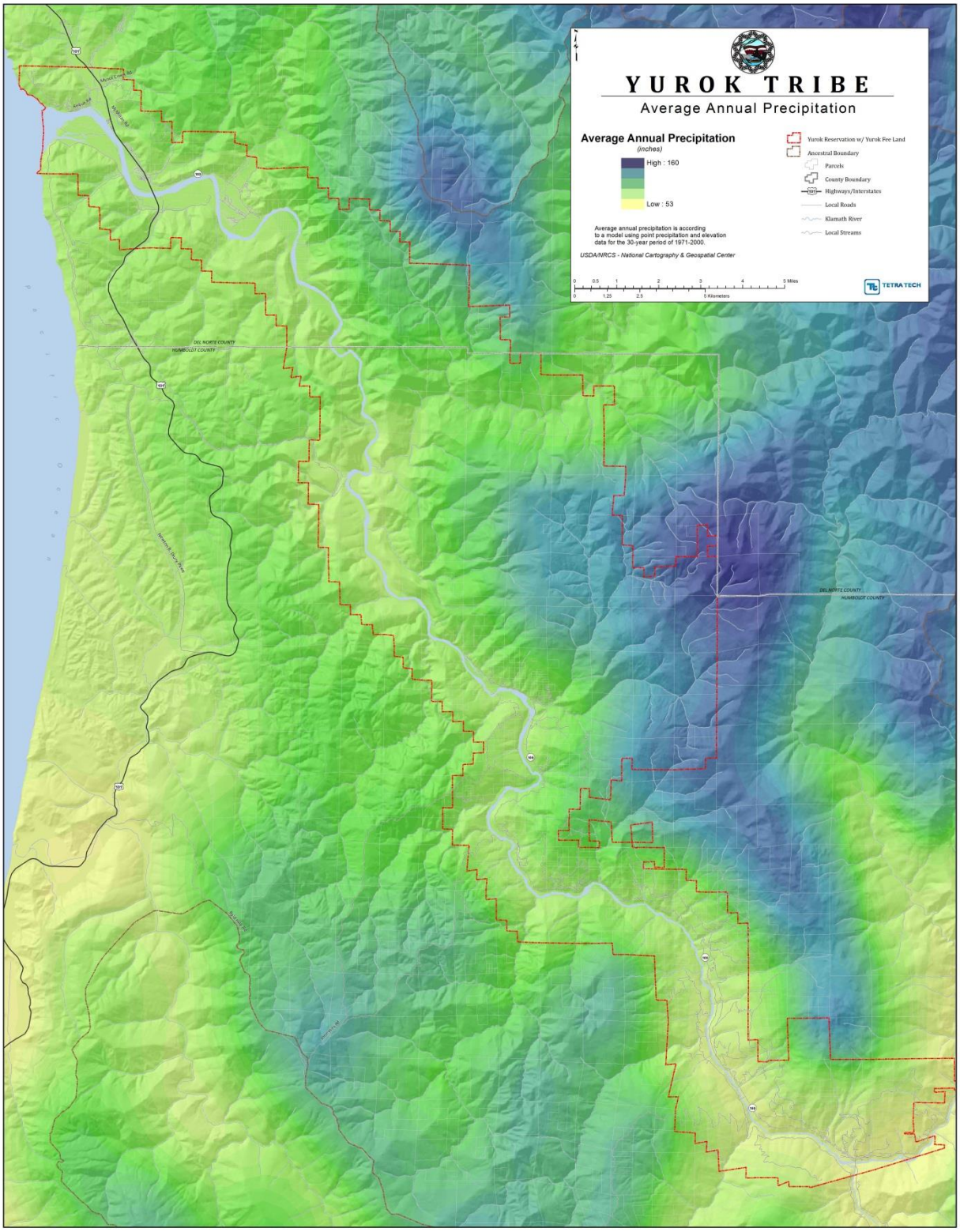

Figure 11-1. Yurok Reservation Average Annual Precipitation

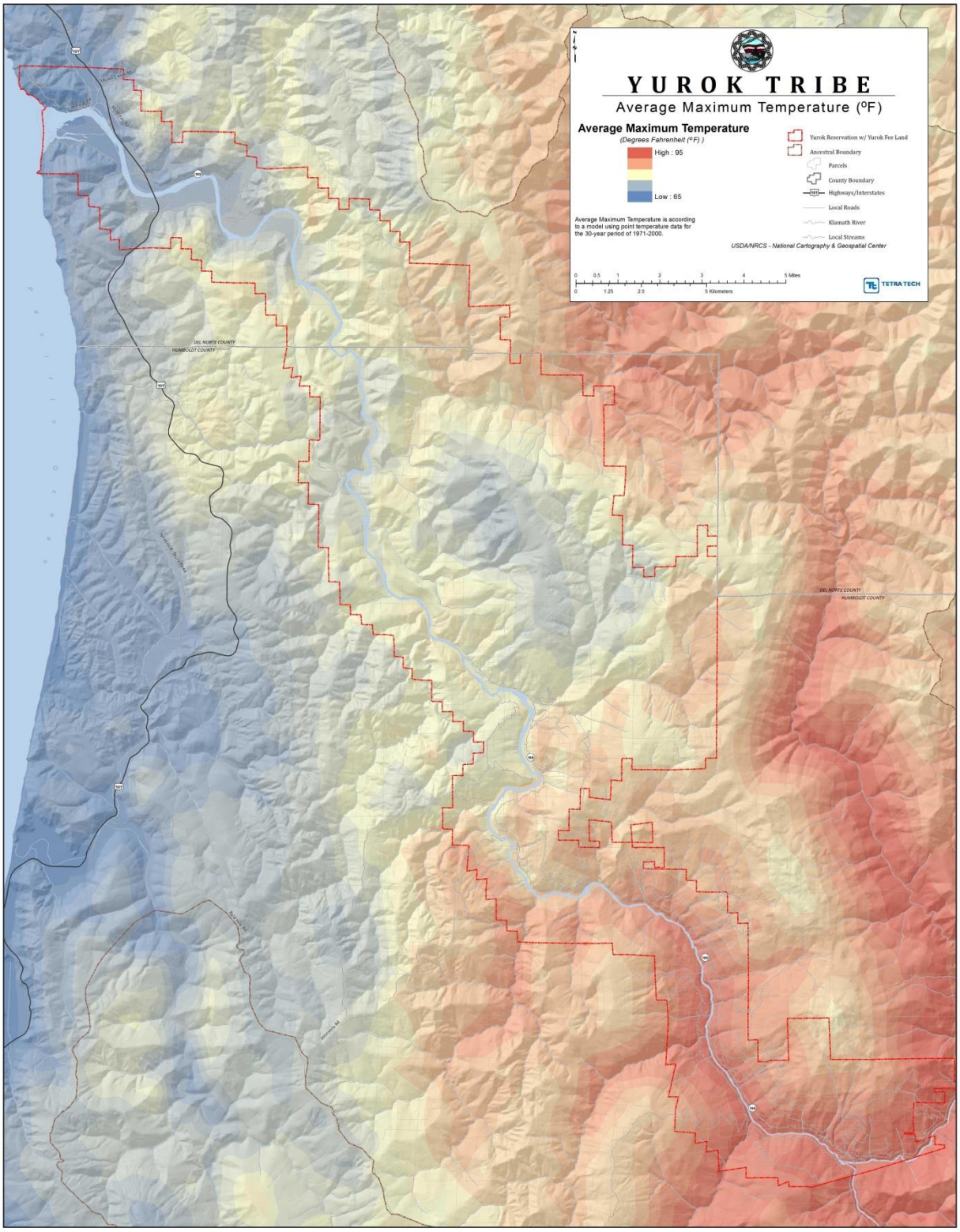

Figure 11-2. Yurok Reservation Average Maximum Temperature

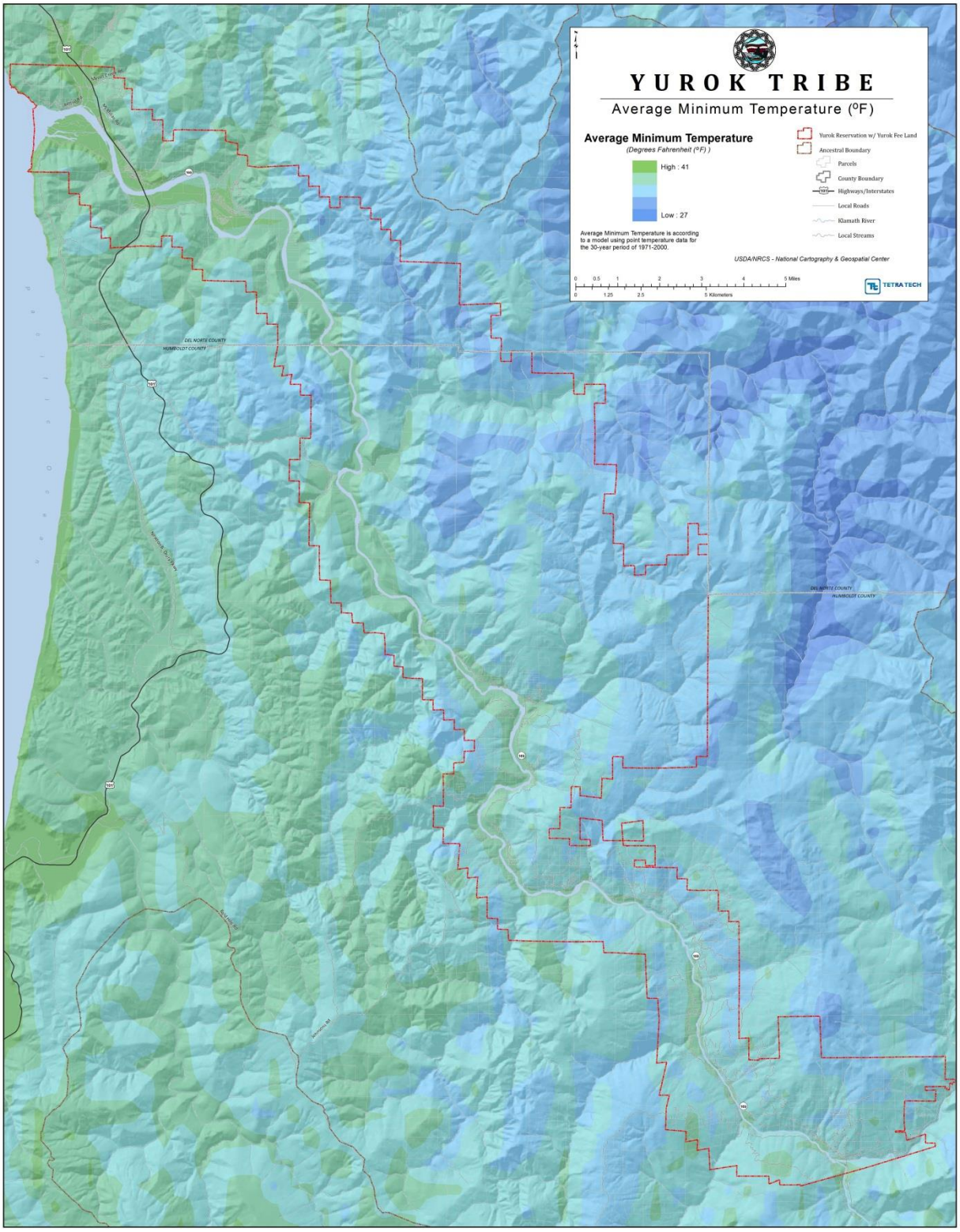

Figure 11-3. Yurok Reservation Average Minimum Temperature

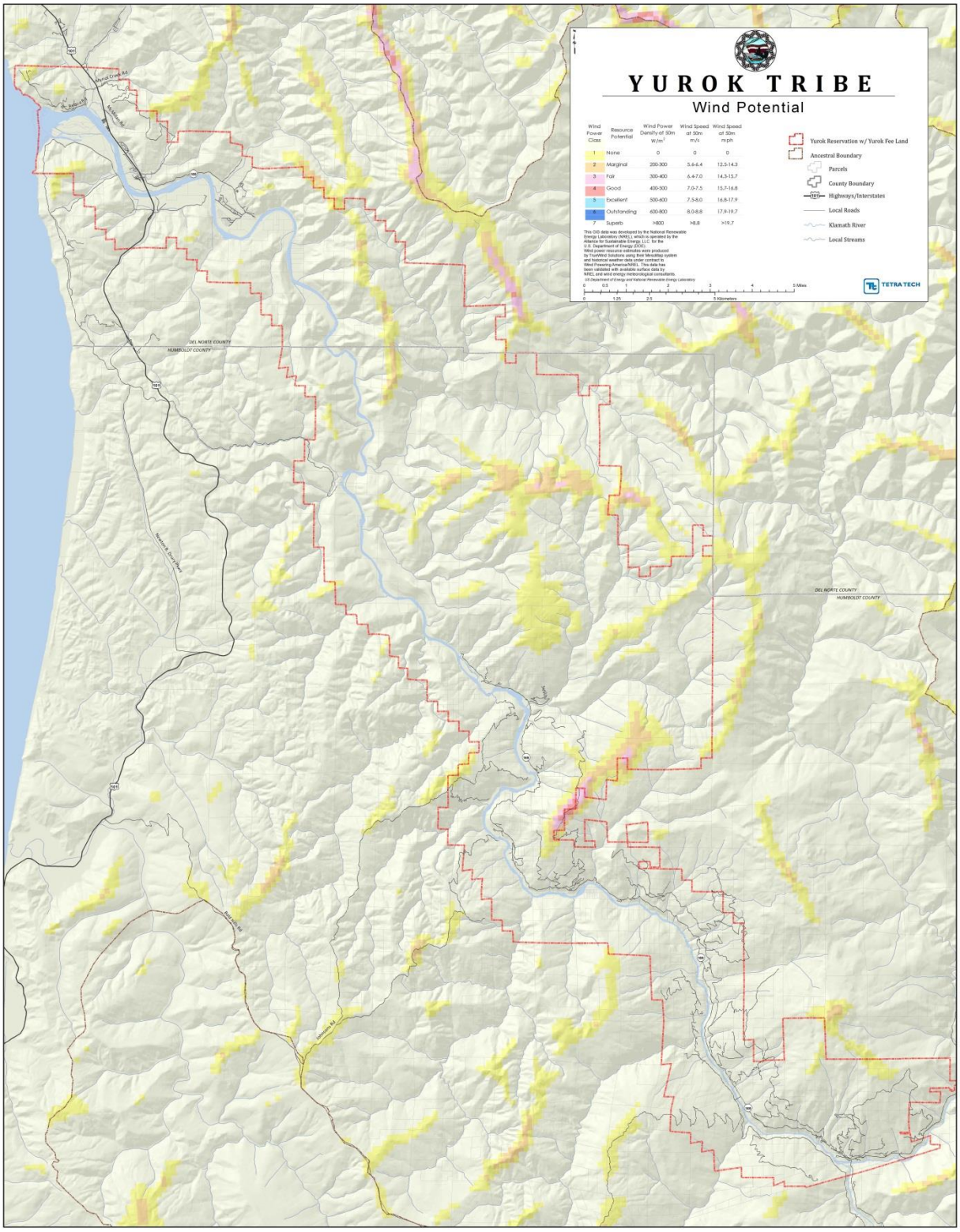

Figure 11-4. Yurok Reservation Wind Potential

11.2.5 Severity

The most common problems associated with severe storms are immobility and loss of utilities. Fatalities are uncommon, but can occur. Roads may become impassable due to flooding, downed trees, ice or snow, or a landslide. Power lines may be downed due to high winds or ice accumulation, and services such as water or phone may not be able to operate without power. Lightning can cause severe damage and injury.

Windstorms can be a frequent problem in the planning area and have been known to cause damage to utilities. The predicted wind speed given in wind warnings issued by the National Weather Service is for a one-minute average; gusts may be 25 to 30 percent higher.

Tornadoes are potentially the most dangerous of local storms, but they are not common in the planning area. If a major tornado were to strike within the populated areas of the planning area, damage could be widespread. Businesses could be forced to close for an extended period or permanently, fatalities could be high, many people could be homeless for an extended period, and routine services such as telephone or power could be disrupted. Buildings may be damaged or destroyed. California ranks 32nd among states for frequency of tornadoes, 44th for the frequency of tornados per square mile, 36th for injuries, and 31st for cost of damage. The state has no reported deaths from tornadoes.

Extreme heat kills by pushing the human body beyond its limits. In extreme heat and high humidity, evaporation is slowed and the body must work extra hard to maintain a normal temperature. Older adults, young children, and those who are sick or overweight are more likely to succumb to extreme heat. Periods of extreme heat can also be lethal to salmonids in the Klamath River and its tributaries. Temperatures capable of killing salmonids could easily be reached during an extreme heat episode. Periods of extreme heat also foster disease and parasites among salmonids (especially as they crowd together in coldwater refugia) and promote the development of toxic algae and other offensive species within the river system.

11.2.6 Warning Time

Meteorologists can often predict the likelihood of a severe storm. This can give several days of warning time. However, meteorologists cannot predict the exact time of onset or severity of the storm. Some storms may come on more quickly and have only a few hours of warning time.

11.3 SECONDARY HAZARDS

The most significant secondary hazards associated with severe local storms are floods, falling and downed trees, landslides and downed power lines. Rapidly melting snow combined with heavy rain can overwhelm both natural and man-made drainage systems, causing overflow and property destruction. Landslides occur when the soil on slopes becomes oversaturated and fails.

11.4 CLIMATE CHANGE IMPACTS

Climate change presents a significant challenge for risk management associated with severe weather. The frequency of severe weather events has increased steadily over the last century. The number of weather-related disasters during the 1990s was four times that of the 1950s, and cost 14 times as much in economic losses. Historical data shows that the probability for severe weather events increases in a warmer climate (see Figure 11-5). The changing hydrograph caused by climate change could have a significant impact on the intensity, duration and frequency of storm events. All of these impacts could have significant economic consequences.

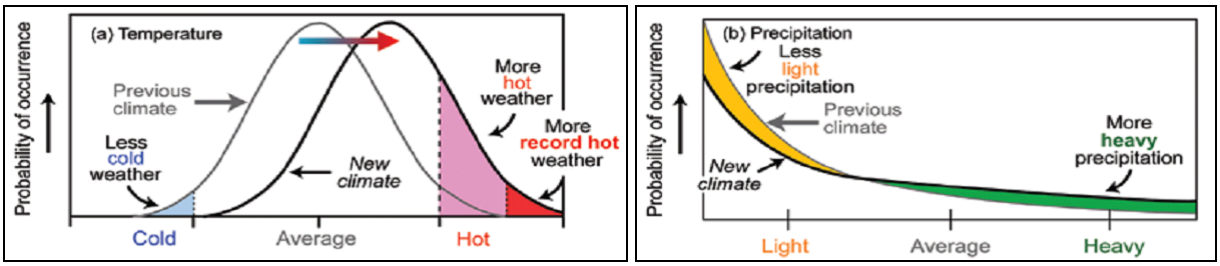

Figure 11-5. Severe Weather Probabilities in Warmer Climates

11.5 EXPOSURE

11.5.1 Population

A lack of data separating severe weather damage from flooding and landslide damage prevented a detailed analysis for exposure and vulnerability. However, it can be assumed that the entire planning area is exposed to some extent to severe weather events. Certain areas are more exposed due to geographic location and local weather patterns. Populations living at higher elevations with large stands of trees or power lines may be more susceptible to wind damage and black out, while populations in low-lying areas are at risk for possible flooding.

11.5.2 Property

Currently there are approximately 892 structures within the planning area, both commercial and residential. The majority of these structures are residential in nature, but all are exposed to the severe weather hazard. The frequency and degree of damage will depend on specific locations. It should be noted that due to the remoteness of the Tribe, and the fact land ownership includes Tribal and non-tribal members, including private and commercial, this number represents all structures, no matter of ownership. The Steering Committee felt that many of the non-Native residents in the area rely on the Tribe to provide emergency services, and therefore should be considered within this planning document. Further, all tribal structures, whether residences or commercial, are included within this analysis, which includes areas falling within the ancestral boundary, but outside of what is the current federally recognized boundary of the Tribe.

11.5.3 Critical Facilities and Infrastructure

All critical facilities exposed to flooding (Chapter 9) are also likely exposed to severe weather. Additional facilities on higher ground may also be exposed to wind damage or damage from falling trees. The most common problems associated with severe weather are loss of utilities. Downed power lines can cause blackouts, leaving large areas isolated. Phone, water and sewer systems may not function. Roads may become impassable due to ice or snow or from secondary hazards such as landslides.

11.5.4 Environment

The environment is highly exposed to severe weather events. Natural habitats such as streams and trees are exposed to the elements during a severe storm and risk major damage and destruction. Prolonged rains can saturate soils and lead to slope failure. Flooding events caused by severe weather or snowmelt can produce river channel migration or damage riparian habitat. Storm surges can erode beachfront bluffs and redistribute sediment loads.

11.6 VULNERABILITY

11.6.1 Population

Vulnerable populations are the elderly, low income or linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. Power outages can be life threatening to those dependent on electricity for life support. Isolation of these populations is a significant concern. These populations face isolation and exposure during severe weather events and could suffer more secondary effects of the hazard.

11.6.2 Property

All property is vulnerable during severe weather events, but properties in poor condition or in particularly vulnerable locations may risk the most damage. It is estimated that the majority of residential structures were built without the influence of a structure building code with provisions for wind loads. Those in higher elevations and on ridges may be more prone to wind damage. Those that are located under or near overhead lines or near large trees may be vulnerable to falling ice or may be damaged in the event of a collapse.

Loss estimations for the severe weather hazard are not based on damage functions, because no such damage functions have been generated. Instead, loss estimates were developed representing 10 percent, 30 percent and 50 percent of the assessed value of exposed structures. This allows emergency managers to select a range of potential economic impact based on an estimate of the percent of damage to the general building stock. Damage in excess of 50 percent is considered to be substantial by most building codes and typically requires total reconstruction of the structure. Table 11-3 lists the loss estimates.

TABLE 11-3.
LOSS ESTIMATES FOR SEVERE WEATHER

Exposed Value	$288,582,522
Estimated Loss Potential from Severe Weather	
10% Damage	$28,858,252
30% Damage	$86,574,756
50% Damage	$144,291,261

11.6.3 Critical Facilities and Infrastructure

Incapacity and loss of roads are the primary transportation failures resulting from severe weather, mostly associated with secondary hazards. Landslides caused by heavy prolonged rains can block roads. High winds can cause significant damage to trees and power lines, blocking roads with debris, incapacitating transportation, isolating population, and disrupting ingress and egress. Snowstorms in higher elevations can significantly impact the transportation system and the availability of public safety services. Of particular concern are roads providing access to isolated areas and to the elderly.

Prolonged obstruction of major routes due to landslides, snow, debris or floodwaters can disrupt the shipment of goods and other commerce. Large, prolonged storms can have negative economic impacts for an entire region.

Severe windstorms, downed trees, and ice can create serious impacts on power and above-ground communication lines. Freezing of power and communication lines can cause them to break, disrupting electricity and communication. Loss of electricity and phone connection would leave certain populations isolated because residents would be unable to call for assistance.

11.6.4 Environment

The vulnerability of the environment to severe weather is the same as the exposure.

11.7 FUTURE TRENDS IN DEVELOPMENT

All future development will be affected by severe storms. The ability to withstand impacts lies in sound land use practices and consistent enforcement of codes and regulations for new construction. The Yurok Tribe has adopted the International Building Code in response to federal mandates for funding purposes. This code is equipped to deal with the impacts of severe weather events. The Tribe is currently in the process of developing land use policies, and once completed, those plans will also address many of the secondary impacts (flood and landslide) of the severe weather hazard. With these tools, the Yurok Tribe will be well equipped to deal with future growth and the associated impacts of severe weather.

11.8 SCENARIO

Although severe local storms are infrequent, impacts can be significant, particularly when secondary hazards of flood and landslide occur. A worst-case event would involve prolonged high winds during a winter storm accompanied by thunderstorms. Such an event would have both short-term and longer-term effects. Initially, schools and roads would be closed due to power outages caused by high winds and downed tree obstructions. In more rural areas, some subdivisions could experience limited ingress and egress. Prolonged rain could produce flooding, overtopped culverts with ponded water on roads, and landslides on steep slopes. Flooding and landslides could further obstruct roads and bridges, further isolating residents.

11.9 ISSUES

Important issues associated with a severe weather in the planning area include the following:

- Older building stock in the planning area is built to low code standards or none at all. These structures could be highly vulnerable to severe weather events such as windstorms.
- Redundancy of power supply must be evaluated.
- The capacity for backup power generation is limited.
- Isolated population centers.

CHAPTER 12.
TSUNAMI

12.1 GENERAL BACKGROUND

From southern British Columbia to northern California, people and property are at risk both from distantly and locally generated tsunamis.

DEFINITIONS

Tsunami—A series of traveling ocean waves of extremely long wavelength usually caused by displacement of the ocean floor and typically generated by seismic or volcanic activity or by underwater landslides.

12.1.1 Tsunami Wave Formation

A tsunami consists of a series of high-energy waves that radiate outward like pond ripples from an area where a generating event occurs. The waves arrive at shorelines over an extended period. The most common cause of a tsunami is an underwater earthquake, as shown in Figure 12-1

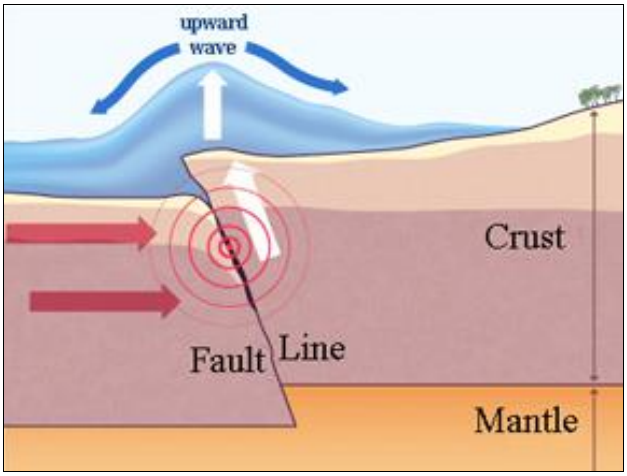

Figure 12-1. Tsunami Wave Formation

12.1.2 Physical Characteristics of Tsunami

All types of waves, including tsunami, have a wavelength, a wave height, an amplitude, a frequency or period, and a velocity, as shown on Figure 12-2 and described below:

- ***Wavelength*** is defined as the distance between two identical points on a wave (i.e. between wave crests or wave troughs). Normal ocean waves have wavelengths of about 100 meters. Tsunami have much longer wavelengths, usually measured in kilometers (up to 500 kilometers).
- ***Wave height*** refers to the distance between the trough of the wave and the crest or peak of the wave.
- ***Wave amplitude***—refers to the height of the wave above the still water line, usually this is equal to 1/2 the wave height. Tsunami can have variable wave height and amplitude that depends on water depth.

Source: Earth Science Available online at: http://earthsci.org/education/teacher/basicgeol/tsumami/tsunami.html

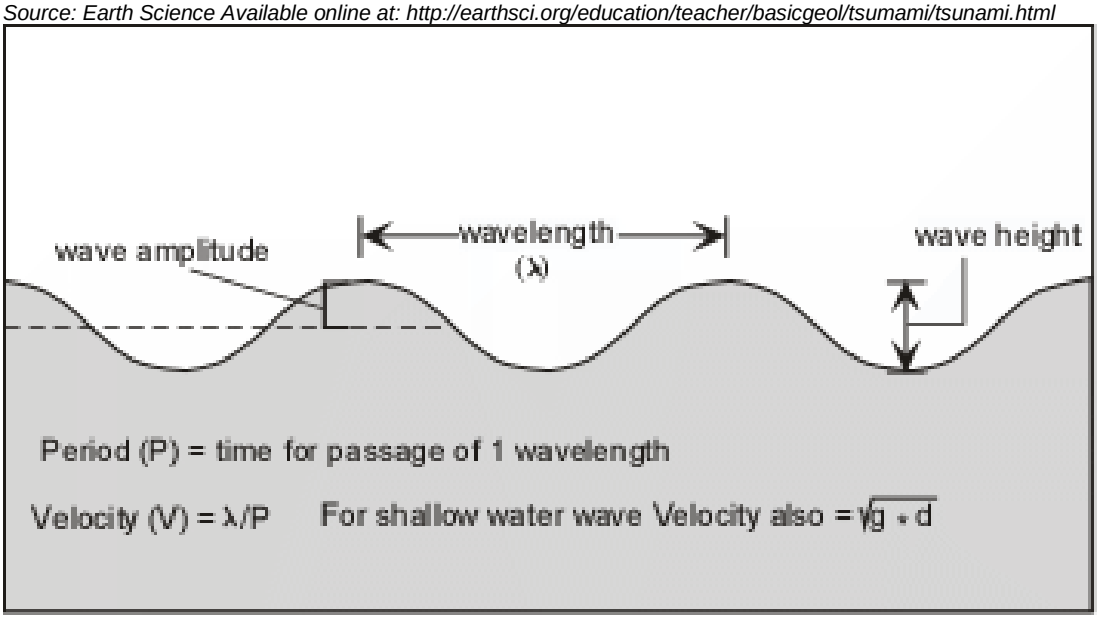

Figure 12-2. Physical Characteristics of Tsunamis

- ***Wave frequency or period***—is the amount of time it takes for one full wavelength to pass a stationary point.
- ***Wave velocity*** is the speed of the wave. Velocities of normal ocean waves are about 90 km/hr while tsunami have velocities up to 950 km/hr (about as fast as jet airplanes), and thus move much more rapidly across ocean basins. The velocity of any wave is equal to the wavelength divided by the wave period.

Tsunami are characterized as shallow-water waves. These are different from the waves most of us have observed on a the beach, which are caused by the wind blowing across the ocean's surface (see Figure 12-3). Wind-generated waves usually have periods (time between two successive waves) of five to twenty seconds and a wavelength of 100 to 200 meters. A tsunami can have a period in the range of ten minutes to two hours and wavelengths greater than 500 km. A wave is characterized as a shallow-water wave when the ratio of the water depth and wavelength is very small.

The rate at which a wave loses its energy is inversely related to its wavelength. Since a tsunami has a very large wavelength, it will lose little energy as it propagates. Thus, in very deep water, a tsunami will travel at high speeds with little loss of energy. For example, when the ocean is 6100 m deep, a tsunami will travel about 890 km/hr, and thus can travel across the Pacific Ocean in less than one day.

As a tsunami leaves the deep water of the open sea and arrives at the shallow waters near the coast, it undergoes a transformation. Since the velocity of the tsunami is also related to the water depth, as the depth of the water decreases, the velocity of the tsunami decreases (Figure 12-4). The change of total energy of the tsunami, however, remains constant.

Furthermore, the period of the wave remains the same, and thus more water is forced between the wave crests causing the height of the wave to increase. Because of this "shoaling" effect, a tsunami that was imperceptible in deep water may grow to have wave heights of several meters or more.

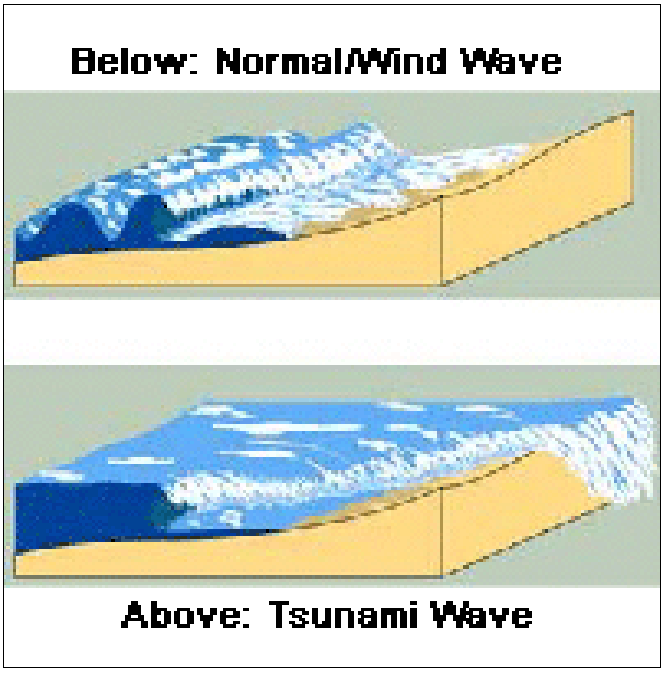

Figure 12-3. Comparison of Tsunami to Normal Waves

Source: Earth Science, Available online at: http://earthsci.org/education/teacher/basicgeol/tsumami/tsunami.html

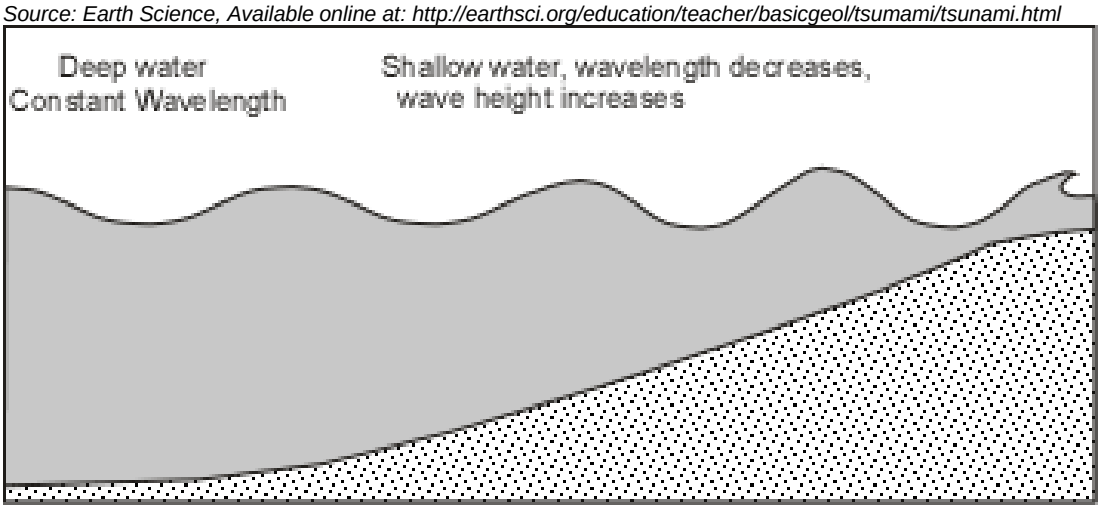

Figure 12-4. Effect of Water Depth on Wave Height

In the open ocean, a tsunami may be only a few inches or feet high, but it can travel with speeds approaching 600 miles per hour. As a tsunami enters the shoaling waters near a coastline, its speed diminishes, its wavelength decreases, and its height increases greatly. The first wave usually is not the largest. Several larger and more destructive waves often follow the first one. As tsunamis reach the shoreline, they may take the form of a fast-rising tide, a cresting wave, or a bore (a large, turbulent wall-like wave). The bore phenomenon resembles a step-like change in the water level that advances rapidly (from 10 to 60 miles per hour).

The configuration of the coastline, the shape of the ocean floor, and the characteristics of advancing waves play important roles in the destructiveness of the waves. Offshore canyons can focus tsunami wave

energy and islands can filter the energy. The orientation of the coastline determines whether the waves strike head-on or are refracted from other parts of the coastline. A wave may be small at one point on a coast and much larger at other points. Bays, sounds, inlets, rivers, streams, offshore canyons, islands, and flood control channels may cause various effects that alter the level of damage. It has been estimated, for example, that a tsunami wave entering a flood control channel could reach a mile or more inland, especially if it enters at high tide.

The first part of a tsunami to reach land is a trough – called a drawdown- rather than a wave crest, the water along the shoreline recedes dramatically, exposing normally submerged areas. Drawdown is followed immediately by the crest of the wave which can catch people observing the drawdown off guard. When the crest of the wave hits, sea level rises (called run-up).

Run-up is usually expressed in meters above normal high tide. Run-ups from the same tsunami can be variable because of the influence of the shapes of coastlines. One coastal area may see no damaging wave activity while in another area destructive waves can be large and violent. The flooding of an area can extend inland by 300 meters or more, covering large areas of land with water and debris. Flooding tsunami waves tend to carry loose objects and people out to sea when they retreat. Tsunami may reach a maximum vertical height onshore above sea level, called a run-up height, of 30 meters. A notable exception is the landslide generated tsunami in Lituya Bay, Alaska in 1958 which produced a 60 meter high wave.

Because the wavelengths and velocities of tsunami are so large, the period of such waves is also large, and larger than normal ocean waves. Thus it may take several hours for successive crests to reach the shore. (For a tsunami with a wavelength of 200 km traveling at 750 km/hr, the wave period is about 16 minutes). Thus people are not safe after the passage of the first large wave, but must wait several hours for all waves to pass. The first wave may not be the largest in the series of waves. For example, in several different recent tsunami the first, third, and fifth waves were the largest.

Rapid drawdown can create strong currents in harbor inlets and channels that can severely damage coastal structures due to erosive scour around piers and pilings. As the water's surface drops, piers can be damaged by boats or ships straining at or breaking their mooring lines. The vessels can overturn or sink due to strong currents, collisions with other objects, or impact with the harbor bottom.

Conversely, the first indication of a tsunami may be a rise in water level. The advancing tsunami may initially resemble a strong surge increasing the sea level like the rising tide, but the tsunami surge rises faster and does not stop at the shoreline. Even if the wave height appears to be small, 3 to 6 feet for example, the strength of the accompanying surge can be deadly. Waist-high surges can cause strong currents that float cars, small structures, and other debris. Boats and debris are often carried inland by the surge and left stranded when the water recedes.

At some locations, the advancing turbulent wave front will be the most destructive part of the wave. In other situations, the greatest damage will be caused by the outflow of water back to the sea between crests, sweeping all before it and undermining roads, buildings, bulkheads, and other structures. This outflow action can carry enormous amounts of highly damaging debris with it, resulting in further destruction. Ships and boats, unless moved away from shore, may be dashed against breakwaters, wharves, and other craft, or be washed ashore and left grounded after the withdrawal of the seawater.

12.2 HAZARD PROFILE

The Cascadia Subduction Zone off the coast of northern California is capable of causing an extreme earthquake that could produce a tsunami along the north coast of California, Oregon and Washington like

that experienced during the 2005 Indonesian Tsunami, and also experienced as a result of the March 2011 earthquake and resulting Tsunami occurring in Japan, which significantly impacted Crest City, CA, an area just north of the planning region.

12.2.1 Past Events

California is at risk from both local and distant tsunamis. Eighty-two possible or confirmed tsunamis in California have been observed or recorded. Table 12-1 summarizes the major events among these that have affected the northern coastal area of the state. Most of these events were small and detected only by tide gages. Twelve events were large enough to cause damage and five events caused deaths. At least four of these events had direct measurable impacts on Del Norte County. Four historical tsunami events caused major damage:

- Yurok oral history, confirmed by current geological evidence, concludes that a tsunami struck the north coast in 1700. The tsunami also struck the coast of Japan. Tribal history tells of a wave that killed many people in Klamath and that traveled up the Klamath River to Weitchpec.
- The 1960 Chilean earthquake produced a great tsunami that impacted the entire Pacific basin. Damage was reported in California ports and harbors from San Diego to Crescent City and losses exceeded $1 million.
- On March 28, 1964, the largest recorded earthquake ever to hit the United States struck Anchorage, Alaska. The earthquake caused tsunami waves along the entire California coastline, including the mouth of the Klamath River and Crescent City about 4 hours after the Alaska earthquake:
  - In Crescent City, the first wave caused flooding. The second and third waves caused no significant damage. The fourth wave was the largest, rising to over 21 feet. It was preceded by a withdrawal of the water that left the Crescent City Harbor dry. At least 11 persons lost their lives in Crescent City.
  - When the wave hit Klamath, two men were fishing for eels around midnight on the north shore, near the mouth of the Klamath River. The men heard a loud sound and then were hit by a twelve-foot high wave that was traveling approximately 50 miles per hour. Both men were caught in a surge of water that pushed them several miles up the Klamath River at a rate of over 30 miles per hour. The movement of the river stopped, then reversed, and began pushing the men out to sea at a rate 35 miles per hour. One man drowned, while the other man narrowly escaped by swimming to a rock, near the Requa Resort boat docks and was rescued by two Yurok men.
- The March 11, 2011 magnitude 9.0 Honshu, Japan earthquake (38.297 N, 142.373 E, depth 29 km) generated a tsunami observed over the Pacific region and caused tremendous local devastation. This is the fourth largest earthquake in the world and the largest in Japan since instrumental recordings began in 1900. This is the deadliest tsunami since the 2004 magnitude 9.1 Sumatra earthquake and tsunami caused nearly 230,000 deaths and $10 billion in damage. This is the most devastating earthquake to occur in Japan since the 1995 Kobe earthquake caused over 5,500 deaths and the deadliest tsunami since the 1993 Hokkaido earthquake generated a tsunami which was responsible for over 200 deaths.
- October 28, 2012. A 7.7 magnitude earthquake off the west coast of Canada near Queen Charlotte Island produced tsunami warnings along the entire western coast; however, no wave increase was reported within the planning area.

TABLE 12-1.
TSUNAMIS THAT HAVE AFFECTED NORTH COAST CALIFORNIA

Date	Origin of Tsunami	Impacted Areas	Run-up (meters)	Observations/comments
3/19/1855	N. California	Humboldt Bay	Observed	Water in the bay agitated for 1 hour
4/6/1943	N. Central Chili	Crescent City	Trace	
4/1/1946	E. Aleutian Islands	Crescent City	1.0	3-foot amplitude and a 12-minute period were recorded for this event.
12/20/1946	Nankaido, Japan	Crescent City	0.2	
3/4/1952	SE Hokkaido, Japan	Crescent City	0.2	
11/4/1952	Kamchatka Peninsula, Russia	Crescent City	1.0	In Crescent City, four boats were overturned and concrete buoys were moved.
3/91957	Central Aleutian Is.	Crescent City	0.7	
5/22/1960	South/Central Chili	Crescent City	1.7	$30,000 in damage. Two ships were destroyed, others were damaged.
10/13/1963	Kuril Islands, Russia	Crescent City	0.5	
3/28/1964	Gulf of Alaska	Crescent City	6.3	Ten people killed, 35 injured, 52 homes and 172 businesses damaged or destroyed. $10 million in damage
		Klamath River		One person killed $4,000 damage to dock and boats at Requa. Damage reported least 2.6 km from mouth of Klamath River. River reversed directions.
		Trinidad		Observed run-up was 5.4 meters above mean lower low water.
2/4/1965	W. Aleutian Islands	Crescent City	0.1	
10/17/1966	Peru	Crescent City	0.1	
5/16/1968	Honshu, Japan	Crescent City	0.6	
7/26/1971	New Ireland	Crescent City	<0.1	
10/3/1974	Peru	Crescent City	<0.1	
5/7/1986	W. Aleutian Islands	Crescent City	0.1	
4/25/1992	Cape Mendocino	Humboldt Bay	0.3 Observed	Waves arrived at Humboldt Bay about 20 minutes after ground shaking.
		Clam Beach	0.6	Water level changed several feet
		Crescent City	0.9	Oscillations in harbor, the fourth wave was the highest recorded.
		Trinidad		Cars were struck on the beach.
9/1/1994	Cape Mendocino	Crescent City	0.14	Recorded on Crescent City tide gauge 45 minutes after earthquake.
11/15/2006	Kuril Islands	Crescent City	1.76	Recorded on Marigram
		Arena Cove	1.18	
		Pt. Reyes	0.62	

TABLE 12-1.
TSUNAMIS THAT HAVE AFFECTED NORTH COAST CALIFORNIA

Date	Origin of Tsunami	Impacted Areas	Run-up (meters)	Observations/comments
01/13/2007	Kuril Islands	Crescent City	0.23	Recorded on Marigram
		Arena Cove	0.25	
		Pt. Reyes	0.12	
08/15/07	Peru	Crescent City	0.16	
02/27/10	Chile	Crescent City	.64	
03/11/2011	Tohoku, Japan	Crescent City	3	
		Klamath River	2.5	One person killed – swept away by wave.

Associated Press

The Klamath River flows into the Pacific Ocean on Sunday, March 13, 2011 at Klamath, Calif. Dustin Weber, 25, was swept out to sea by a tsunami swell on Friday when he hiked down to a small beach on the north side of the river with two friends. Rescuers were unable to reach him and called off their efforts; he is presumed dead, though his body has not been found. Weber would be the first death of a person on the West Coast by a tsunami since 1964, when 11 people in nearby Crescent City died from the surge created by an earthquake in Alaska

VisualLightBox.com

Figure 12-5. March 2011 Tsunami Impact at Klamath River

12.2.2 Location

The earth's crustal plates may pull apart from, slide past, override, or under-ride ("subduct") one another. Plate boundaries coincide with faults that produce earthquakes as the plates move against one another. These earthquakes may produce displacements of the sea floor that can set the overlying column of water in motion, initiating a tsunami, depending on the magnitude of the earthquake and the type of faulting. With the exception of one damaging event, the majority of California's tsunami events were generated by distant sources.

Local tsunamis have the potential to cause locally greater wave heights. The mouth of the Klamath and nearby sections of the river are susceptible to oceanic tsunami surges that will travel down the river channel.

Figure 12-6 shows the estimated extent and location of the maximum tsunami hazard zones for Reservation. The source of this inundation data is based on best available data provided by the California Tsunami Preparedness and Hazard Mitigation Program. Figure 12-7 is the original version of the map.

12.2.3 Frequency

The frequency of tsunamis is related to the frequency of the events that cause them, so it is similar to the frequency of seismic or volcanic activities or landslides. Generally four or five tsunamis occur every year in the Pacific Basin, and those that are most damaging are generated in the Pacific waters off South America rather than in the northern Pacific.

12.2.4 Severity

Tsunamis are a threat to life and property to anyone living near the ocean. According to the Pacific Tsunami Warning Center (2011), major tsunamis occur about once per decade. There is an average of two destructive tsunamis per year in the Pacific basin. Based on historical data, about 59% of the world's tsunamis have occurred in the Pacific Ocean, 25% in the Mediterranean Sea, 12% in the Atlantic Ocean, and 4% in the Indian Ocean. Most of these tsunamis are generated by earthquakes that cause displacement of the seafloor.

Tsunamis have been reported since ancient times. They have been documented extensively, especially in Japan and the Mediterranean areas. The first recorded tsunami occurred off the coast of Syria in 2000 B.C. Since 1900 (the beginning of instrumentally located earthquakes), most tsunamis have been generated in Japan, Peru, Chile, New Guinea and the Solomon Islands. However, the only regions that have generated remote-source tsunamis affecting the entire Pacific Basin are the Kamchatka Peninsula, the Aleutian Islands, the Gulf of Alaska, and the coast of South America. Hawaii, because of its location in the center of the Pacific Basin, has experienced tsunamis generated in all parts of the Pacific.

From 1950 to 2011, over 625 tsunamis were recorded globally (NOAA/NGDC, 2011). Over half of these events caused fatalities. The overwhelming majority of these events occurred in the Pacific basin. Recent tsunamis have struck Nicaragua, Indonesia, and Japan, killing several hundred thousand people. Property damage due to these waves exceeds $300 billion. Historically, tsunamis originating in the northern Pacific and along the west coast of South America have caused more damage on the west coast of the United States than tsunamis originating in Japan and the Southwest Pacific.

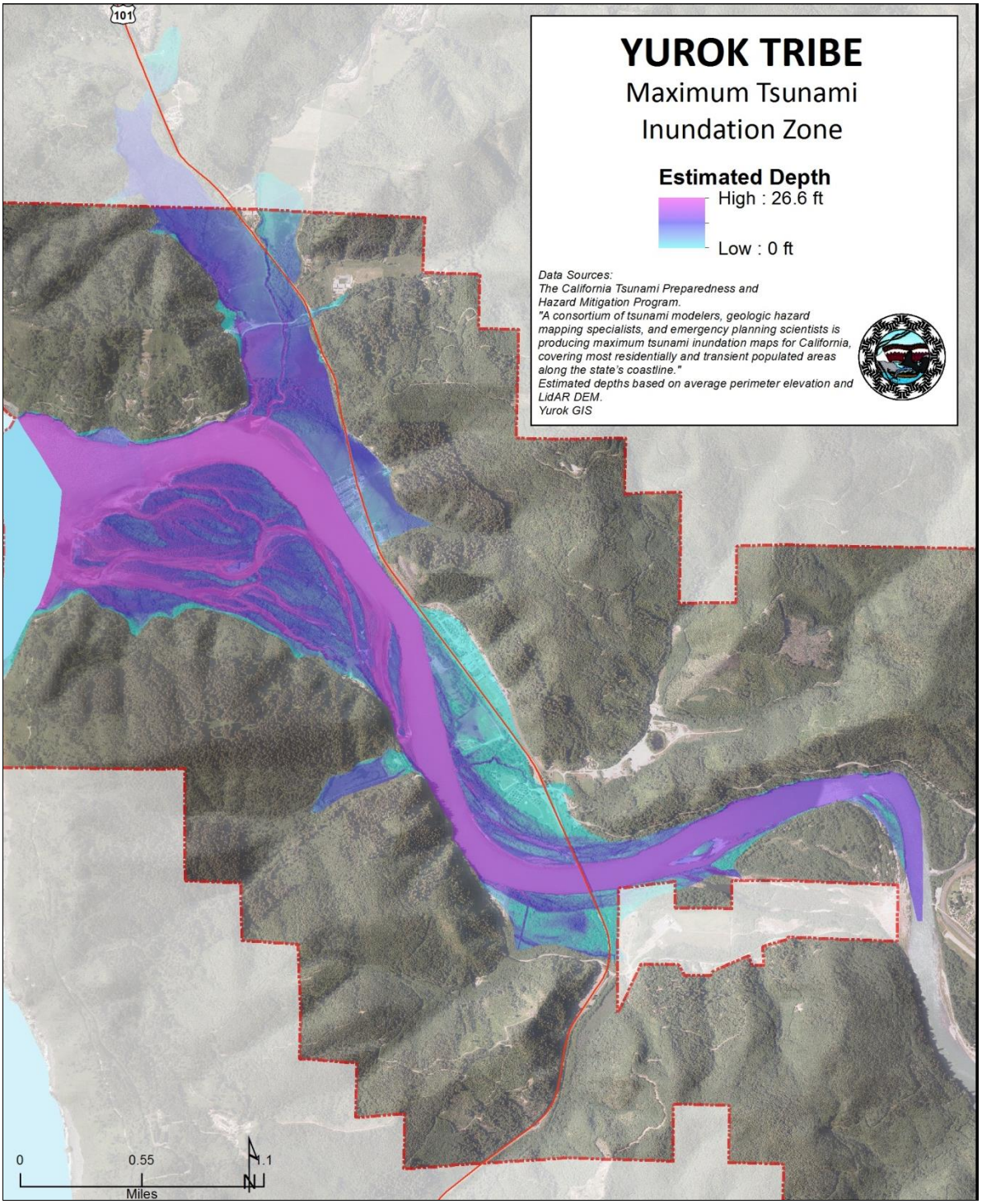

Figure 12-6. Yurok Reservation Maximum Tsunami Inundation Zone

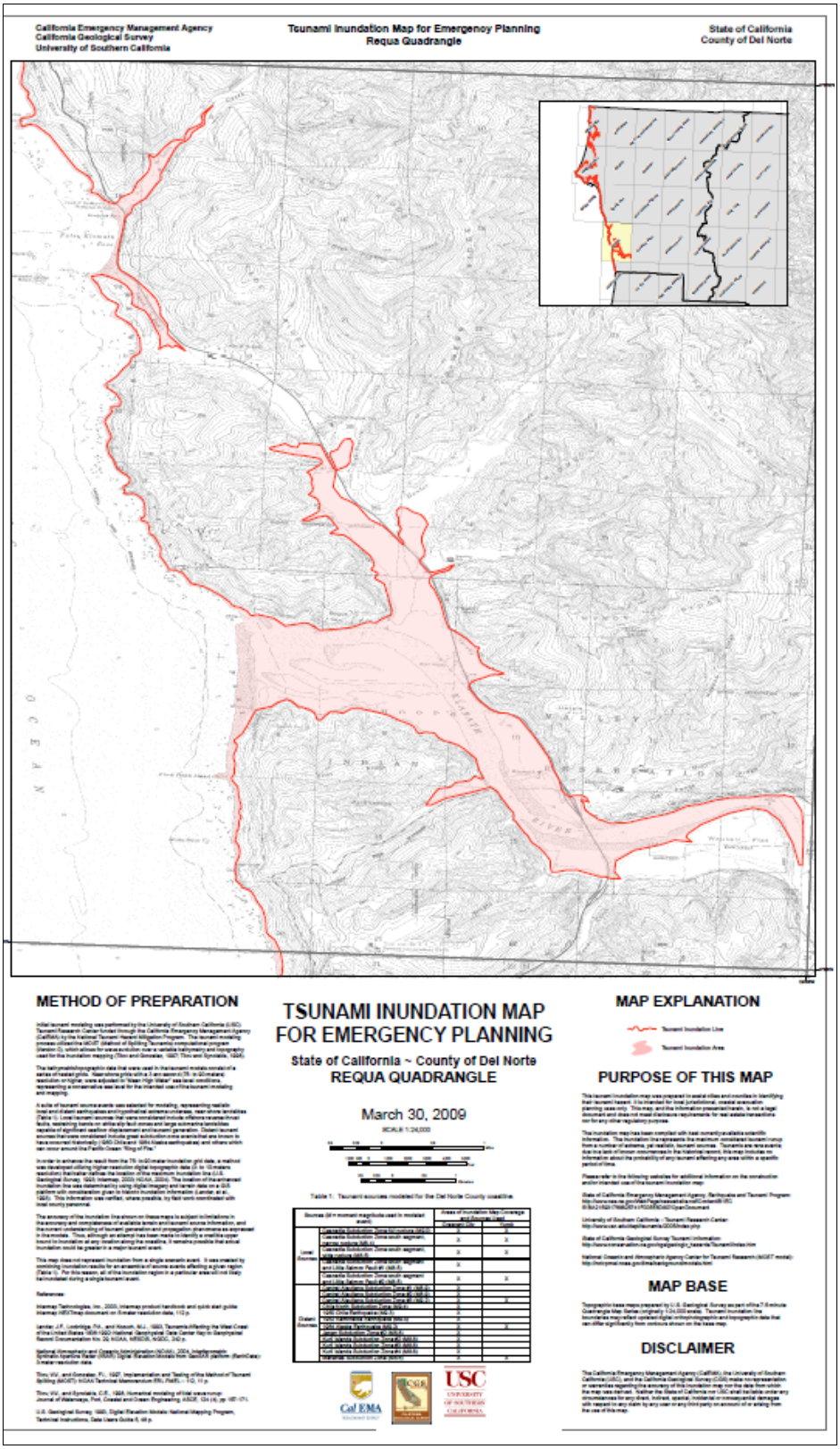

Figure 12-7. Maximum Tsunami Inundation Zone (CalEMA Mapping)

The Cascadia subduction zone will produce the planning area's largest tsunami. The Cascadia subduction zone is similar to the Alaska-Aleutian trench that generated the 1964 Alaska earthquake and the Sunda trench in Indonesia that produced the December 2004 Sumatra earthquake. Native American accounts of past Cascadia earthquakes suggest tsunami wave heights on the order of 60 feet, comparable to water levels in Aceh Province Indonesia during the December 2004 tsunami there. Water heights in Japan produced by the 1700 Cascadia earthquake were over 15 feet, comparable to tsunami heights observed on the African coast after the Sumatra earthquake. The Cascadia subduction zone last ruptured in 1700, creating a tsunami that left markers in the geologic record from Humboldt County, California, to Vancouver Island in Canada and is noted in written records in Japan. At least seven ruptures of the Cascadia subduction zone have been observed in the geologic record.

12.2.5 Warning Time

Typical signs of a tsunami hazard are earthquakes and/or sudden and unexpected rise or fall in coastal water. The large waves are often preceded by coastal flooding and followed by a quick recession of the water. Tsunamis are difficult to detect in the open ocean; with waves less than 3 feet high. The tsunami's size and speed, as well as the coastal area's form and depth, affect the impact of a tsunami; wave heights of 50 feet are not uncommon. In general, scientists believe it requires an earthquake of at least a magnitude 7 to produce a tsunami.

Most tsunamis originate in the Pacific Ocean, where tsunami waves triggered by seismic activity can travel at up to 500 miles per hour, striking distant coastal areas in a matter of hours. Figure 12-8 shows tsunami travel times measured for the 1960 Chilean earthquake event and the 1964 Alaskan earthquake event.

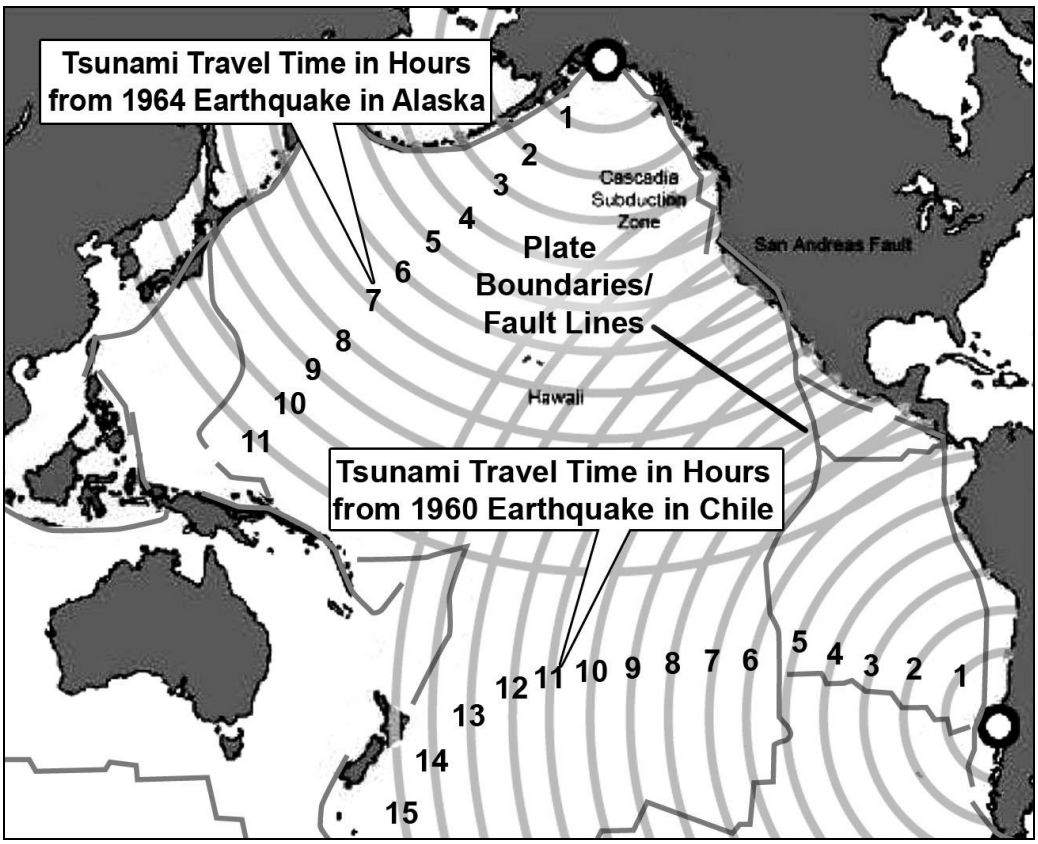

Figure 12-8. Potential Tsunami Travel Times in the Pacific Ocean

The Pacific tsunami warning system evolved from a program initiated in 1946. It is a cooperative effort involving 26 countries along with numerous seismic stations, water level stations and information distribution centers. The National Weather Service operates two regional information distribution centers. One is located in Ewa Beach, Hawaii, and the other is in Palmer, Alaska. The Ewa Beach center also serves as an administrative hub for the Pacific warning system.

The warning system only begins to function when a Pacific basin earthquake of magnitude 6.5 or greater triggers an earthquake alarm. When this occurs, the following sequence of actions occurs:

- Data is interpolated to determine epicenter and magnitude of the event.
- If the event is magnitude 7.5 or greater and located at sea, a TSUNAMI WATCH is issued.
- Participating tide stations in the earthquake area are requested to monitor their gages. If unusual tide levels are noted, the tsunami watch is upgraded to a TSUNAMI WARNING.
- Tsunami travel times are calculated, and the warning is transmitted to the disseminating agencies and thus relayed to the public.
- The Ewa Beach center will cancel the watch or warning if reports from the stations indicate that no tsunami was generated or that the tsunami was inconsequential.

NOAA utilizes a Deep-ocean Assessment and Reporting of Tsunamis (DART) system to collect data, which is then relayed to the Pacific Tsunami Warning Center in Honolulu, Hawaii (see Figure 12-9). These units generate computer models which predict tsunami arrival, usually within minutes of the arrival time. This information is relayed in real time.

Source: NOAA

Figure 12-9. Deep-Ocean Assessment and Reporting of Tsunamis (DART) System

However, this system is not considered to be as effective for communities close to the tsunami because the first wave would arrive before the data were processed and analyzed. In the case of the Yurok Tribe, strong ground shaking would provide the first warning of a potential tsunami. In response to the Tribe's vulnerability to this hazard, they have taken several proactive measures to help ensure the safety of its members and citizens living within the Reservation boundaries.

TsunamiReady

The State of California has several communities which are TsunamiReady Communities. Proudly, the Yurok Tribe is one of two Native American Tribes in California which are also recognized as TsunamiReady by the National Weather Service.

After years of hard work by the Tribe's Planning and Public Safety Departments, NOAA deemed Klamath and surrounding communities Tsunami Ready. In order to become Tsunami Ready the Tribe purchased and installed warning sirens and educated residents about the impacts of a tsunamis and how to prepare for such a disaster. The Yurok Tribe also succeeded in accomplishing the largest tsunami evacuation drill ever conducted in California. The Tribe continues to build upon these past accomplishments by placing tsunami sirens and other measures. Tim Sanderson is the current Yurok Tribe's Emergency Services Specialist and continues to work collaboratively with NOAA and other agencies in continued placement of Tsunami Sirens.

Figure 12-10. The National Weather Service's Troy Nicollini presents LaBecca Nessier with a Community Leader Award

Figure 12-11. Tsunami Warning Sign

AHAB Sirens

The Tribe's warning sirens are installed at locations shown on Figure 12-12. The Tribe also created evacuation routes, some of which are trails up into wooded hillsides. The Tribe worked closely with the National Weather Service, National Oceanic and Atmospheric Administration, and Del Norte Office of Emergency Services to develop this comprehensive plan.

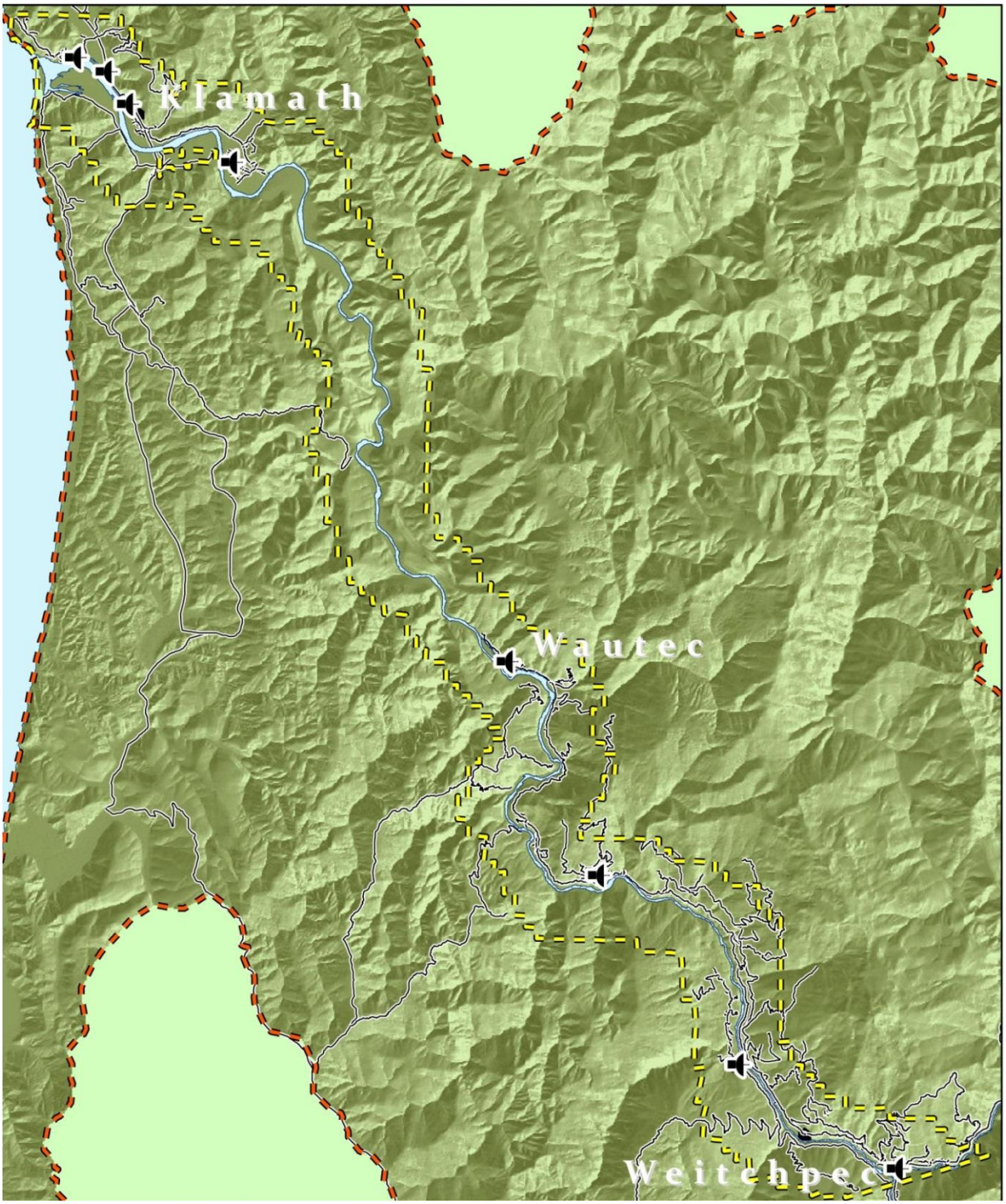

Figure 12-12. Tsunami Siren Locations

12.3 SECONDARY HAZARDS

Aside from the tremendous hydraulic force of the tsunami waves themselves, floating debris carried by a tsunami can endanger human lives and batter inland structures. Ships moored at piers and in harbors often are swamped and sunk or are left battered and stranded high on the shore. Breakwaters and piers collapse, sometimes because of scouring actions that sweep away their foundation material and sometimes because

of the sheer impact of the waves. Railroad yards and oil tanks situated near the waterfront are particularly vulnerable. Oil fires frequently result and are spread by the waves.

Port facilities, naval facilities, fishing fleets and public utilities are often the backbone of the economy of the affected areas, and these are the resources that generally receive the most severe damage. Until debris can be cleared, wharves and piers rebuilt, utilities restored, and fishing fleets reconstituted, communities may find themselves without fuel, food and employment. Wherever water transport is a vital means of supply, disruption of coastal systems caused by tsunamis can have far-reaching economic effects.

As a result of the March 2011 Japan Earthquake and ensuing Tsunami, NOAA has conducted significant studies related to the debris which will wash ashore along the western coastline of the United States. Several planning concepts are underway. Figure 12-13 depicts NOAA's projections for onshore flow of the debris.

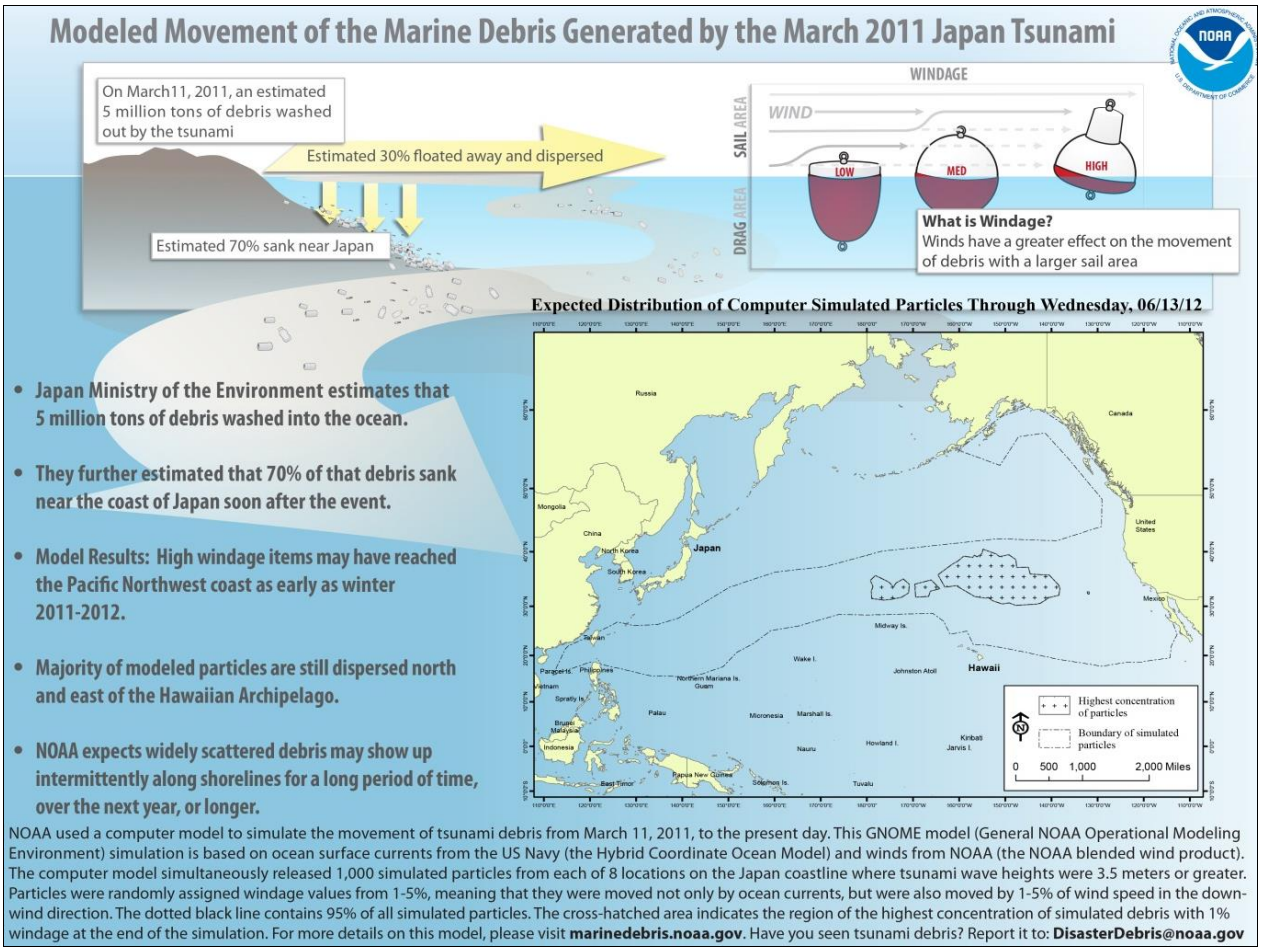

Figure 12-13. Projected Debris Flow from March 2011 Tsunami

12.4 CLIMATE CHANGE IMPACTS

The impacts of climate change on the frequency and severity of tsunami events could be significant in regions with vulnerable coast line. Global sea-level rise will affect all coastal societies, especially small island states and densely populated low-lying coastal areas. *The Scientific Basis* estimates a sea level rise of 0.3 to 2.9 feet from 1990 to 2100. Currently sea level is rising at a rate of about 0.1 inches per year. This rise has two effects on low-lying coastal regions: any structures located below the new level of the

sea will be flooded; and the rise in sea level may lead to coastal erosion that can further threaten coastal structures. As a rule-of-thumb, a sandy shoreline retreats about 100 feet for every 1-foot rise in sea level.

12.5 EXPOSURE

The Level 2 HAZUS-MH flood protocol was used to assess the risk and vulnerability to the tsunami inundation area. A user defined facility building specific model was developed, incorporating a depth grid developed in GIS, which has a level of accuracy acceptable for planning purposes. Where possible, the HAZUS-MH default data was enhanced using local GIS data from Tribe, state and federal sources.

12.5.1 Population

The population living in tsunami hazard zones was generated by analyzing the Tribes total population (both Tribal and non-Tribal) and total households that intersect the inundation zone. The populations that would be most exposed to this type of hazard are those along beaches, low-lying coastal areas, tidal flats and river deltas that empty into ocean-going waters. The methodology used to generate population estimates was determined by multiplying the average household size for the Yurok Reservation (3 persons per household) by the number of exposed residential buildings. Using this approach, it was estimated that 165 people, or 55 single-family households, are exposed to the tsunami hazard zone.

12.5.2 Property

The value of exposed buildings in the tsunami hazard zone in the planning area was generated using HAZUS-MH at the user-defined level. Table 12-2 summarizes the area and number of structures in the tsunami hazard zone. There are 79 structures within the tsunami hazard area, 70 percent are residential.

TABLE 12-2.
EXPOSURE AND VALUE OF STRUCTURES IN TSUNAMI INUNDATION ZONE

Area in Tsunami Hazard (acres)	2184
Number of Structures in Tsunami Hazard	
Tribal Facilities	4
Non-Tribal Government	3
Non-Single Family Residential	17
Single Family Residential	55
Total	**79**

The value of exposed buildings in the tsunami hazard zone within the planning area was generated using HAZUS-MH at the user-defined level and is summarized in Table 12-2. The estimates include the value of both the buildings and their contents. This methodology estimates that that there are 79 structures exposed to the tsunami hazard within the planning area, with an assessed value of $30.3 million.

12.5.3 Critical Facilities and Infrastructure

Roads or railroads that are blocked or damaged can prevent access throughout the planning area and can isolate residents and emergency service providers needing to get to vulnerable populations or to make repairs. Bridges washed out or blocked by tsunami inundation or debris from flood flows also can cause isolation. Water and sewer systems can be flooded or backed up, causing further health problems.

Underground utilities can also be damaged during flood events. Table 12-3 provides an estimate of the number and types of critical facilities exposed to the tsunami hazard.

TABLE 12-3.
STRUCTURES EXPOSED TO TSUNAMI INUNDATION ZONE

	Assessed Value			
	Structure	Contents	Total	% of AV
Tribal Facilities	$6,120,000	$6,120,000	$12,240,000	24.58%
Non-Tribal Government	$626,864	$626,864	$1,253,728	9.20%
Non-Residential	$3,519,154	$2,780,831	$6,299,985	27.67%
Residential	$7,034,004	$3,517,002	$10,551,006	5.21%
Total	**$17,300,022**	**$13,044,697**	**$30,344,719**	**10.52%**

Roads

Roads are an important component in the management of tsunami-related emergencies in that they act is the primary resource for evacuation to higher ground before and during the course of a tsunami event. Roads often act as flood control facilities in low depth, low velocity flood events by acting as levees or berms and diverting or containing flood flows. HAZUS-MH indicated that Highway 101 and Highway 169 as well as numerous arterial roads and streets may be impacted by tsunami events.

Bridges

Bridges exposed to tsunami events can be extremely vulnerable due to forces transmitted by the wave run-up and by the impact of debris carried by the wave action. HAZUS-MH identified 12 bridges that would be exposed to the tsunami scenario event.

Water/Sewer/Utilities

Water and sewer systems can be affected by the flooding associated with tsunami events. Floodwaters can back up drainage systems, causing localized flooding. Culverts can be blocked by debris from flood events, also causing localized urban flooding. Floodwaters can get into drinking water supplies, causing contamination. Sewer systems can be backed up, causing wastes to spill into homes, neighborhoods, rivers and streams. The forces of tsunami waves can impact above-ground utilities by knocking down power lines and radio/cellular communication towers. Power generation facilities can be severely impacted by both the impact of the wave action and the inundation of floodwaters.

12.5.4 Environment

All waterways would be exposed to the effects of a tsunami; inundation of water and introduction of foreign debris could be hazardous to the environment. All wildlife inhabiting the area also is exposed.

12.6 VULNERABILITY

12.6.1 Population

The populations most vulnerable to the tsunami hazard are the elderly, disabled and very young who reside near beaches, low-lying coastal areas, tidal flats and river deltas that empty into ocean-going

waters. In the event of a local tsunami generated in or near the planning area, there would be little warning time, so more of the population would be vulnerable. The degree of vulnerability of the population exposed to the tsunami hazard event is based on a number of factors:

- Is there a warning system?
- What is the lead time of the warning?
- What is the method of warning dissemination?
- Will the people evacuate when warned?

For this assessment, the population vulnerable to possible tsunami inundation is considered to be the same as the exposed population.

12.6.2 Property

All structures along beaches, low-lying coastal areas, tidal flats and river deltas would be vulnerable to a tsunami, especially in an event with little or no warning time. The impact of the waves and the scouring associated with debris that may be carried in the water could be damaging to structures in the tsunami's path. Those that would be most vulnerable are those located in the front line of tsunami impact and those that are structurally unsound. HAZUS-MH generated loss estimates for the estimated tsunami hazard areas, as reflected in Table 12-4. It is estimated that there would be up to $5.5 million of loss from a scenario tsunami hazard event. HAZUS estimated that on the average, buildings would receive 60 percent damage to structures and 50 percent damage to contents during the scenario tsunami event.

TABLE 12-4.
LOSS ESTIMATES FOR TSUNAMI

	Structures Impacted[a]	Estimated Loss			% of Total Value
		Structure	Value	Total	
Tribal Facility	1	$1,530,000	$1,080,000	$2,610,000	5.24%
Government Non-Tribal	0	$0	$0	$0	0.00%
Non Residential	9	$672,388	$766,070	$1,438,458	6.32%
Single Family Residential	8	$815,489	$387,746	$1,203,236	0.59%
Total		**$3,017,878**	**$2,233,816**	**$5,251,694**	**1.82%**

a. Impacted structures are those structures expected to receive measurable damage from the scenario tsunami event because they have lowest floor elevations below the projected tsunami inundation height.

12.6.3 Environment

The vulnerability of aquatic habit and associated ecosystems would be highest in low-lying areas close to the coastline. Areas near gas stations, industrial areas and Tier II facilities would be vulnerable due to potential contamination from hazardous materials.

Tsunami waves can carry destructive debris and pollutants that can have devastating impacts on all facets of the environment. Millions of dollars spent on habitat restoration and conservation in the planning area

could be wiped out by one significant tsunami. There are currently no tools available to measure these impacts. However, it is conceivable that the potential financial impact of a tsunami event on the environment could equal or exceed the impact on property. Community planners and emergency managers should take this into account when preparing for the tsunami hazard.

12.7 FUTURE TRENDS IN DEVELOPMENT

The information in this plan provides the Yurok Tribe a tool to ensure that there is no increase in exposure within the tsunami hazard zones of the planning area with respect to future development in high-hazard areas. Development trends in both Del Norte and Humboldt Counties are not such that there is major concern about development in identified tsunami hazard zones. However, given the limited land mass which makes up the Yurok Reservation, areas for development are currently limited, and therefore, other mitigation-type efforts will be needed to protect tribal members. Given the potential tsunami wave heights for some portions of the planning area, standard floodplain development regulation may also not provide adequate risk protection for new development. Significant gaps exist with respect to data and science which can be applied to official mapping with assigned probabilities of occurrence. Once more specific data becomes available, the Yurok Tribe will re-evaluate the hazard scenarios, and may want to consider regulatory provisions for new development in high risk tsunami inundation areas.

12.8 SCENARIO

The worst-case scenario for the planning area is a local tsunami event triggered by a seismic event along the Cascadia subduction zone. Historical records suggest that tsunami wave heights on the order of 15 to 60 feet could be generated by a Cascadia subduction event. A major tsunami event in the region would have devastating impacts on the people, property and economy of the Yurok Tribe.

12.9 ISSUES

The planning team has identified the following issues related to the tsunami hazard for the planning area:

- Hazard Identification: To truly measure and evaluate the probable impacts of tsunamis on planning, new hazard mapping based on probabilistic scenarios likely to occur needs to be created. The science and technology in this field are emerging. For tsunami hazard mitigation programs to be effective, probabilistic tsunami mapping will need to be a key component.
- Present building codes and guidelines do not adequately address the impacts of tsunamis on structures, and current tsunami hazard mapping is not appropriate for code enforcement.
- As tsunami warning technologies evolve, the tsunami warning capability within the planning area will need to be enhanced to provide the highest degree of warning.
- With the possibility of climate change, the issue of sea level rise may become an important consideration as probable tsunami inundation areas are identified through future studies.
- Special attention will need to be focused on the vulnerable communities in the tsunami zone and on hazard mitigation through public education and outreach.

CHAPTER 13.
COMMUNITY WILDFIRE PROTECTION PLAN

13.1 GENERAL BACKGROUND

A wildfire is any uncontrolled fire on undeveloped land that requires fire suppression. Wildfires can be ignited by lightning or by human activity such as smoking, campfires, equipment use or arson. The potential for significant damage to life and property exists in areas designated as "wildland urban interface (WUI) areas," where development is adjacent to densely vegetated wildland areas.

Population de-concentration in California has resulted in rapid development in the outlying fringe of metropolitan areas and in rural areas with attractive recreational and aesthetic amenities, especially forests. This demographic change is increasing the size of the wildland-urban interface (WUI), defined as *the area where structures and other human development meet or intermingle with undeveloped wildland.* The WUI is where wildfire poses the biggest risk to human lives and structures. The expansion of the WUI in recent decades has significant implications for wildfire management and impact. The WUI creates an environment in which fire can move readily between structures and vegetation fuels. Its expansion has increased the likelihood that wildfires will threaten structures and people.

WUI is composed of both *interface and intermix* communities. In both interface and intermix communities, housing must meet or exceed a minimum density of one structure per 40 acres. *Intermix* communities are places where housing and vegetation intermingle. In *intermix*, wildland vegetation is continuous, more than 50 percent vegetation, in areas with more than 1 house per 40 acres. *Interface* communities are areas with housing *in the vicinity* of contiguous vegetation. Interface areas have more than 1 house per 40 acres, have less than 50 percent vegetation, and are within 1.5 miles of an area that is more than 75 percent vegetated. An interface can also be defined as a zone where human-made infrastructure is located in, or adjacent to, wildfire prone areas. At a community-level perspective, the interface can be defined as the conditions that contribute to a neighborhood or community's vulnerability to a wildland fire. Based on these factors, the Yurok Reservation constitutes an *intermix* community, as housing and wildland vegetation are intermingled, with continuous vegetation surrounding structures.

During the pre-settlement period (before 1875) the Native American people commonly used fires for many reasons, including

DEFINITIONS

Conflagration—A fire that grows beyond its original source area to engulf adjoining regions. Wind, extremely dry or hazardous weather conditions, excessive fuel buildup and explosions are usually the elements behind a wildfire conflagration.

Firestorm—A fire that expands to cover a large area, often more than a square mile. A firestorm usually occurs when many individual fires grow together into one. The involved area becomes so hot that all combustible materials ignite, even if they are not exposed to direct flame. Temperatures may exceed 1000°C. Superheated air and hot gases of combustion rise over the fire zone, drawing surface winds in from all sides, often at velocities approaching 50 miles per hour. Firestorms seldom spread because of the inward direction of the winds, but there is no known way of stopping them. Within the area of the fire, lethal concentrations of carbon monoxide are present; posing a serious life threat to fire forces. In very large events, the rising heated air and combustion gases carry enough soot and particulate matter into the upper atmosphere to cause cloud nucleation, creating a locally intense thunderstorm and the hazard of lightning strikes.

Interface Area—An area susceptible to wildfires and where wildland vegetation and urban or suburban development occur together. An example would be smaller urban areas and dispersed rural housing in forested areas.

Wildfire—Fires that result in uncontrolled destruction of forests, brush, field crops, grasslands, and real and personal property in non-urban areas. Because of their distance from firefighting resources, they can be difficult to contain and can cause a great deal of destruction.

food harvesting and for cultural and traditional practices. It also helped drive out rodents and insects, and kept the forest understory open, which made for easier travel and hunting. Additionally, it enhanced the forbs and grasses used in basket weaving, something which was, and continues to be, a common practice for many of the Yurok people.

The access to the coast for trading and food, the relatively mild temperatures, and the many tributaries provided for fresh water and food. The Native Americans found the areas surrounding the Klamath River to be well suited to their needs, and established their ancestral boundary – an area much greater than what is represented as the present-day Yurok Tribal boundary.

The practiced use of fire maintained the natural balance on the lands of the Reservation, and provided the resources necessary to maintain and support the lifestyle of the Tribal Nations surrounding the area of the Klamath River. Over time, the ability to continue the use of controlled fires by the Yurok People has been restricted to a great extent. These restrictions have not only impinged upon the Yurok People's way of life, but have also impacted nature's way of sustaining and maintaining itself. While suppression activities are intended to protect us, these activities, ultimately, have also significantly increased fire danger to some degree. In response to the increased fire danger, development of a CWPP has become a normal practice in order to mitigate against the impacts from these potential fires. This plan serves as the Yurok Tribe's initiative to help protect its members and residents.

13.1.1 Community Wildfire Protection Plan

The CWPP is intended to serve as the guiding document for reducing the risk of fire to the Yurok Reservation and its surrounding communities, and to serve the following uses:

- Promote fire safety;
- Build capacity of local fire organizations;
- Coordinate local activities of the federal and state agencies charged with fire protection and management responsibilities;
- Incorporate planning for fire safe communities into the County land use planning process;
- Provide planning tools for fire safe communities; and
- Identify funding sources to support local organizations that provide fire prevention and protection services.

Federal fire policy is derived principally from three sources: the Federal Wildland Fire Management Policy, the Western Governors' Association *Ten-Year Comprehensive Strategy: A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment* (August 2001), and the Healthy Forests Restoration Act (2003). These documents call for a single comprehensive federal fire policy for the Interior and Agriculture Departments (the agencies using federal fire management resources). All three mandate community-based collaboration in reducing risks from wildfire.

As a result of several significant fires throughout the United States from 1995 to 2000, Congress implemented the National Fire Plan in 2001. A major aspect of the National Fire Plan is joint risk reduction planning and implementation, carried out by federal, state, and local agencies and communities. The National Fire Plan, since renamed as the National Cohesive Wildland Fire Management Strategy (Cohesive Strategy), seeks national solutions to wildland fire management issues.

To use the Cohesive Strategy, a community must first determine its wildfire risk, and then develop strategies to reduce potential impacts. This often includes development of a Community Wildfire

Protection Plan (CWPP). A CWPP provides a framework for identifying wildfire hazard areas and establishing strategies to reduce wildfire risks. Under the Healthy Forests Restoration Act, the U.S. Forest Service and U.S. Bureau of Land Management give priority consideration when developing forest management and hazardous fuels reduction projects to treatment areas and methods identified in a CWPP.

Completion of a CWPP increases a community's competitiveness for federal grant programs, such as those under the Healthy Forests Restoration Act, the National Fire Plan, FEMA's Pre-Disaster Mitigation Program, and the Secure Rural Schools and Community Self Determination Act.

The California Fire Plan process calls for using the best available data for analysis and having community stakeholders validate that data, to the best of their ability. Based on that process, tactical project decisions are then made on the best combination of strategic assessments combined with local knowledge. This chapter of the Yurok Tribe's Hazard Mitigation Plan incorporates all of the required CWPP elements, thereby serving as the Tribe's CWPP, and blueprint for a safer community.

13.1.2 Purpose, Goals and Objectives

Wildfire suppression costs have grown tremendously in recent years. Projections indicate this trend may increase as a result of unhealthy forests, hazardous fuel build-up, changes in climate conditions, and increasingly populated WUI areas. In order to enhance resiliency of fire protection, a community must first know the area which they are protecting, and thereafter determine what, and how, they should go about protecting their properties.

The purpose and objective to develop a Community Wildfire Protection Plan (CWPP) is to provide insight into the hazard, as well as determine measurable activities which can enhance the survivability of the residents living within the WUI, while also enhancing the survivability of the surrounding lands and infrastructure.

Elements included within this portion of plan as defined below, when combined, develop the YR's CWPP:

- Introduction and general background information
- Agency Roles in Fire Planning
- Humboldt, Del Norte and Tribal Emergency Response Capabilities
- Fire Ecology and Environment
- Fire Hazard Severity Zones
- Communities at Risk (per California Fire Alliance)
- Risk Assessment and Mitigation Strategies Tribal-wide (developed by planning team)
- Public Outreach Process and Findings
- Community Based Assessment (beginning section 13.9)
- Mitigation Strategies, Priorities, Findings and Recommendations based on community assessment
- Tribal Policy Recommendations
- Implementation Measures

The planning community of the Yurok Tribe has undertaken the development of this CWPP with the same end goals as those intended for the Tribe's Updated Hazard Mitigation Plan:

- Goal 1—Reduce natural hazard-related injury and loss of life.
- Goal 2—Reduce property damage.
- Goal 3—Promote a sustainable economy.
- Goal 4—Preserve the cultural integrity of the Yurok Tribe and its members
- Goal 5—Maintain, enhance and restore the natural environment's capacity to absorb and reduce the impacts of natural hazard events.
- Goal 6—Increase public awareness and readiness for disasters.

Combined, these efforts meet the Healthy Forest Restoration Act criteria for Community Wildfire Protection Plans (CWPP) by:

- Engaging in a collaborative process
- Prioritizing fuel reduction activities
- Recommending treatments for reducing structural ignitability

13.1.3 Collaboration

At the time of the planning process for the Tribe's Hazard Mitigation Plan and this CWPP, Humboldt County was also in the process of updating the County's Fire Protection Plan. It was determined that the efforts of both jurisdictions would be best served if the two joined forces, and all planning efforts conducted by the County of Humboldt and by the Yurok Tribe were conducted in support of one another. The general public outreach strategy, including survey questionnaires, website development and newsletter publications which were conducted for the development of the hazard mitigation plan also included specific criteria for CWPP development.

During the development of the hazard mitigation plan and the CWPP process, the Tribe also elected to work towards establishing a Fire Safe Council, and personnel were recruited to serve in that capacity. It was determined that the same members who served on the Steering Committee for the mitigation plan development were also the same relevant members to serve on the Fire Safe Council, again the intent being to join forces whenever possible to help ensure involvement with the limited resources of the Tribe, and to enhance involvement which might otherwise be impacted by its remote location. The Steering Committee/Fire Safe Council was responsible for providing planning oversight and review of plan development. It also served as a forum for sharing fire safety information, assessing fire risk, and setting fire protection priorities. The second phase of the planning process focused on community outreach and refinement of implementation measures.

The demographics of the planning area lends itself to many special interest groups which have a wide array of needs. Generally speaking, the stakeholders involved in this planning process included representatives of tribal/governmental entities, private land stewards (both large and small), rural and interface/intermix homeowners, and special interest groups. This plan demonstrates a compilation of efforts from various groups and agencies from throughout the planning area who have come together in an effort to address the mitigation of the hazards of concern in general, and specifically wildland fire as it relates to the communities at risk. The plan also addresses the priorities put forth by the community based on the key issues gathered from cooperators, and the community assessments conducted.

Figure 13-1. CWPP 2012 Open House

13.1.4 Humboldt-Del Norte Fire Unit

The California Department of Forestry and Fire Protection (CalFire) Humboldt Del Norte Unit (the Unit) is remotely located representing the most northern Unit along the California coastline. The Unit extends north to south approximately 180 miles and inland approximately 50 miles. This encompasses 1,941,991 acres of state responsibility lands and 1,963,581 of direct protection area. Approximately 70% of these lands are zoned for timber production and another 10% are recreation areas. Several watersheds exist within the lands, including the Smith, Klamath, Mad, Trinity, Van Duzen, Mattole and Eel Rivers.

The planning area is home to not only the world's tallest living trees, but also the largest remaining stands of old growth coast redwood. Many of these stands are protected in parks and recreational areas. These include 11 State Parks, 20 County parks and beaches, Redwood National Park, United States Forest Service (USFS) Six Rivers National Forest and the newly acquired Headwaters Forest. Much of the livelihood of the planning region is dependent on the resources the land itself has to offer, both in the form of timber production and recreation. Landowners in the area manage their land for timber production, ranching, cultural preservation, and for residential purposes.

The Unit is culturally diverse as well. Twelve tribal agencies reside within the Unit, including the Yurok Tribe. Humboldt and Del Norte counties each have an urban interface/intermix dilemma.

During 2011, the Yurok Volunteer Fire Department reported to the following responses within their services area:

- Structural Fires 12
- Vehicle Fires 2
- Fire Alarm 6
- Vegetation Fire 8
- Motor Vehicle Accidents 16
- EMS Assistance 155

13.1.5 Wildland Urban Intermix Planning Area

The wildland-urban intermix exists wherever residential and supporting commercial land uses intermingle with forest and range commercial uses and wildlands. Typically in these situations, homes and other structures are built into the wildlands so that there is little separation between the flammable native vegetation and structures. In some places, the landscapes around homes have been largely modified from the native vegetation, but homes lie close to the wildlands and are not constructed to resist ignition in a wildfire.

Much of the native wildland of North America adapted to frequent wildfire over the thousands of years since climate warming at the end of the last ice age. Individual species adapted to fire. Over time, the species in the fire-adapted wildlands adjusted to each other until many ecosystems not only tolerate fire, but also often depend on fire to sustain the relationships that keep the system healthy. One of the important roles of frequent fire has been to keep fuel from accumulating. In the last century, land managers became more and more successful in excluding fire. As they did so, vegetation accumulated and the species composition and structure of forests changed. As a result, few present-day landscapes still resemble the native landscapes. In many of the forest types preferred for wildland-urban intermix development, vegetation is much denser, there is more dead, woody material within the stands, and thickets of suppressed reproduction beneath the canopy easily carry fire from the surface into the tree crowns.

The Yurok Reservation incorporates land mass in both the Del Norte and Humboldt Counties. Hazard Severity Zones for both regions have prioritized the planning area into both Local Response Areas (LRA) and State Response Areas (SRA).

In 2007, CalFire updated its fire hazard severity zone maps for the State of California. The fire hazard model considers wildland fuels, topography, weather, crown fire potential, and ember production and movement. This model does not consider risk. The end product is the identification of fire hazard severity zones rated moderate, high, or very high. Specifically, “Wildfire hazard zones represent areas of variable size ranging from 20 acres in urbanized areas to at least 200 acres in wildland areas, with relatively homogeneous characteristics regarding expected burn probability and potential fire behavior attributes based on climax fuel conditions over a 30-50 year time horizon” (CalFire, 2007).

Fire Hazard Severity Zones applicable to the Yurok Reservation as shown on Figure 13-2.

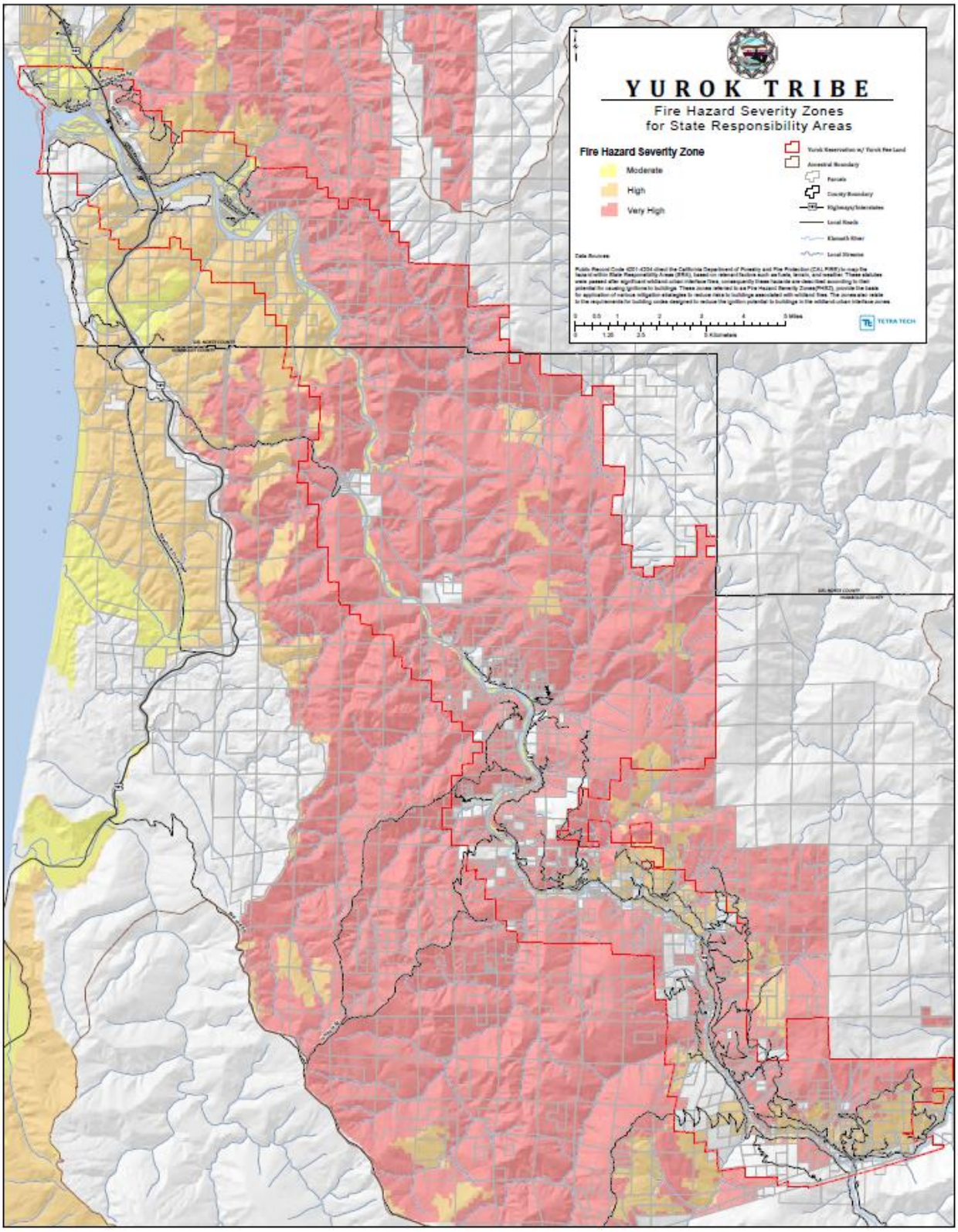

Figure 13-2. Fire Hazard Severity Zones on the Yurok Reservation

According to the analysis conducted by CalFire, the Del Norte portion of the Reservation is rated as High or Very High Fire Hazard Severity Zone. A small portion of the YR around Klamath Glen is rated as Moderate Fire Hazard Severity Zone. The areas lying west of the Klamath River encompass those portions of the Reservation which analysis depicts as High FHSZ, with the areas lying east of the river rated as Very High FHSZ.

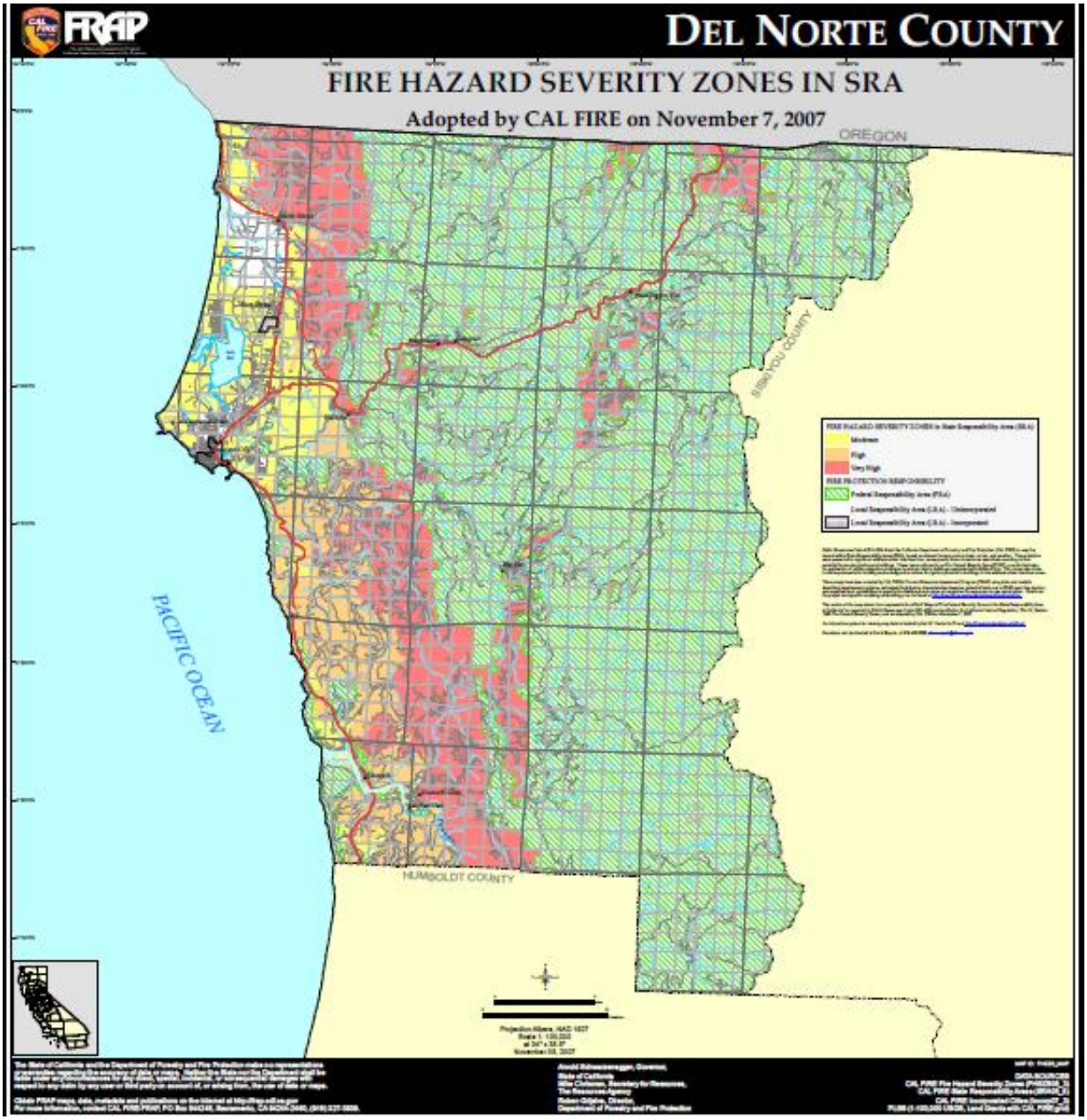

Figure 13-3. Del Norte County Fire Hazard Severity Zones as Defined by FRAP

With respect to the Humboldt County portions of the YR, a small portion of the area contiguous to Del Norte County along the western border of the Klamath River is rated as being a High FHSZ, but the majority of the Reservation falling within the boundaries of Humboldt County is rated as Very High.

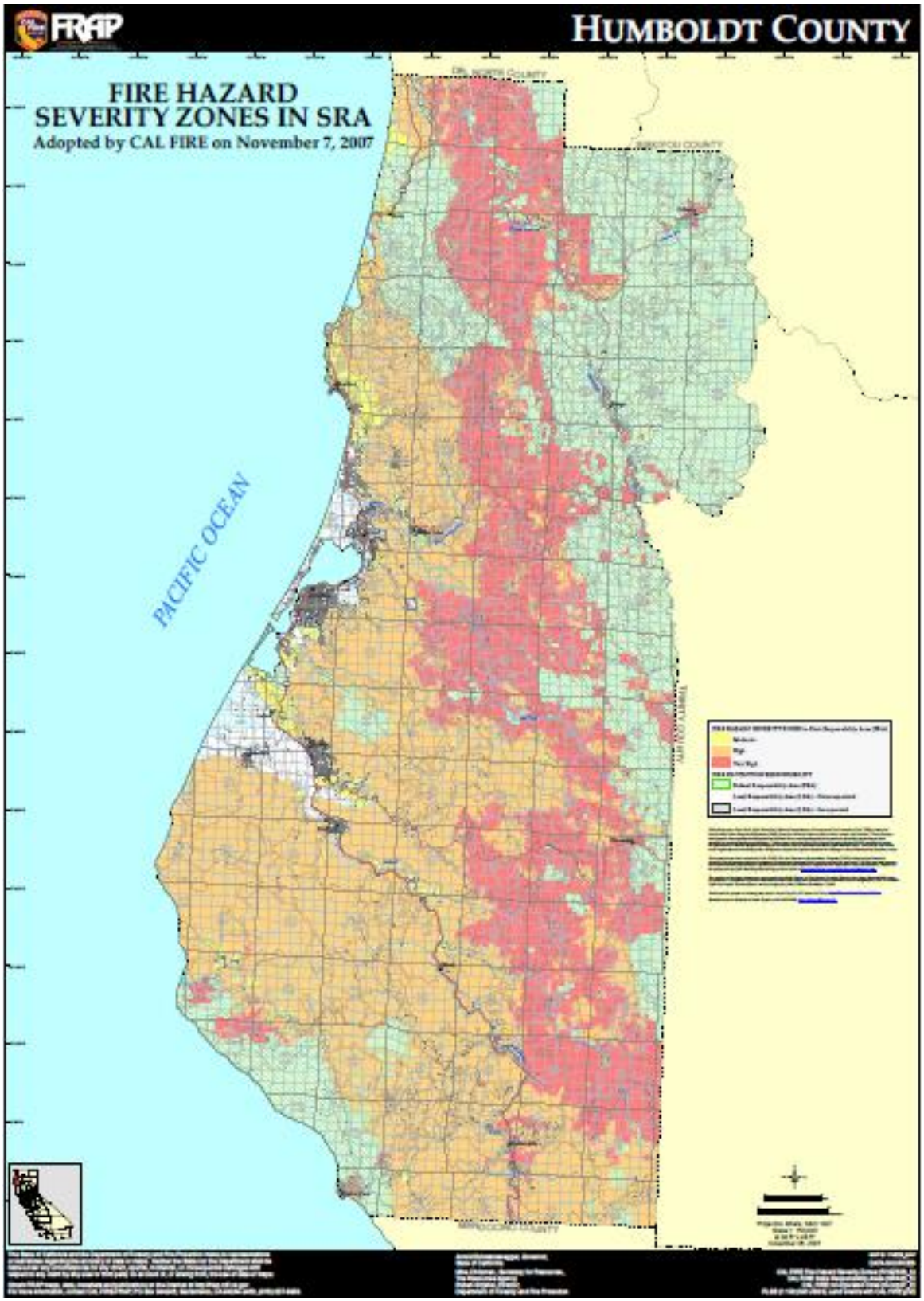

Figure 13-4. Humboldt County Fire Hazard Severity Zones as Defined by FRAP

13.1.6 Wildfire Management and Agency Roles and Responsibilities

The variation with respect to ownership and land distribution within the Reservation boundaries manifests itself into many unique obstacles with respect to fire management practices. Much of the land incorporated within the Reservation boundaries are owned by private land owners, which includes timber companies, while much of the Reservation as a whole is surrounded by National and State Forests.

The Yurok Tribe provides funding, equipment and facilities for a volunteer fire department that protects a portion of the Reservation. The Tribe does have limited staff and resources that provide contract fire protection services through the Bureau of Indian Affairs. The Bureau of Indian Affairs also has an agreement with CAL FIRE to protect trust lands. The Tribe has attempted to maintain fire protection services Reservation wide, but funding makes it difficult to provide this service for the entire planning area.

Depending upon where the fire occurs on the Reservation determines response times. When a fire is reported on the Upper Reservation to 911, the call is routed through the Fortuna CAL FIRE dispatch. Fortuna CAL FIRE dispatches the Yurok Volunteers, as well as the CAL FIRE engine from Elk Camp on Bald Hills Road or Orick. Under normal conditions, time before arrival is at least one hour for an engine and crew to get to Martin's Ferry Bridge in Weithpec, and an additional 45 to 60 minutes to get to Wautec at the end of U.S. 169. Currently, the Lower Reservation has no Tribal fire department in place, and must rely on surrounding assets and resources to provide fire protection. For these reasons, when determining the fire response element of the fire risk assessment, a rating of high or extreme was assessed for the entire Reservation.

Fire Safe Councils

Local Fire Safe Councils assist in educating Californians to protect their homes, communities, and environments from wildfire. These councils serve as forums for stakeholders to share and validate fire safety and fire planning information. With the development of this Hazard Mitigation Plan and Community Wildfire Protection Plan, the Tribe is utilizing the Steering Committees for these processes to serve as their first Fire Safe Councils on the Reservation.

- Federal Programs and Agencies Related to Wildland Fire:
  - USDA Forest Service Six Rivers National Forest—The USDA Forest Service role in wildfire management is primarily focused on National Forest lands. However, Forest Service personnel will respond to wildland and structural fires on adjacent lands through mutual aid agreements when crews and equipment are available. Forest Service fire stations are un-staffed outside of fire season.
  - Bureau of Land Management—The U.S. Bureau of Land Management (BLM) funds and coordinates wildland fire management programs and structural fire management and prevention on BLM lands. BLM works closely with the USDA Forest Service and state and local governments to coordinate and prioritize fire safety activity. The Interagency Fire Coordination Center in Boise, Idaho serves as the nerve center for this effort.
  - Bureau of Indian Affairs—The U.S. Bureau of Indian Affairs' Fire and Aviation Management National Interagency Fire Center provides wildland fire protection, fire use and hazardous fuels management, and emergency rehabilitation on Indian forest and range lands held in trust by the United States, based on fire management plans approved by the appropriate Indian Tribe.

  - National Park Service, Redwood National Park—The National Park Service provides wildland and structure fire protection and conducts wildland fire management within its units. These activities are guided by the National Park Service Fire Management Plan.
  - U.S. Fish and Wildlife Service (USFWS) – The USFWS fire management strategy supports resource management decisions. The strategy employs prescribed fire to maintain early successional fire-adapted grasslands and other ecological communities throughout the National Wildlife Refuge System.
- State Programs and Agencies Related to Wildland Fire
  - California Fire Safe Council—In 1993, the statewide Fire Safe Council, consisting of private and public membership, was formed to encourage Californians to plan for wildfires. In 2002, this group created a nonprofit organization and board of directors, called the California Fire Safe Council (CFSC). The CFSC facilitates the distribution of National Fire Plan grants for wildfire risk reduction and education. The CFSC assists local Fire Safe Councils (FSCs), distributes educational materials, and provides technical assistance, primarily through regional representatives.
  - California Department of Forestry and Fire Protection, Humboldt/Del Norte Unit—CAL FIRE has responsibility for wildfires in areas that are not under the jurisdiction of the USDA Forest Service or a local fire organization, including lands designated as State Responsibility Areas. CAL FIRE also has fire protection responsibilities by contract and mutual aid agreements. The CAL FIRE Humboldt/Del Norte Unit Chief serves as the Humboldt County Fire Warden to assist local agencies.
  - California Department of Parks and Recreation (State Parks) – State Parks manages portions of the California's coastline including coastal wetlands, estuaries, beaches, and dune systems. The State Parks Resources Management Division has limited wildland fire protection resources available to suppress fires on State Park lands. State Parks does not operate a fire station in Humboldt County and relies on CalFire as the primary wildfire protection resource for the lands under their management. State Parks cooperates with CalFire and Redwood National Park on prescribed burns, and can provide limited mutual aid.
- Technical Support Agencies
  - There are federal and state agencies that provide technical support to fire agencies/organizations. For example, the U.S. Fire Administration, which is a part of FEMA, provides leadership, advocacy, coordination, and support for fire agencies and organizations. The Office of the State Fire Marshal is a division of CAL FIRE and has a wide variety of fire safety and training responsibilities.

13.2 FIRE ECOLOGY

13.2.1 Wildfire Behavior

How a fire behaves depends on many factors, including, but not limited to the following:

- **Fuel**—Lighter fuels such as grasses, leaves and needles quickly expel moisture and burn rapidly, while heavier fuels such as tree branches, logs and trunks take longer to warm and ignite. In an effort to gain valid data, concurrent with the development of the mitigation plan and CWPP, the Tribe is also conducting a vegetation study, which data will support the efforts of the Tribe with respect to fuels management.

- **Weather**—Relevant weather conditions include temperature, relative humidity, wind speed and direction, cloud cover, precipitation amount and duration, and the stability of the atmosphere. Of particular importance for wildfire activity are wind and thunderstorms:
  - Strong, dry winds produce extreme fire conditions. Such winds generally reach peak velocities during the night and early morning hours. East wind events can persist up to 48 hours, with wind speed reaching 60 miles per hour. Being a coastal community, the Reservation experiences significant winds on a fairly regular basis during all times of the year.
  - The thunderstorm season typically begins in June with wet storms, and turns dry with little or no precipitation reaching the ground as the season progresses into July and August.
- **Topography —**Topography includes slope, elevation and aspect. The topography of a region influences the amount and moisture of fuel; the impact of weather conditions such as temperature and wind; potential barriers to fire spread, such as highways and lakes; and elevation and slope of land forms (fire spreads more easily uphill than downhill).

The "wildfire behavior triangle" (Figure 13-5) illustrates how these three factors influence wildfire behavior. Each point of the triangle represents one of the three factors; the sides represent the interplay between the factors. For example, drier and warmer weather combined with dense fuel loads and steeper slopes will cause more hazardous fire behavior than light fuels on flat ground.

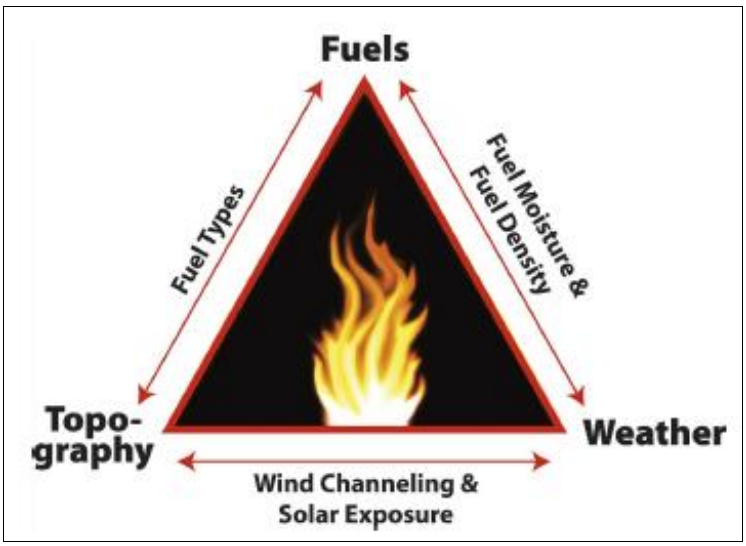

Figure 13-5. The Wildfire Behavior Triangle

Time of day also affects wildfire behavior, as a fire's peak burning period generally is between 1 p.m. and 6 p.m. Forest practices are an additional influence on wildfire behavior. In densely forested areas, stands of mixed conifer and hardwoods that have experienced thinning or clear-cut provide an opportunity for rapidly spreading, high intensity fires that are sustained until a break in fuel is encountered.

Fire behavior can be categorized as follows:

- **Smoldering**—Involves the slow combustion of surface fuels without generating flame, spreading slowly and steadily. Smoldering fires can linger for days or weeks after flaring has ceased, resulting in potential large quantities of fuel consumed. They heat the duff and

mineral layers, affecting the roots, seeds, and plant stems in the ground. These are most common in peat bogs, but are not exclusive to that vegetation.

- **Crawling**—Surface fires that consume low-lying vegetation such as grass, forest litter, and debris.
- **Ladder**—Fires that consume material between low-level vegetation or forest floor debris and tree canopies, such as small trees, low branches, vines, and invasive plants.
- **Crown**—Fires that consume low level surface fuels, transition to ladder fuels, and then consume suspended materials at the canopy level. These fires can spread at an incredible pace through the top of a forest canopy, burning entire trees, and can be extremely dangerous (sometimes referred to as a "firestorm").

Wildfires may spread by jumping or spotting, as burning materials are carried by wind or firestorm. Burning materials can also jump over roadways, rivers, or even firebreaks and start distant fires. Updraft caused by large wildfire events draw air from surrounding area, and these self-generated winds can also lead to a firestorm.

13.2.2 Wildfire Impact

Beyond the threat to humans, wildfire presents a risk to vegetation and wildlife habitats. Short-term loss caused by a wildfire can include the destruction of timber, wildlife habitat, scenic vistas, and watersheds. Long-term effects include smaller timber harvests, reduced access to affected recreational areas, and destruction of cultural and economic resources and community infrastructure. Vulnerability to flooding increases due to the destruction of watersheds. The potential for significant damage to life and property exists in WUI areas, where development is adjacent to densely vegetated areas. At present time, the area surrounding the Reservation is not densely populated, but is heavily wooded.

As a result of relevant landscapes that extend beyond the currently recognized Tribal boundary, the analysis included in this CWPP extends into other political boundaries, incorporating portions of the Tribe's ancestral boundaries. It is recognized that the effects of fire do no respect political boundaries, and it is important to determine fire hazards which have the potential to travel onto Tribal lands. Some of these areas of impact represent locations where there are agreements in place for response to fire across these political lines by fire districts and other agencies.

13.2.3 Communities at Risk

At the request of Congress, states submitted lists of all communities within their borders where there was a high level of wildfire risk from adjacent federal lands. The preliminary criteria and methodology for evaluating wildfire risk to communities is published in the *Federal Register*, January 4, 2001. Based on that criteria, a national list of "Communities at Risk" was published in the Federal Register in 2001.

In coordination with the federal effort, CalFire generated a statewide list establishing the communities at risk. Three main factors used to determine the wildfire threat in the wildland-urban interface areas of California were: fuel hazards, probability of fire, and areas of suitable housing density that could create wildland urban interface fire protection strategy situations. California's analysis (CAL FIRE, 2001) included the entire extent of the state's wildland urban interface (not just those adjacent to federal lands).

The California Fire Alliance (2001) defines Communities at Risk as all areas within "the vicinity" of 1.5 miles of wildland vegetation, roughly the distance that firebrands can be carried from a wildland fire to the roof of a house. It captures the idea that even those homes not sited within the forest are at risk of

being burned in wildland fire. With the use of the above definition as a foundation, the communities in and around these WUI areas become "Communities at Risk".

There are currently 1,272 communities at risk in California, ranging in size from large cities such as San Diego and Los Angeles, to small unincorporated areas with few residents (Figure 13-6). Bio-regionally, 78 percent of these communities are found in the Klamath/North Coast, Sierra, South Coast and Bay/ Delta bioregions (Table 13-1).

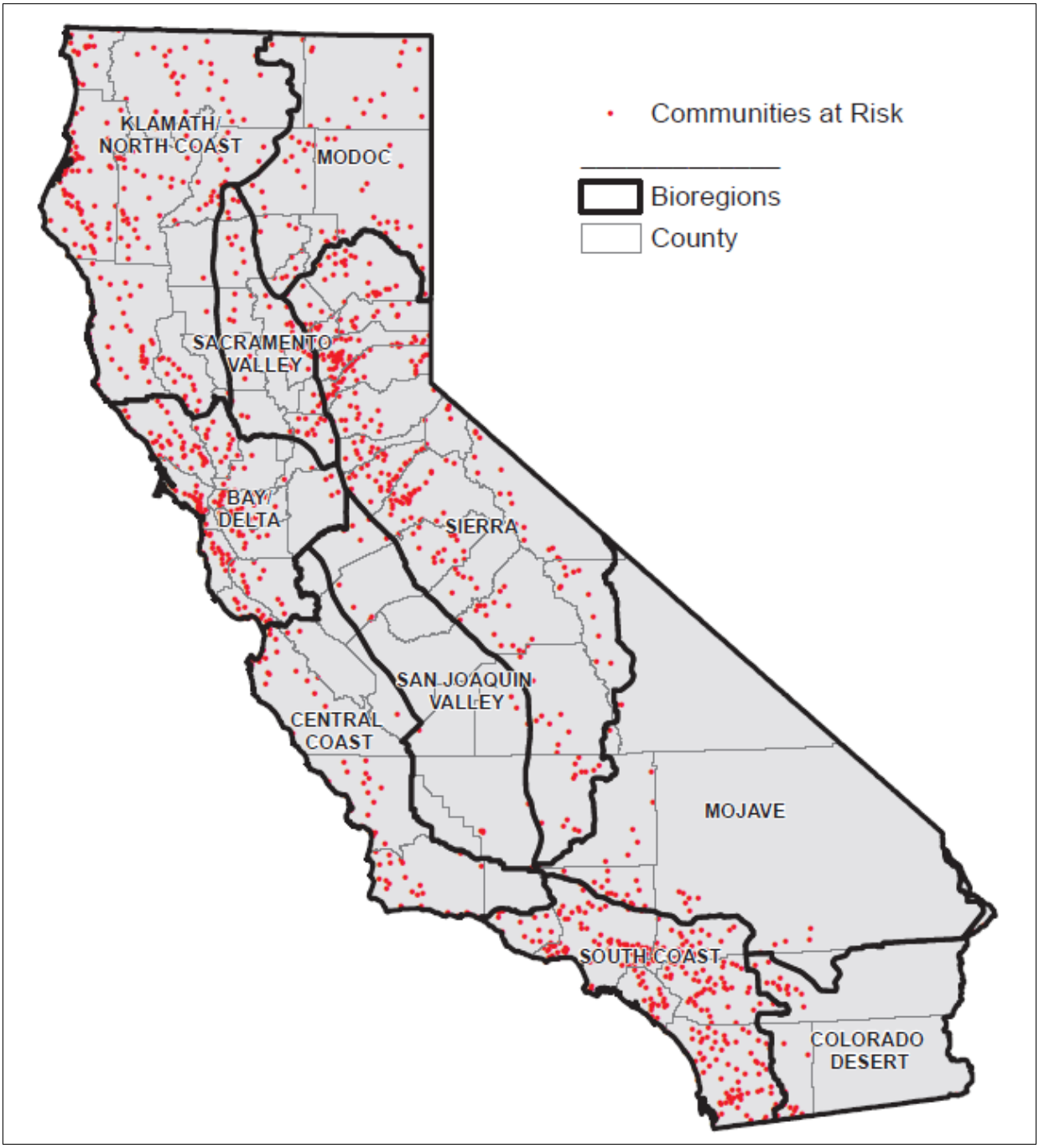

Figure 13-6. Statewide Communities at Risk (CalFire)

TABLE 13-1.
BIOREGIONS AT RISK

Bioregion	Number of Communities at Risk	Percent of Communities at Risk
Sierra	314	25
South Coast	269	21
Klamath/North Coast	226	18
Bay/Delta	177	14
Central Coast	72	6
Modoc	66	5
Sacramento Valley	61	5
Mojave	41	3
Colorado Desert	28	2
San Joaquin Valley	18	1
Total	1,272	100

Based on the communities at risk analysis conducted by the California Fire Alliance, the areas of the Yurok Reservation listed in Table 13-2 are identified as Communities at Risk. It should be noted that while some of the areas of the Reservation are addressed, available data from the California Fire Alliance does not reflect the Threat Hazard Level within each community.

TABLE 13-2.
YUROK TRIBE COMMUNITIES AT RISK AS DEFINED BY CALIFORNIA FIRE ALLIANCE HUMBOLDT AND DEL NORTE COUNTIES DISTRIBUTION

	Community Name	Threat Hazard Level*	Federal List
	Yurok Reservation	3	Yes
Upper Reservation Humboldt County	Bald Hills		
	Ke'pel		
	McKinnon Hill		
	Notchco		
	Pecwan		
	Tulley Creek		
	Wautec		
	Weitchpec	2	Yes
Lower Reservation Del Note County Boundary	Blake Allotment		
	Hoppel		
	Hunter Creek (Not Reservation lands)		
	Klamath	3	Yes
	Klamath Beach Road		
	Klamath Glen	3	Yes
	Requa	3	Yes
	Resighini Rancheria (Separate Tribe)		

13.2.4 Identifying Wildfire Hazard

When analyzing the impact from wildfire damage and danger, we identify the wildfire hazard as the physical conditions that cause damage, while the risk associated with the hazard refers to the potential damage the hazard can cause. The Wildfire hazard to communities is generally determined by the number, size and types of wildfires that have historically affected the area; historical fire regimes and fire classifications; topography; fuel and weather; suppression capability of local and regional resources; where and what types of structures are in the WUI; what types of pre-fire mitigation activities have been completed; and the structural ignitability. Identifying areas most susceptible to wildfire or determining the course a fire takes requires precise science. While this analysis will propose vulnerable areas, the purpose of this analysis *is not to determine fire behavior*, and fire managers or response personnel should not view this document as an attempt to make that determination. Data necessary to conduct that type of analysis are limited for the Reservation, and are not included in this analysis. At the present time, the following data is most useful in assessing hazard impact in the planning area:

- Spatial factors:
  - Topography (slope and aspect)
  - Vegetation (fire fuels)
- Climate/Weather
- Human factors:
  - Response network
  - Viewshed
- Fire History
  - Historic fire regimes

Once the above data has been assimilated, the critical facilities layer for the Reservation, which includes homes, roads, fire stations, and some natural resources, was introduced into the analysis. Applying standard GIS analysis methods, these data sets are used to determine parts of the Reservation with the highest wildfire hazard and highest risk of catastrophic loss. This information results in demonstration of those facilities and structures that have need for protection in relation to wildfire hazard.

13.3 COMPONENT-BASED HAZARD RATING

13.3.1 Model Projection

Fire hazard analysis is comprised of multiple datasets and layers, which combined provide information necessary to determine fire hazards in a particular area. Determining fire hazard is a precise science, and *this document does not represent a scientific analysis, but rather a methodology of analysis which incorporates those elements necessary to determine potential fire hazard on the YR*. Utilizing this data provides the Reservation with information which can be incorporated into response planning, resource allocation, financial allocations, and land use development

13.3.2 Hazard Assessment Rating Table

Points were used to help weight each map layer by potential contribution to wildfire behavior, which, when summed, determines the relative wildfire hazard levels for the Yurok Reservation as shown on Table 13-3

TABLE 13-3.
HAZARD ASSESSMENT RATING LEVELS

Category	Item	Points	Point Category	Hard Rating	Overall Rating Percent
Spatial	Fuels	5	Light/Agriculture	Low	35%
		10	Medium	Moderate	
		20	Heavy	High	
		25	Slash/Heavy	Extreme	
	Slope	1	<10%	Minimal	12%
		4	10-20%	Low	
		7	21-30%	Moderate	
		8	31-40%	High	
		10	>40%	Extreme	
	Aspect	0	North	Low	4%
		2	East	Moderate	
		3	West	High	
		5	South	Extreme	
Human	Response Network	0	<6 minutes	Minimal	12%
		1	6-10 minutes	Low	
		2	11-15 minutes	Moderate	
		3	15-60 minutes	High	
		4	>60 minutes	Extreme	
	Viewshed	0	Viewed from roadway and communication network in place	Visible	5%
		4	Not in easy view	Limited visibility	
		6	Visible	Visible/lack of infrastructure to report quickly	
		10	Not visible	Not visible	
Climate	Weather	1	Average monthly Precipitation (70%)	Low	32%
		35	Average Monthly Temperature (30%)	Extreme	
Maximum Possible		**89**			**100%**

13.3.3 Fuel

As we have learned, wildfires require a combination of three factors in order to exist, including: fuel, topography and weather. Each of those three elements play a critical role, and fire cannot exist without all three. In the case of a wildfire, fuel is synonymous with vegetation.

Many factors are considered when determining the risk associated with the various types of vegetation including, but not limited to:

- The type fuel/vegetation, categories into four groups – timber, brush, grasses and slash, with the differences in fire behavior among these groups related to fuel load and its distribution among the fuel particle size classes.
- The type of tree—deciduous (leaf) or needles (Douglas Fir).
- The type of leaf – oil based.
- Fuel density—dense forests usually provide more shade, resulting in lower ambient temperatures and greater humidity, therefore, being less susceptible to wildfires.
- Rate of ignition—less dense materials, such as grasses and leaves, are easier to ignite because they contain less water than denser materials, such as branches and trunks.
- Rate of burn – the type of material (among other things) determines the rate at which fire will spread, and the intensity (heat) of the fire for continued ignition.
- The age of trees and associated diameter or size of the stands.
- The health of the forest.
- Forest canopy height – the average height of the top of a vegetated canopy.
- Forest canopy base height, which describes the average height from the ground to the forest stand's canopy bottom (the lowest height in a stand at which there is sufficient amount of forest canopy fuel to propagate fire vertically into the canopy).

Fire Prediction Modeling is a very precise science. Because of the precise science involved in determining all of these factors, in conjunction with the Healthy Forest Act, various agencies and organizations have been tasked with compiling the required information for local entities to use so as to assist in conducting wildfire risk assessments, while also providing standardized methodologies to maintain consistency in determining the threat level. One such approach, the 13 Anderson Fire Behavior Fuel Model, serves as input for the (mathematical) surface fire behavior and simulated spread models to determine burn rate and intensity (Rothermel, 1972). For the purpose of this analysis, the 13 Anderson Fire Fuel Models has been utilized.

Fuels for the study area are modeled using data available from multiple sources, including: CalFire (FRAP), the 2012 Yurok Vegetation Study, and the LANDFIRE data, a federally funded organization devoted to providing spatial data to wildland managers (http://www.landfire.gov).

The fuel models are based on the 13 Anderson Fuel Models created by the U.S. Forest Service, and link vegetative type (such as a woodlot) to a set of average fuel loadings (such as timber, size, litter and understory) that can help predict wildfire behavior. LANDFIRE provides the data set on a 30-m grid with each pixel assigned a value corresponding to the Anderson Fuel Model code (Figure 13-7). Hazard levels for the fuels are based on the NFPA's 2002 *Standard for Protection of Life and Property from Wildfire* (NFPA 1144, 2002 edition). The fuel data accounts for 35% of the overall hazard rating. It should be noted that not all fuel behavior models listed in Table 13-4 are applicable to the planning region.

Figure 13-7. Fuel Map

TABLE 13-4.
PLANNING AREA FUELS

Fuel Behavior Model	Vegetation	Hazard Points	Category
1	Short Grass (1 foot)	5	Low
2	Timber (grass and understory)	5	Low
5	Brush (2 feet)	5	Low
93	Agriculture	5	Low
3	Tall grass (2.5)	10	Moderate
6	Dormant brush, hardwood slash	10	Moderate
8	Closed timber litter	10	Moderate
9	Hardwood litter	10	Moderate
4	Shrub Group	20	High
7	Southern rough	20	High
10	Timber (litter and understory)	20	High
11	Light Logging Slash	25	Extreme
12	Medium Logging Slash	25	Extreme
13	Timber/Heavy slash	25	Extreme

Utilization of the 2012 Vegetation Study completed for the Tribe resulted in a comparison of the vegetation type depicted in the Landfire layer to that of the vegetation classification to determine accuracy. At the time of this analysis, the vegetation study completed for the Tribe did not include the size of various vegetation stands, which in its simplest terms impacts the rate of fire spread and ignition based on the vulnerability of the type of vegetation stands. In an effort to determine the accuracy of the Landfire data, a GIS union function of the two datasets was attempted (Landfire and 2012 GHD Veg Study). This union resulted in a dataset too large to accurately project, as the sources were projected in polygon format, and not by point data. The two datasets are represented below, showing the level of risk associated with each data source. Figure 13-8 is the Landfire data with associated fuel hazard ranking. Figure 13-9 is the GHD data with associated fuel hazard ranking.

The vegetation classification based on the 2012 study, while maintaining increased accuracy with respect to vegetation type, does not represent projection by size, thereby reducing the level of impact throughout the reservation. Based on this, it was determined that the Landfire dataset would be utilized for the purposes of this analysis.

There are a wide range of ecosystems on the Reservation, providing a variety of fuel models for consideration within this study. Within the greater region, there is a rain shadow created by the Klamath Mountains; as cool moist air moves inland from the Pacific Ocean, the mountains “dam” clouds, and orographic uplift causes the moisture to drain out of the air and fall as precipitation in the western portion of the Reservation. On the other side of the rain shadow, the area is considerably dryer. This difference in precipitation, along with the economic activities of logging provides the region with everything from fine grassy fuels to heavy timber and slash. Fuel moisture is one of the elements considered when determining the classification of vegetation area. Figure 13-10 depicts the average fuel moister for the 2011-2012 timeframe.

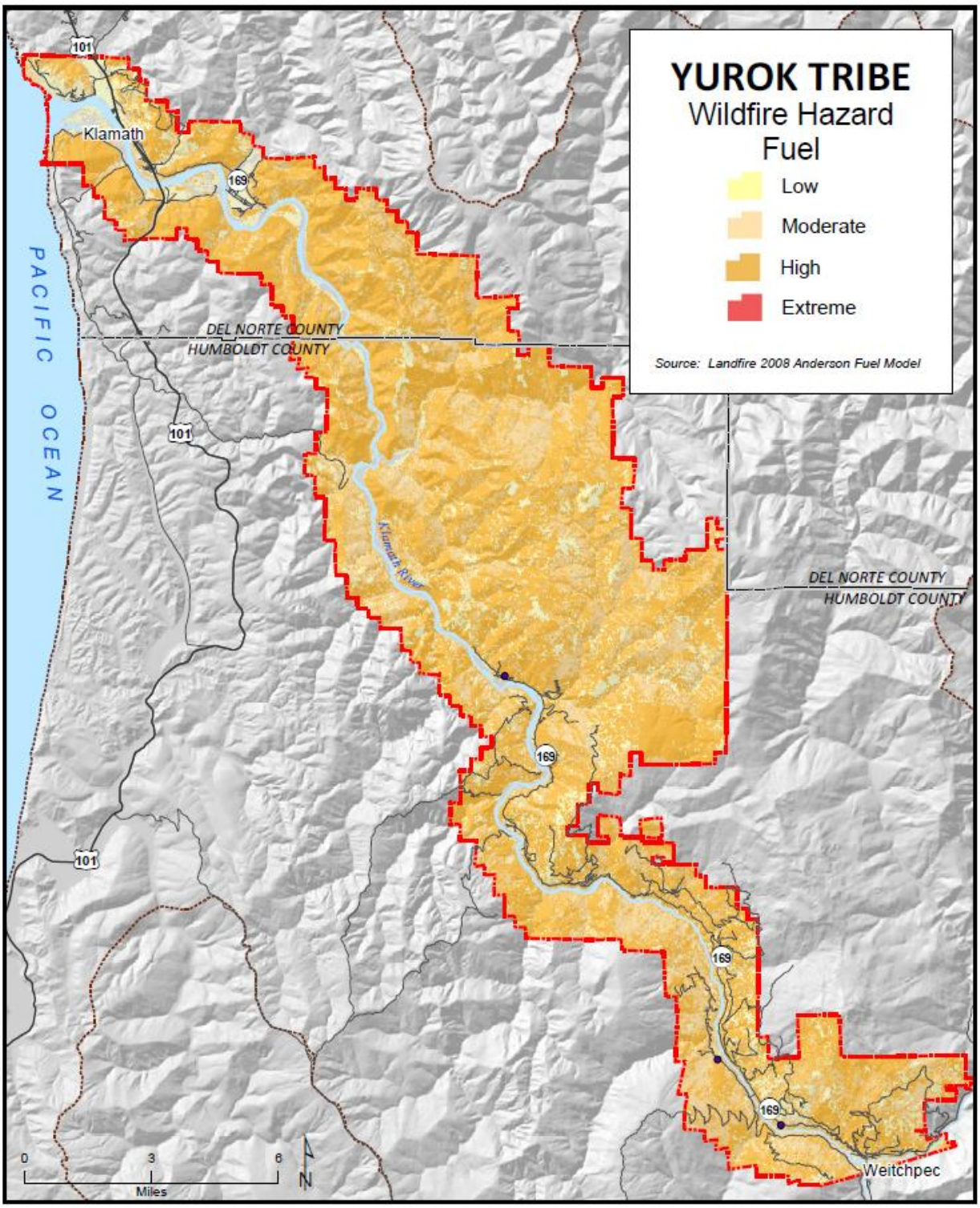

Figure 13-8. Landfire Fuel with Hazard Ranking

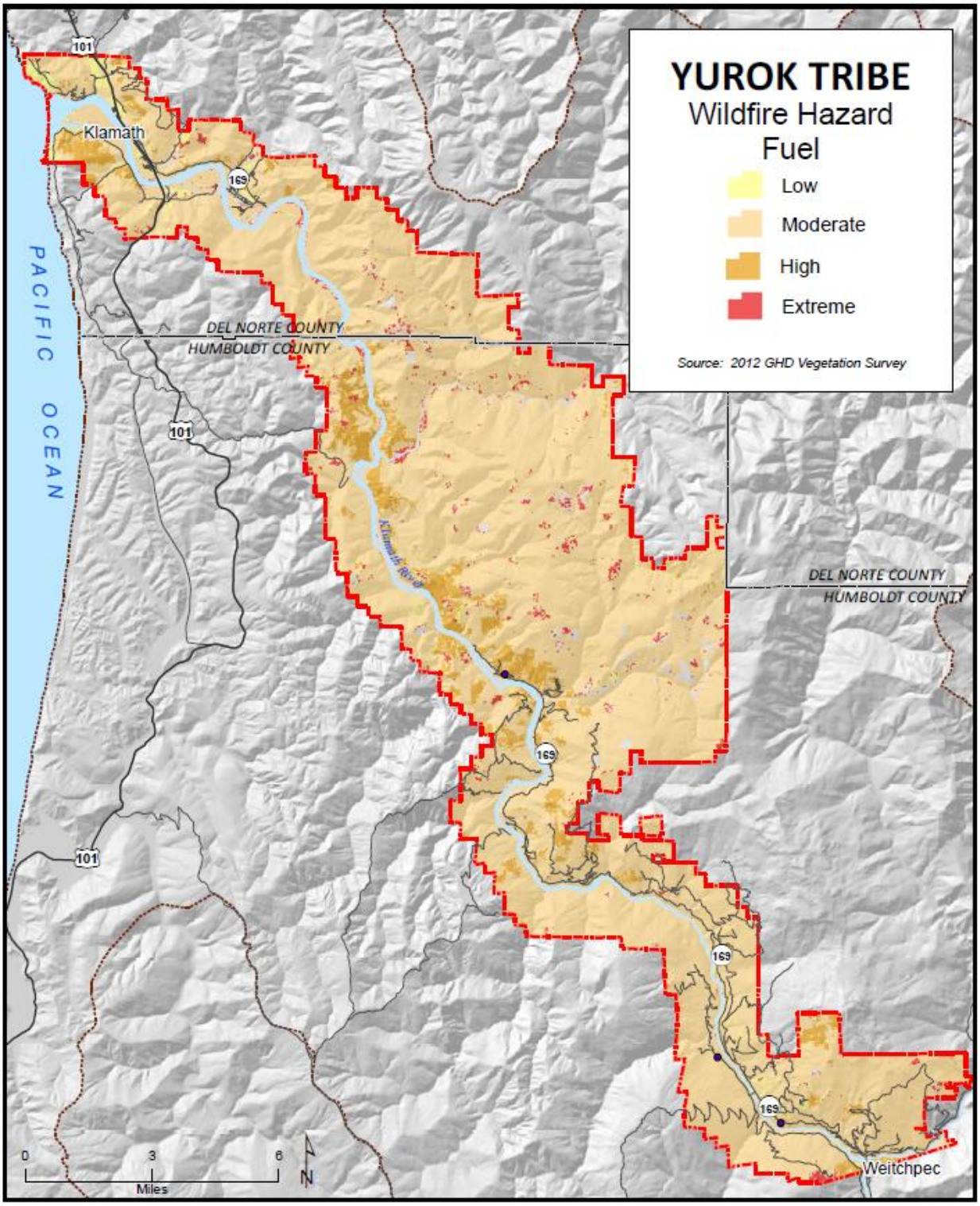

Figure 13-9. 2012 Vegetation Study Fuel with Hazard Ranking

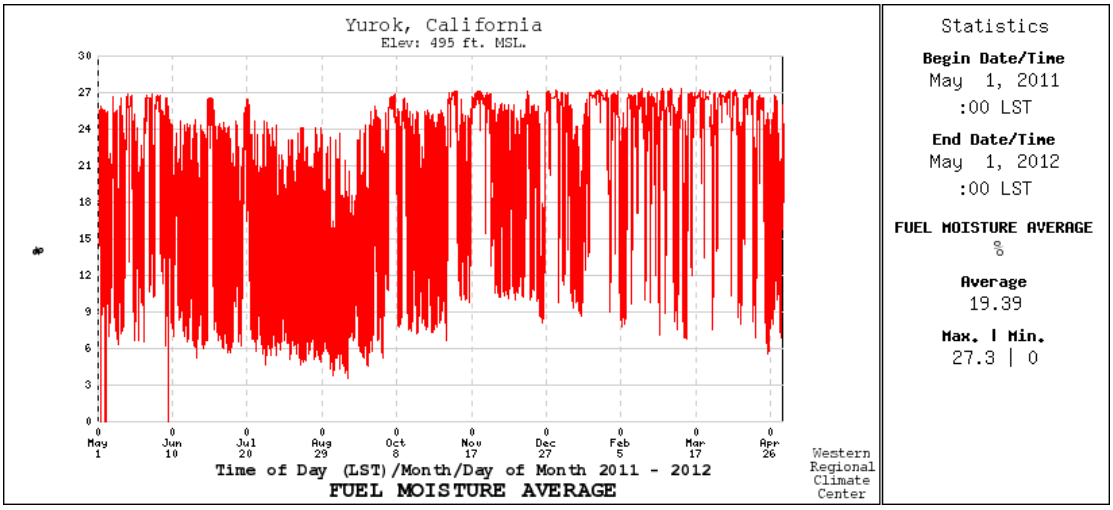

Figure 13-10. Fuel Moisture Average May 2011-April 2012

The Reservation has historically been logged, and there remains logging slash in place. Likewise, the Reservation also has fuel consisting of brush, closed timber litter, hardwood litter and understory, which will burn with greater intensity. Some of the fires occurring on the Reservation have burned lands with harvestable stands.

Many years ago, the members of the tribe practiced controlled burns for ecological and cultural reasons. However, due to restrictions implemented by both Humboldt and Del Norte Counties and the various federal entities, prescribed burns have not taken place for many, many years, thereby increasing the fire danger on the Reservation. Currently the Yurok Tribe is working with CalFire and the BIA to develop a burn plan (approved by CalFire and BIA) with a fuels specialist, recognizing the importance of control burns in the overall environmental health and cultural importance on the reservation.

The Yurok Reservation is predominantly timberlands and parklands, interspersed with riparian channels and associated vegetation. The Redwood National Park boundary is located on the west side of the Klamath River. Surrounding forests are predominantly mixed conifer forest consisting of coast redwood, Douglas fir and spruce of different maturity levels, with intermingled hardwoods, including: alder, maple, cottonwood, and very dominant amounts of tanoak in the southern half of the reservation on the northern and eastern facing slopes. Redwood and spruce are a prominent feature near the mouth of the river, and approximately half way along the river corridor. Pine and chaparral are a limited feature in a few elevated, exposed serpentine soiled areas. The Reservation has a few areas of logging slash and blow over, with limited fire scars. There are also some limited natural grasslands, with chaparral.

The large amount of precipitation received on an annual basis increases vegetation growth, which increases fuel source. A key component of this fuel type is the amount of down and dead woody fuel, including slash.

13.3.4 Slope

The percent slope is derived from a 30 m digital elevation model (DEM) (Figure 13-11). The slope hazard rating is a large contributor (12%) to the hazard rating because of its influence on fire spread and the increased difficulty of fighting wildfire as slope steepens.

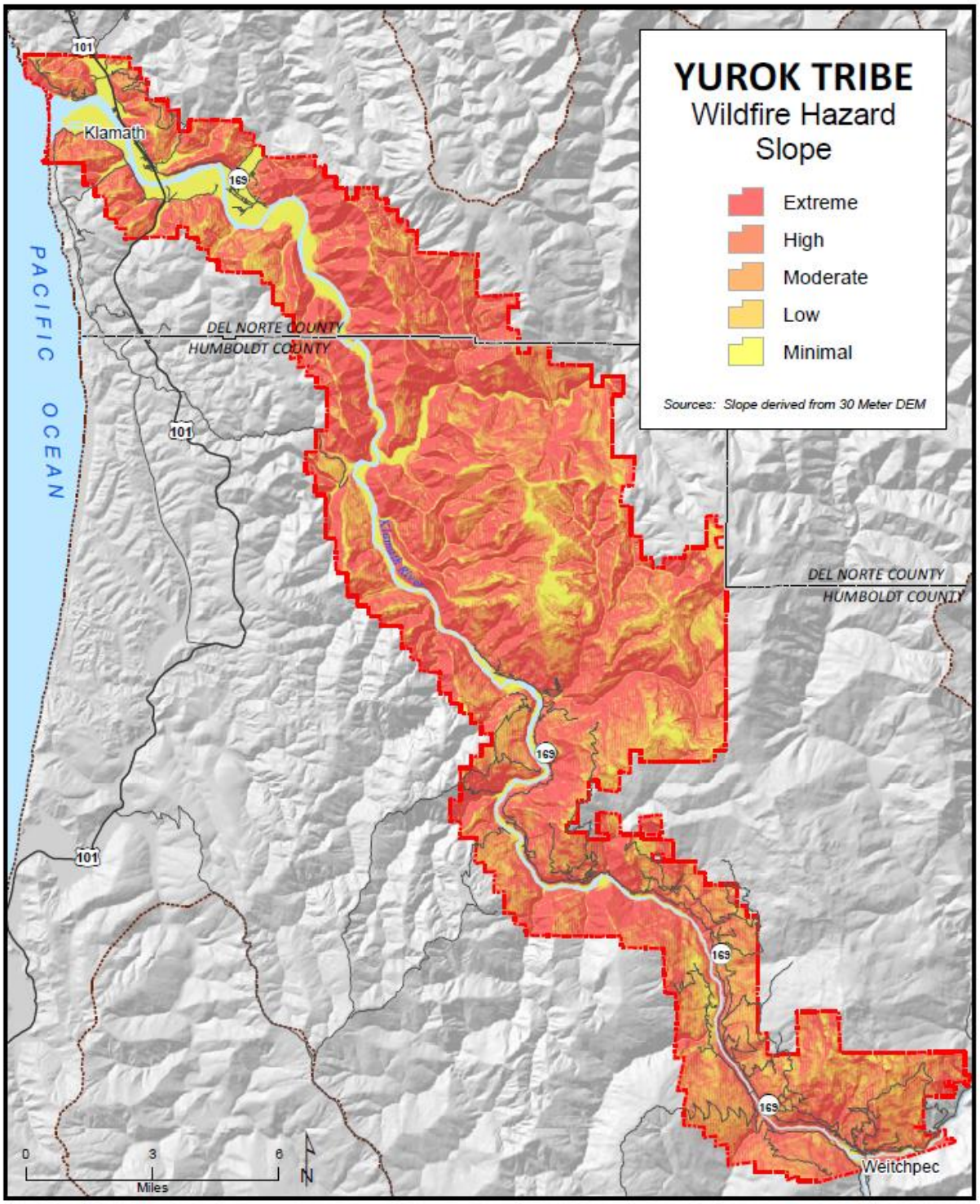

Figure 13-11. Slope Map

The geologic makeup of the Reservation consists of valleys and drainages running from the mountainous regions to the ocean. Composed of several watersheds and bordering densely wooded areas, precipitation in the area cuts down through the predominantly sedimentary rocks, carving both steep canyons and wide drainages into the ocean. These steep slopes increase a fire's rate of spread uphill and can create topographic influences on wind. The slope values were associated with hazard classes based upon NFPA 1144 Standards for Protection of Life and Property from Wildfire (2002), as summarized in Table 13-5.

TABLE 13-5.
SLOPE AND ASSOCIATED HAZARD

Slope	Hazard Points	Category
<10%	1	Minimal
10 – 20%	4	Low
21 – 30%	7	Moderate
31 – 40%	8	High
>40%	10	Extreme

Review of the slope data for the various areas of the Reservation have a range of minimal along the coastline, to more extreme slopes in the inner boundaries of the Reservation, much of which is forest lands.

The Tribe has initiated several watershed restoration projects which will protect and re-establish forestlands from non-forest uses. The restoration programs provide for not only traditional forest uses, but also enhance and protect the water, cultural resources, fish and wildlife. Its intent is to protect the lands from development, and require sustainable forestry practices. Many of the areas of extreme slope are part of these conservation and reforestation projects that will remain protected.

13.3.5 Aspect

Aspect, as demonstrated in

Figure 13-12 has a noticeable influence on humidity and vegetation type in the planning region, particularly during the fire season months. Within in the Reservation, south- and west-facing slopes receive more solar radiation than slopes with a north aspect due to increased solar insolation at higher latitudes (Figure 13-13). Thus, these areas are drier with varying types of vegetation and fuel patterns (Table 13-6). Figure 13-14 depicts the level of solar radiation for the time period May 1, 2011-April 30, 2012. The majority of the planning region has moderate to extreme aspect, with some limited areas having low aspect. While important, aspect is not a major driver of fire behavior and thus accounts for 4% of the hazard ratings.

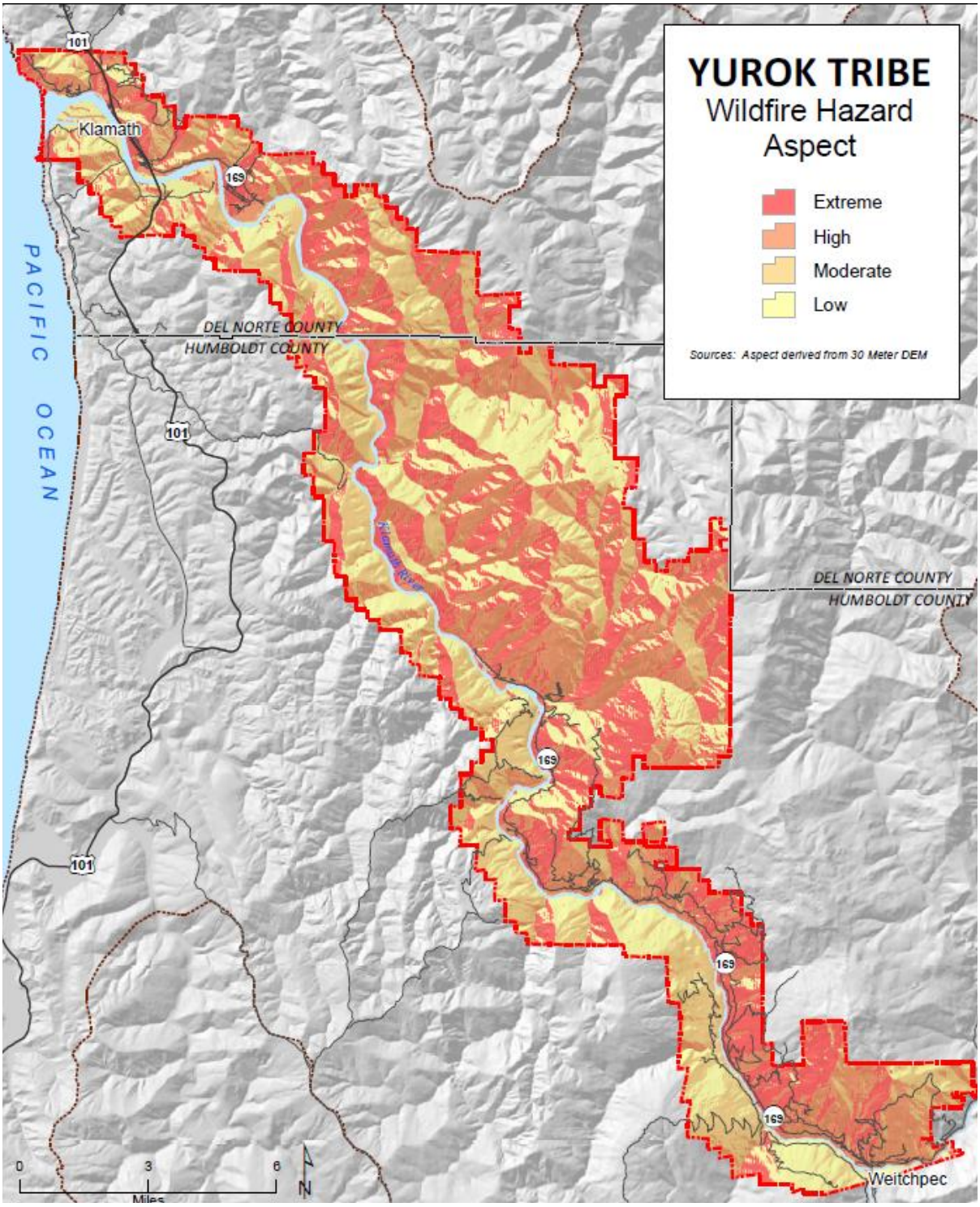

Figure 13-12. Aspect Map

Figure 13-13. Solar Radiation on North and South Aspects

TABLE 13-6.
ASPECT AND ASSOCIATED HAZARD

Aspect	Degrees	Hazard Points	Category
N	315.01 – 45	0	Low
E	45.01 – 135	2	Moderate
W	135.01 – 225	3	High
S	225.02 – 315	5	Extreme

Source: Western Region Climate Center http://www.raws.dri.edu/cgi-bin/rawMAIN.pl?caCYUR

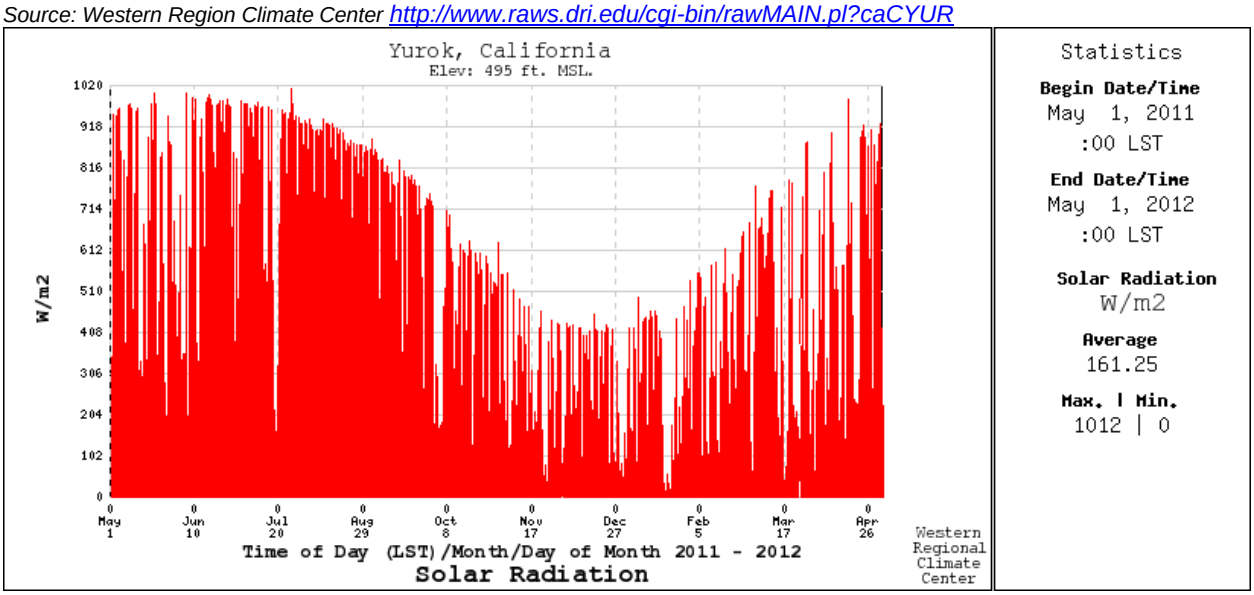

Figure 13-14. Solar Radiation May 2011-April 2012

13.3.6 Weather

Vegetative fuel moisture/temperature, air temperature, and relative humidity are the most important drivers of wildfire behavior. Unfortunately, there are no existing geographic data sets for the Reservation that provides an overall picture of these variables. To serve as a surrogate for these variables, a grid was produced from long-term climate data for each month. While typically fire season ranges from July-October, historic fire regimes demonstrate that fires within the region can occur any time of the year. The peak period of July, August and September are often times related to thunderstorms and lightning strikes.

Climate data was obtained from WORLDCLIM, a geographic dataset based on comparisons of regional weather stations and remotely sensed weather data (Figure 13-15). Monthly datasets of mean temperature and precipitation are combined into a single data set that weights precipitation as 70% and maximum temperature as 30% of the relative contributions to hazard based on climate. The weighting is justified by: 1) the very important influence of fuel moisture on fire behavior, and 2) the variable precipitation from month-to-month, with a relatively more steady maximum temperature range throughout the fire season. The climate factor provides 35% of the weight toward the overall hazard rating.

Precipitation in Northern California is usually at its lowest from July to September. During the dry summer months, the abundant vegetation dries out and becomes hazardous fuel. That fuel combined with any type of wind factor — especially in a hot and dry form—can produce extreme fire danger.

Thunderstorm activity, which typically begins in June with wet storms, turns dry with little or no precipitation reaching the ground as the season progresses into July and August. Thunderstorms with dry lightning are more prevalent in the eastern portion of the county. July and August are when local winds (slope winds and sea breezes) predominate, with the Pacific jet stream weak and well to the north. By mid or late September, north to northeast winds return, bringing in moist ocean air. These winds are more critical for bringing in moist ocean air than in the late spring, due to much lower large dead fuel moistures, and the stressed live fuels.

The western portion of the Reservation's fire season typically is shorter than the eastern half due to the following reasons:

- ✓ The western half of the Reservation receives more rainfall
- ✓ The west has spring seasons that are wetter and cooler than the east.
- ✓ Temperatures in the eastern portion of the reservation are much higher in the summer months
- ✓ Much of the precipitation received in the east is snow that falls during the winter.

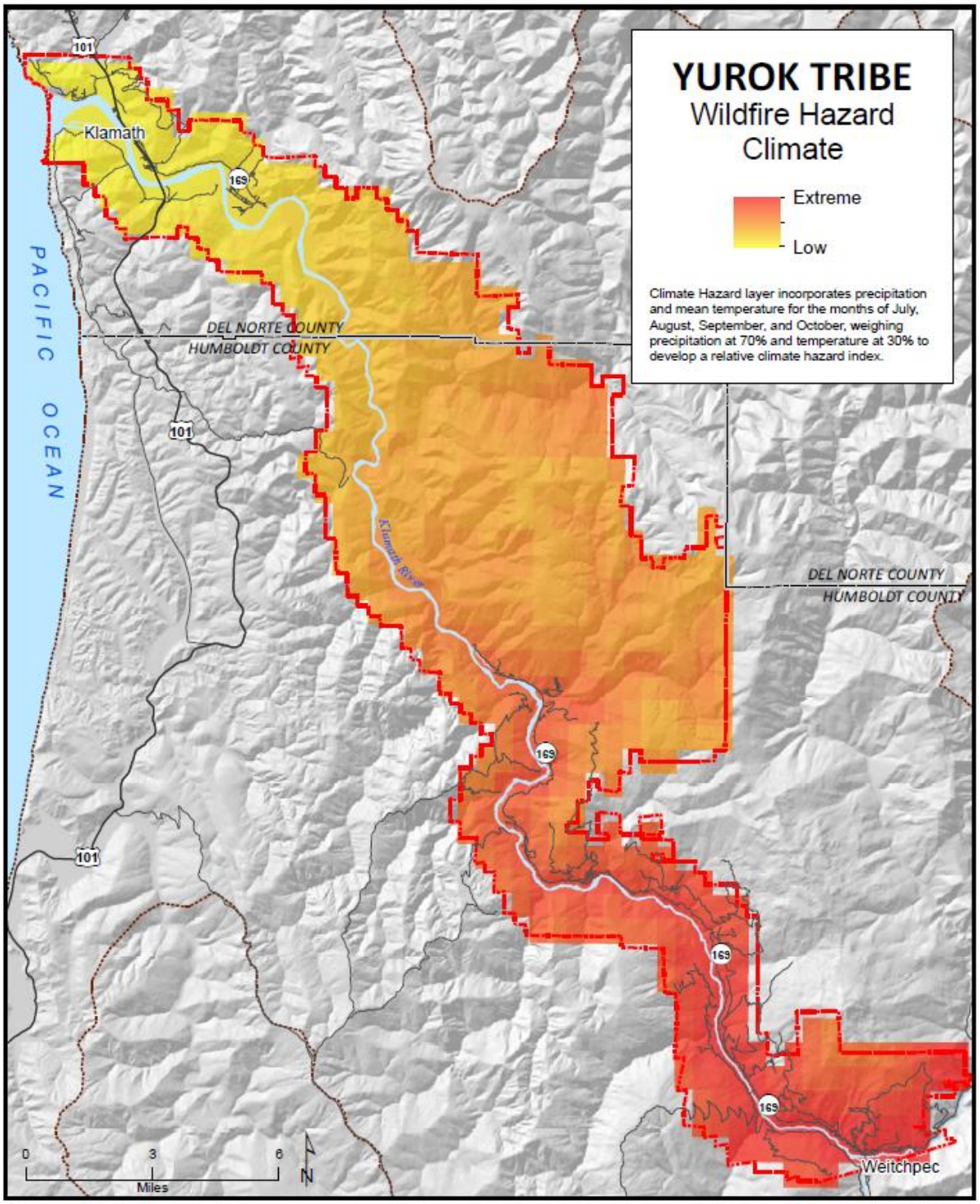

Figure 13-15. Climate Hazard Layer

13.3.7 Roads and Fire-Response Network

Because the YR is very rural, there are few fire stations, and even fewer of them are staffed with full-time fire crews within the area. A response network assessment, based on ESRI's StreetMap dataset, allows a classification of higher hazard in areas that are more distant from timely response. The hazard time breakdowns are based on local and generalized parameters for what qualifies as a good response time (Table 13-7). In addition to the response time, response area is also considered. This includes the average distance an engine can provide service from a location while parked on along a road (about 500 feet). Response network accounts for 12% of the hazard rating.

TABLE 13-7.
TRAVEL TIME AND ASSOCIATED HAZARD

Response Time	Hazard Points	Category
< 6 minutes	0	Minimal
6 – 10 minutes	1	Low
10 – 15 minutes	2	Moderate
15 – 60 minutes	3	High
> 60 minutes	5	Extreme

Due to the rural nature of the region, response times for wildland fire crews are a critical factor in early suppression. The less-than-favorable road conditions in the area of the YR (including Wilderness Areas managed by NPS and USFS) pose a challenge for transportation of fire suppression resources and fire response activities. Fire stations considered within the assessment area include stations operated by the Yurok Volunteer Fire Department located in the Weitchpec area, and the Del Norte Fire Unit near Klamath.

Historically, fire response time for areas is calculated using the speed limit on each road segment, starting from each station. Emergency vehicles can travel at five miles per hour over the speed limit, but will slow down for traffic, for navigating traffic controls, and at dangerous intersections. Thus, the speed limit would normally be considered a reasonable basis for evaluating travel times.

It was determined that this approach was not feasible for the Yurok Reservation for a number of reasons: the condition of much of road network on the Reservation, including roadways which are blocked by locked gates; the lack of adequate roadways in many areas in which housing exists; size of the roadway not allowing for certain types of fire response vehicles, and the fact that the fire departments servicing the area are volunteer departments, requiring additional time for reporting to the station prior to reporting to the scene of the burn.

Based on those factors, it was determined that at best, areas within the 500 foot buffer of major roadways which have a response time of less than 60 minutes would be assigned a "high" value in determining risk, while all other areas would be assigned a value of "extreme" as response times are greater than 60 minutes, and/or roadways cannot support the various types of fire suppression or emergency response equipment which may be needed. Figure 13-16 depicts the results of this analysis.

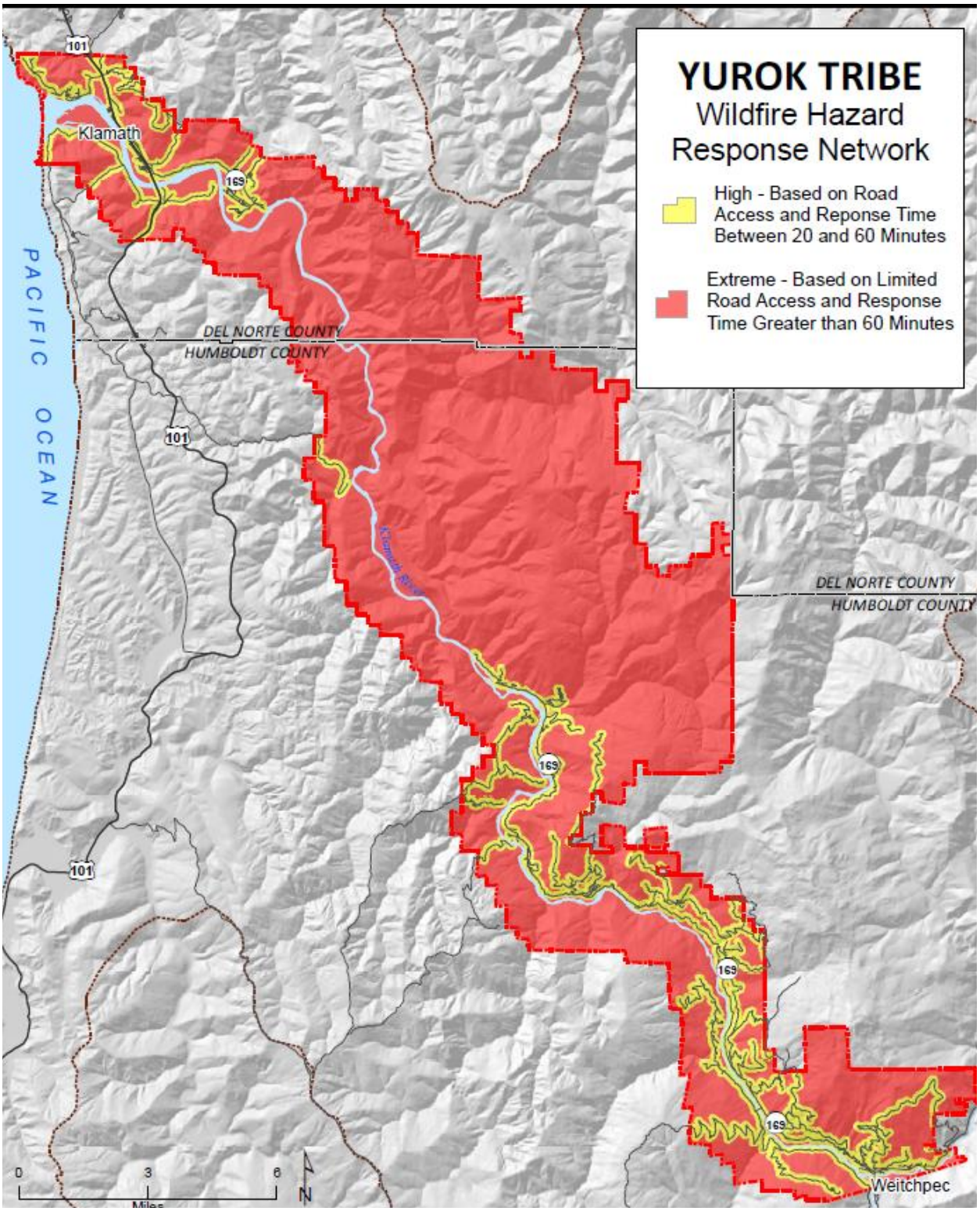

Figure 13-16. Response Map

13.3.8 Viewshed

A viewshed of areas visible from major roads provides an assessment of areas of the Reservation that—because fires or smoke plumes might be more quickly seen from areas more well-traveled—could be detected more quickly after ignition. Faster detection can lead to better chances of earlier suppression by fire crews.

In normal situations, a transportation network across the YR would be valuable in early fire detection, as residents and vehicles moving along the major roads serve as the first line of detection for wildfires. However, due to the limited transportation system, the density of the forest canopy, and the significant restrictions with respect to the lack of telephones and cell towers within areas of the YR, early detection by way of viewshed is severely hampered.

Equally important to the overall hazard profiling is the fact that many parts of the Reservation are approximately 2 hours or more of travel time away from any fire response agencies. This limits the significance of reporting the fire based on early smoke visibility. While the road onto the Reservation is a highway system road, its use is limited to a large extent to those individuals living on the Reservation, tourists to the area, businesses traveling to the Reservation, and delivery to the businesses on the reservation. Therefore the potential for early smoke detection indicating fire, or visibility of the fire, is limited in nature.

The viewshed analysis demonstrates the area visible from structures located on the reservation, based on a 30-m DEM. The building inventory dataset was developed using information provided by Tribal staff. Areas visible from structures are associated with a reduced wildfire hazard because they will usually have reduced detection times. Results are shown on Figure 13-17.

While road factors in many situations is of less significance to the overall wildfire hazard when compared to the spatial and climatic variables, in the instance of the YR, because the limitations and restrictions with respect to transportation on the Reservation, the limited viewshed, and the negative impact the transportation system has on firefighting capabilities, this factor was given a 5% weighting factor in the overall rating.

Historical Fire Regime

Alterations of historical fire regimes and vegetation dynamics have occurred in many landscapes in the U.S., including the Yurok Reservation through the combined influence of land management practices, fire exclusion, insect and disease outbreaks, climate change, and the invasion of non-native plan species. Anthropogenic influences to wildfire occurrence have been witnessed through arson, incidental ignition from industry (e.g., logging, railroad, sporting activities), and other factors. Likewise, wildfire abatement practices has reduced the spread of wildfires after ignition.

The LANDFIRE Project produces maps of simulated historical fire regimes and vegetation conditions using the LANDSUM landscape succession and disturbance dynamics model. The LANDFIRE Project also produces maps of current vegetation and measurements of current vegetation departure from simulated historical reference conditions. These maps support fire and landscape management planning outlined in the goals of the National Fire Plan, Federal Wildland Fire Management Policy, and the Healthy Forests Restoration Act. The Simulated Historical Mean Fire Return Interval (MFRI) data layer quantifies the average number of years between fires under the presumed historical fire regime. This data layer is derived from vegetation and disturbance dynamics simulations using LANDSUM. LANDSUM simulates fire dynamics as a function of vegetation dynamics, topography, and spatial context, in addition to variability introduced by dynamic wind direction and speed, frequency of extremely dry years, and landscape-level fire characteristics.

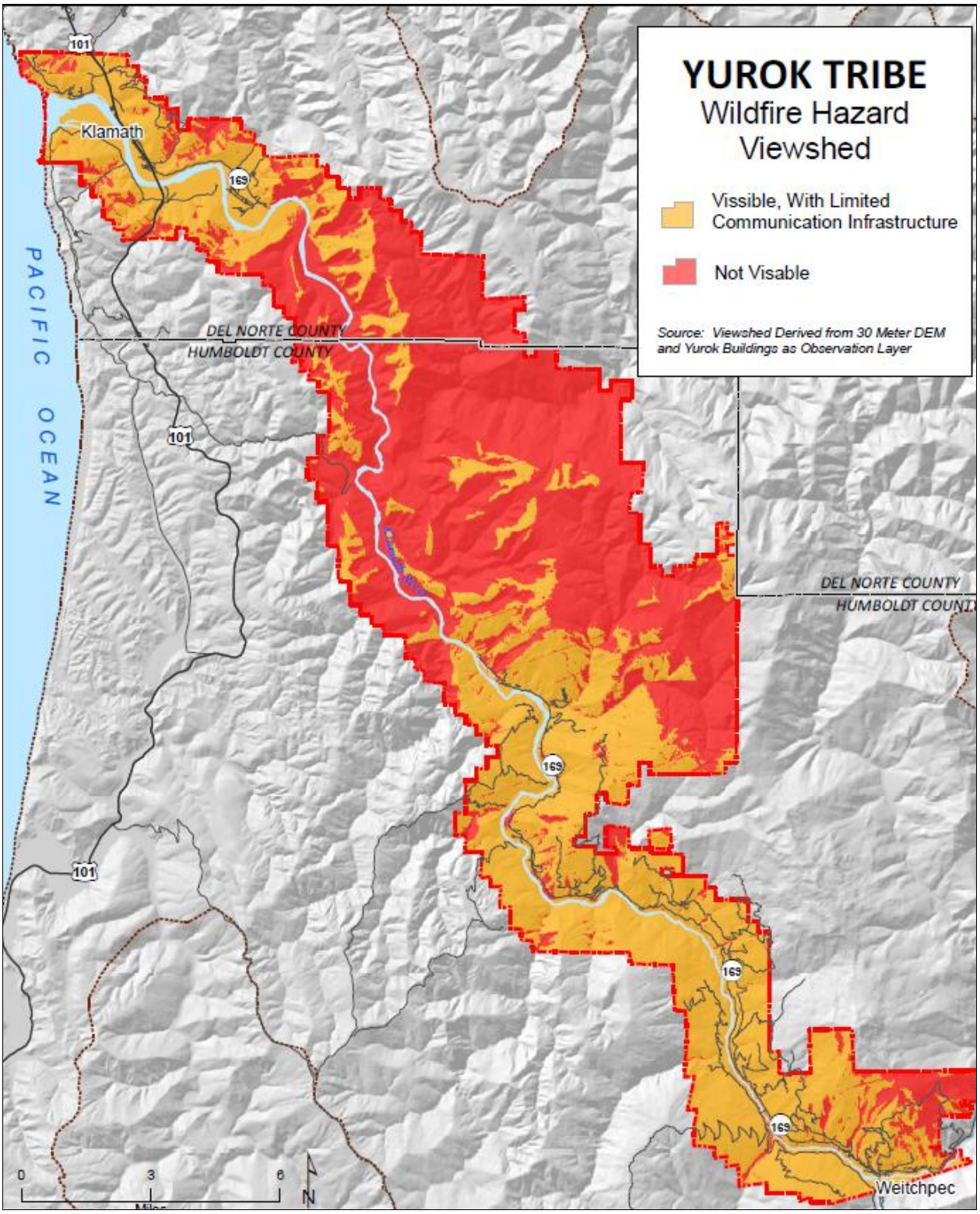

Figure 13-17. Viewshed Map

The Simulated Historical Fire Regime Groups utilized in LANDFIRE (HFRG, 2006), categorize simulated MFRI and fire severities into five fire regimes defined in the Interagency Fire Regime Condition Class Guidebook, as follows (see Figure 13-18 and Figure 13-19):

- Regime 1: 0-35 year frequency, low to mixed severity
- Regime II: 0-35 year frequency, replacement severity
- Regime III: 35-200 year frequency, low to mixed severity
- Regime IV: 35 -200 year frequency, replacement severity
- Regime V: 200+ year frequency, replacement/any severity

13.3.9 Departure and Fire Regime Condition Class

Fire is a natural and critical process in most diverse terrestrial ecosystems, dictating, at least in part, the types, structure and spatial extent of native vegetation. Most ecosystems within the planning area are adapted to a historic fire regime as defined above, which characterizes the historic patterns of fire occurrence in a given area. Once the historic fire regimes are determined, variances from those historic regimes must also be assessed to determine the Fire Regime Condition Class. Fire regime condition classes reflect the current conditions' degree of departure from modeled reference conditions.

FRCC assessments measure departure in two main components of ecosystems: 1) fire regime (fire frequency and severity) and 2) associated vegetation. Managers can use the departure and condition class data to document possible changes to key ecosystem components (Schmidt and others 2002). Examples include vegetation characteristics (defined below) (e.g., species composition, structural stage, stand age, canopy closure, and mosaic pattern); fuel composition; fire frequency, severity, and pattern; and other associated disturbances, such as insect and disease mortality, grazing, and drought.

Characteristic conditions are defined as those occurring within the natural fire regime and associated vegetation (for example, low departure [FRCC 1]). Stated another way, characteristic conditions are those described in available biophysical settings models. In contrast, *uncharacteristic* conditions are those that did not occur within the natural regime, and hence produce an FRCC 3 (high departure) assessment outcome.

Uncharacteristic conditions include (but are not limited to): invasive species (weeds and insects), diseases, "high graded" forest composition and structure (in which, for example, large fire-tolerant trees have been removed and small fire-intolerant trees have been left within a frequent surface fire regime), or overgrazing by domestic livestock that adversely impacts native grasslands or promotes unnatural levels of soil erosion.

Historically, Native Americans often burned the lands for various cultural and ecological reasons to maintain the health of the lands. Fire would clear the understory of the forested areas, driving out insects and rodents. Fire also enhanced the grasses and forbs used to weave baskets. During the settlement period (1875-1897) European settlers used fire for enlarging and replenishing pasture/agricultural lands, but these fires often escaped their control. During the post-settlement era (1898-1940), logging was a dominant activity in much of the planning area, and these logged areas were often burned to remove logs and debris.

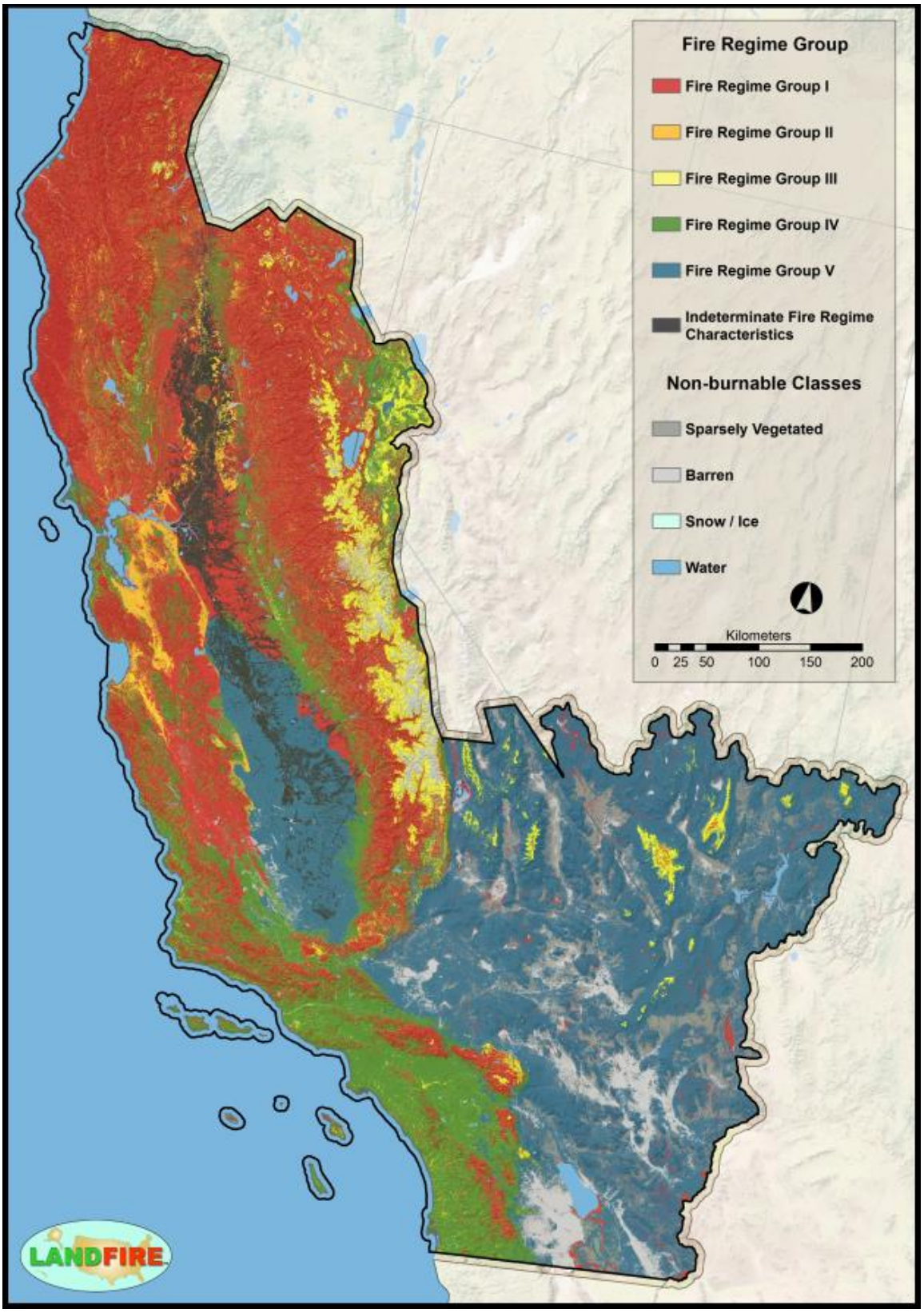

Figure 13-18. Fire Regime Groups for the Pacific Southwest

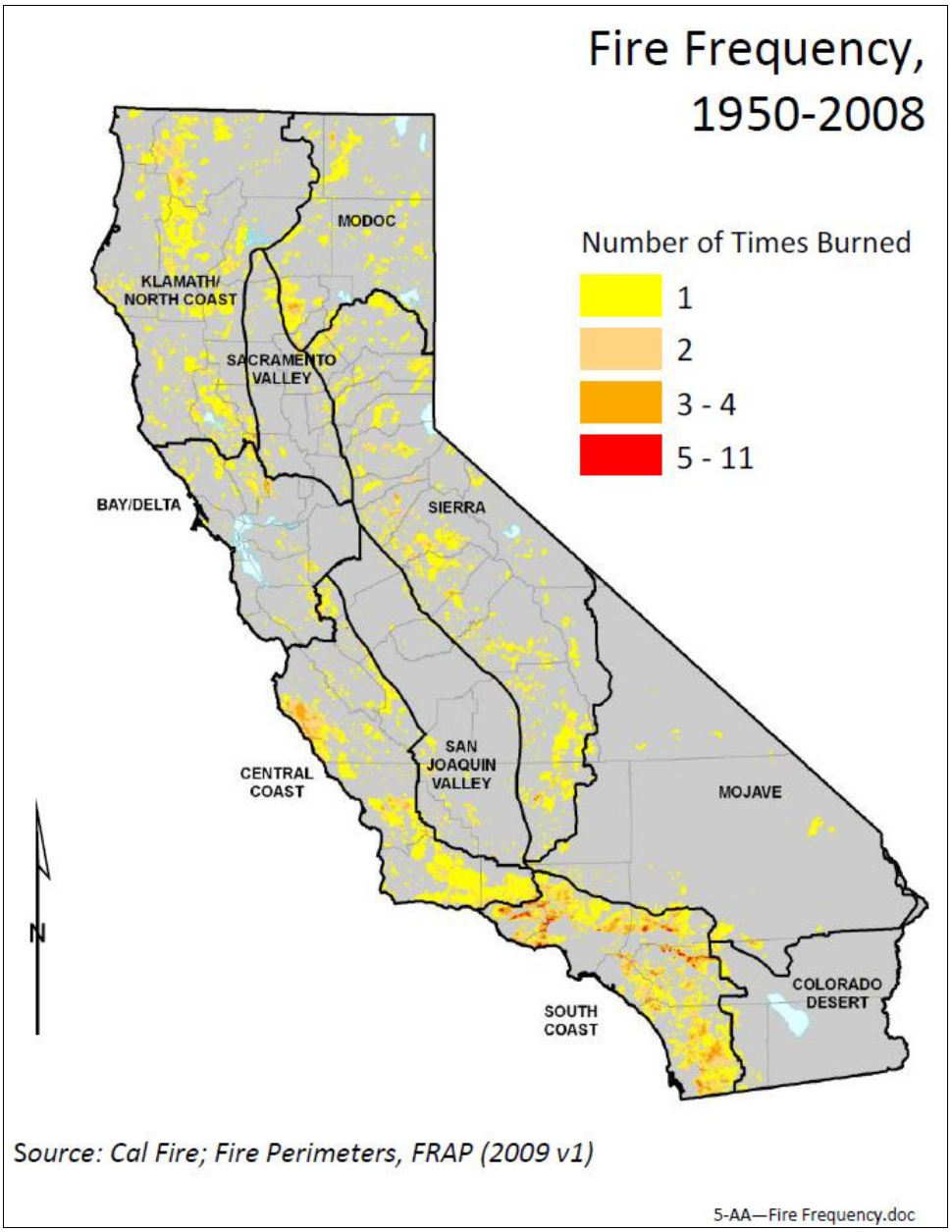

Figure 13-19. Distribution of Burn Frequency from 1950 to 2008

Over the course of time as suppression activities have become more effective, the suppression of wildfire has resulted in a buildup of fuel and has increased the potential for large fires, which burn with greater intensity than under "natural" conditions. These intense fire events generally result in greater resource damage than "natural" condition events. Large-scale watershed disturbance such as wildfire can result in loss of vegetative cover, increased runoff, and severe erosion and sediment production. Erosion following fires can cause large sediment loads in streams; the sediment may then be transported and deposited into rivers and contribute to further damaged aquatic habitat in riparian areas.

The measure of the deviation from the range of natural variability is the Fire Regime Condition Class, which classifies the landscapes into three classes dependent on their degree of departure from the natural fire regimes as shown on Figure 13-20 and described in Table 13-8.

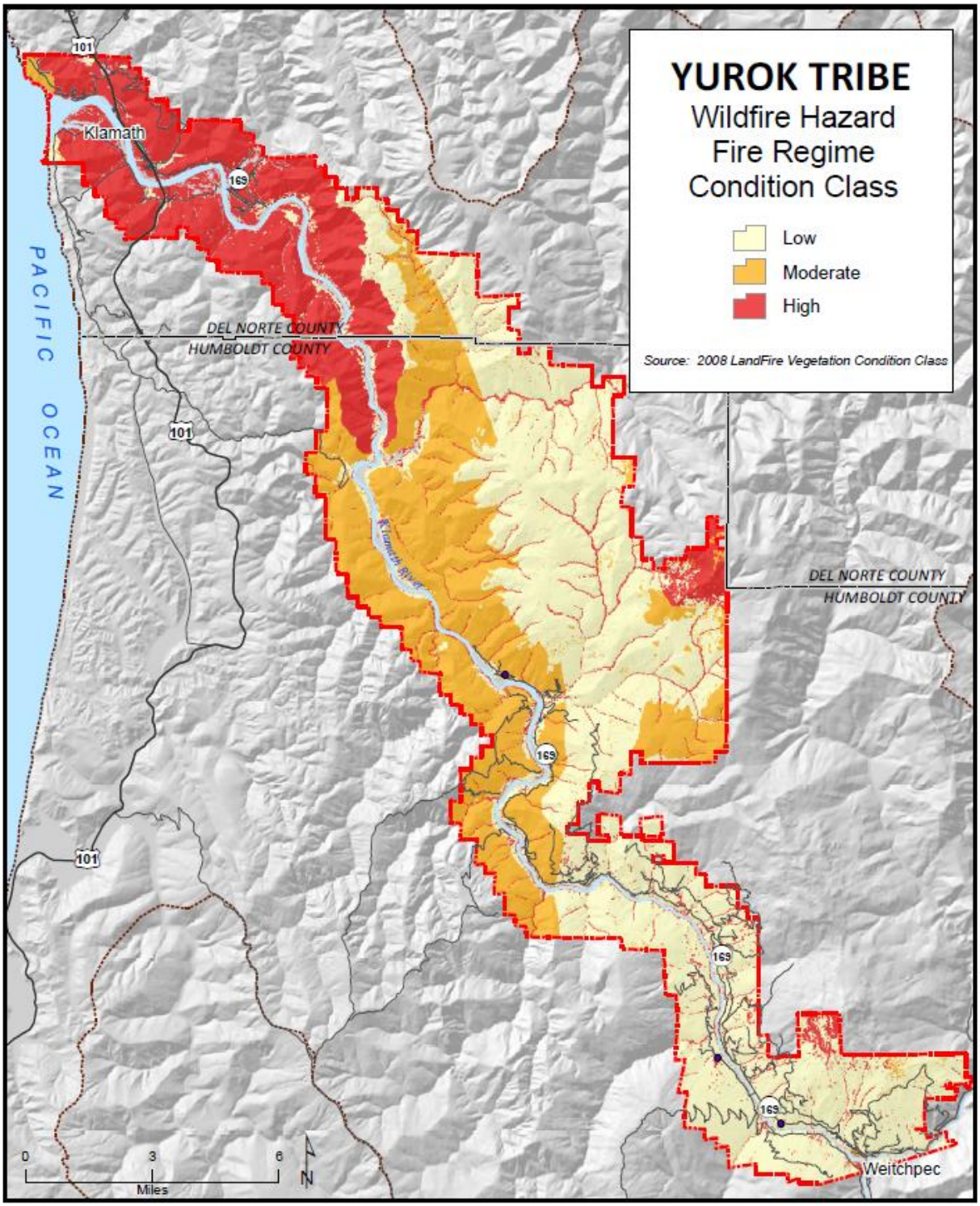

Figure 13-20. Fire Regime Condition Class

TABLE 13-8.
FIRE REGIME CONDITION CLASS DESCRIPTIONS

Class	Description
Low: Condition Class 1	Fire regimes : Fire regimes are within their historical range, with a low risk of losing key ecosystem components during a fire. Vegetation attributes (composition and structure) are well intact and functioning.
Moderate: Condition Class 2	Fire regimes have been moderately altered from their historical range, with a moderate risk of losing key ecosystem components during a fire. Fire frequencies are one or more fire return intervals away from historical frequencies.
High: Condition Class 3	Fire regimes have been significantly altered from their historical range, which a high risk of losing key ecosystem components. Fire frequencies are multiple return intervals away from historical frequencies. Vegetation attributes have been significantly altered from their historical range.

Based on analysis of these FRCC, the 2010 California State Hazard Mitigation Plan states that "roughtly 37 million acres in California are ecologically at risk from fire with 17 million acres at high risk. Particular susceptible are mixed-conifer forests of the Klamath Mountain and Sierra Nevada bioregions, sagebrush-grasslands…." (CA-SHMP, 2010, p. 278). Table 13-9 demonstrates the percentage of California bioregions containing either Fire Regime Condition Classes 2 or 3.

TABLE 13-9.
PERCENT OF CALIFORNIA BIOREGION AREA WITH CLASS 2 OR 3 FIRE REGIME CONDITION CLASS

Bioregion	Percentage	Habitats with Large Proportions of Condition Classes 2 and 3
Bay Area/Delta	41	Mixed Conifer
Central Coast	51	Sagebrush; Grassland
Colorado Desert	5	Sagebrush; Grassland
Klamath/North Coast	68	Klamath Mixed Conifer
Modoc	86	Sagebrush; Grassland
Mojave	6	Sagebrush; Grassland
Sacramento Valley	30	Ponderosa Pine
San Joaquin Valley	11	Sierran Mixed Conifer
Sierra	68	Ponderosa Pine
South Coast	72	Coastal Sage Scrub

Source: 2003 Forest and Range Assessment

It is important to note that FRCC is *not* a fire hazard metric, and while demonstrated through mapping within this planning process, it was not taken into consideration in determining fire hazard contained in this analysis (Hardy 2005; Odion and Hanson 2006; Hammer and others 2007).

Instead, FRCC is a tool for measuring ecological trends, which trends can also be influenced by other inter-relationships within the ecosystem. Nonetheless, indirect inferences about fire risk can sometimes be made after examining fuels data in tandem with FRCC data, and therefore, demonstration of the variance from historical fire regimes as presented in the condition class does provide relevant data (Hann and others 2003; Zimmerman 2003; Williams 2004; Laing and others 2005; O'Laughlin 2005; Stephens and Ruth 2005; Hyde and others 2006; Platt 2006; Hessburg and others 2007; McKenzie and others 2007; Miller 2007; Theobald and Romme 2007).

For example, a principal cause of intensifying wildfire severity in mixed-conifer type forests such as that existing within the YR study region is the increasing quantity – and continuity – of forest fuels that have resulted from historic fire exclusion, increasing the number of years passing between what would be considered naturally occurring fires. Practices such as the introduction of grazing which removes fine fuels necessary for fires to spread between forested stands has increased the propensity to high-intensity, high-severity crown confides among Conifer forests that historically experienced frequent, but low-intensity surface fires. Likewise, vegetation which requires fire to germinate are threatened due to infrequent ignitions, which in essence is leading to a type conversion of potentially non-native grasslands, increasing the intensity and severity of fires when they do erupt.

13.3.10 Component-Based Wildfire Hazard Rating

Each dataset was reclassified for generalized hazard categories corresponding with its hazard level, which were presented in previous pages. The datasets were also combined into a single dataset using map algebra to obtain a final point score. This score was then reclassified to the same generalized hazard categories for the final hazard map (Figure 13-21). The complete hazard analysis is based on all of the spatial categories. The maps below represents the relative hazard for any time of year, given the conditions on the ground. The four hazard categories (Low, Moderate, High, and Extreme) were determined using spatial analysis weighting factors. A Quantile methodology separated the hazard ratings into four intervals with an equal amount of cells. This allows for relative comparisons to be made between locations. Four classes were chosen to spatially represent the large scale and highly variable data with minimal distortion of wildfire hazard across the YR.

Many improvements could be made by further refining the fire input data, collecting new data, and working with fire managers to better understand how more complex factors create wildfire hazard or drive wildfire behavior in the region. These maps are not intended to predict fire, nor are they to be considered fire modeling per se, but rather to provide information for fire managers and emergency management personnel to assess what areas of the Reservation will most benefit from wildfire prevention and mitigation efforts, including the capture of more Reservation specific information.

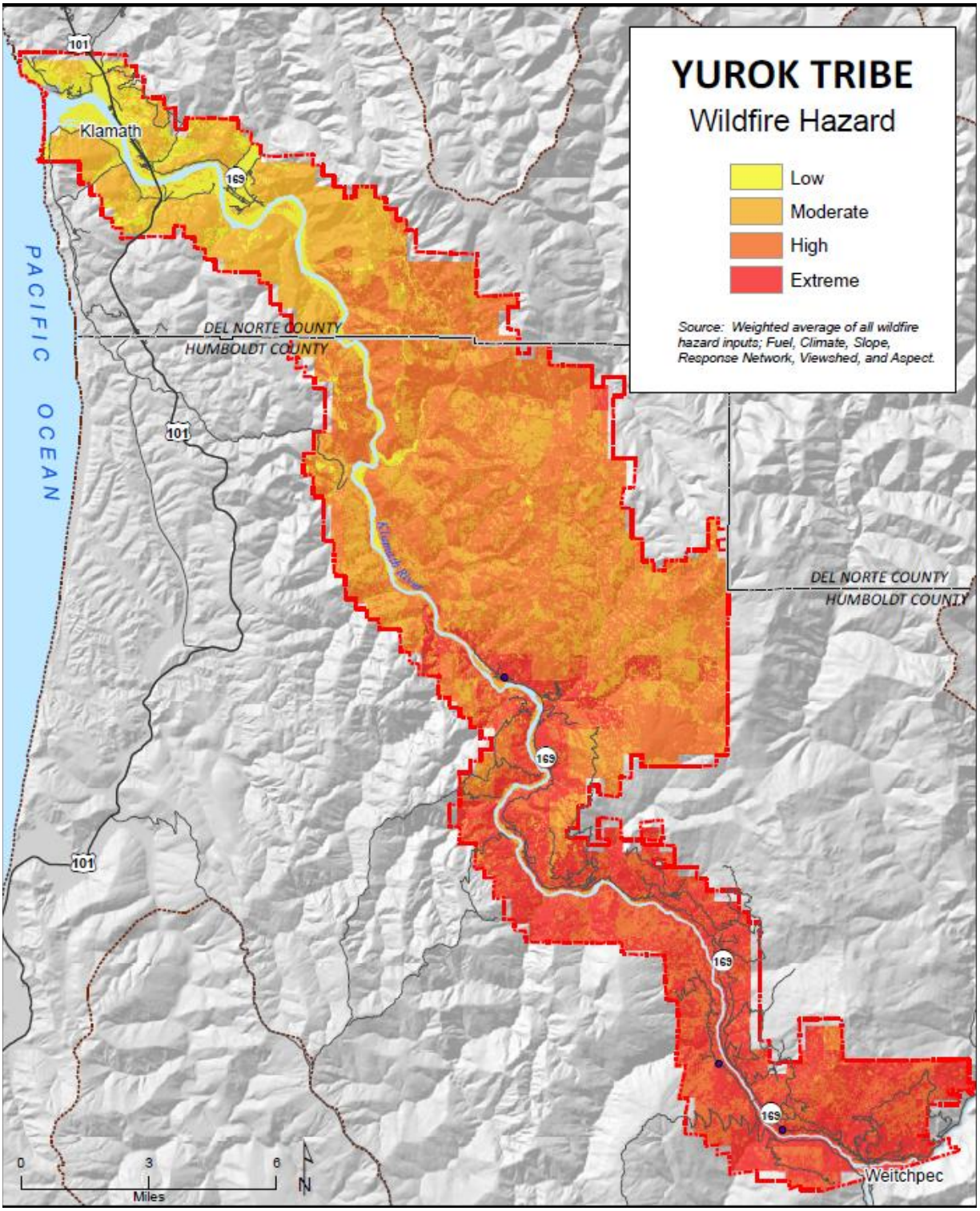

Figure 13-21. Component-Based Hazard Map

13.4 HAZARD PROFILE

13.4.1 Location

The California Department of Forestry and Fire Protection (CAL FIRE) developed a fire hazard severity scale that characterizes zones by the number of days of moderate, high and extreme fire hazard. These zones, referred to as Fire Hazard Severity Zones (FHSZ), define the application of various mitigation strategies to reduce risk associated with wildfires. This map is the basis for this wildfire risk assessment. The designation for the area around the Yurok Reservation is "Very High" (see Figure 13-23). There is substantial risk of forest fire, particularly in the upper areas of the Reservation. The canyon along U.S. 169 on the upper Reservation has been described by experienced firefighters as potentially deadly due to steep hillsides covered with very flammable material, wooden bridges than can burn easily, single lane access for the most part and few escape routes except the river and logging roads, some of which are gated.

Wildfires also cause hazardous air quality conditions many miles away. In the Klamath Basin, wildfires generally occur in the late summer to early fall. Temperature inversions are common during this time, which can cause the smoke from a wildfire to be trapped in the valleys and canyons. The smoke can then travel in a downstream pattern similar to the flow of a river. During the Megram fire in 1999, hazardous air quality conditions were present throughout the Reservation for weeks, even though the fire was 60 miles away from the Reservation.

13.4.2 Past Events

Figure 13-24 summarizes fire activity occurring within the planning area. Significant recent fires in the vicinity of the planning area are described below.

Megram Fire, September– November 1999

The Megram Fire was located approximately sixty miles east of Weitchpec. The Megram Fire started by lightning in August, fanned by high winds in September was knocked down by rain in October so that firefighters could bring it under control. Dense smoke forced the evacuation of thousands of residents from eastern Humboldt County. Visibility was often less than 150 feet. Smoke and ashes spread over much of Northwest California. $75 million was spent on firefighting, $1.3 million in damage to commercial timber, $16 million potential damage to fisheries and $6.2 million needed for rehabilitation for a total cost of $98.5 million. This was the fifth largest fire (acreage) in California history with 141,200 acres burned. No fatalities or injuries were directly caused by weather. While the Megram Fire did not burn on the Yurok Reservation, the resulting smoke caused many people to evacuate for health reasons. A local health emergency was declared. Humboldt County received both a Governor's Proclamation and a Presidential Declaration.

Biscuit Fire, July 2002

The largest recent fire was the Biscuit Fire in 2002, which burned in southern Oregon and northern California. It began on July 13, 2002, due to lightning strikes and ended up burning a total of 501,070 acres. Its heavy smoke contributed to health problems for residents within a 100-mile radius. The Biscuit Fire was the region's largest and most devastating wildland fire over the last 125 years. Its boundaries stretched from 10 miles east of the coastal community of Brookings, Oregon; south to the communities of Hiouchi and Gasquet; east to the Illinois Valley in southern Oregon; and north to within a few miles of the Rogue River in Oregon. The fire became one of the most difficult fires to contain in recent history.

Figure 104: Satellite image of Smoke from November 2008 California Wildfires

2008 November Wildfires

In excess of $32 million dollars in federal and state disaster assistance was approved for a series of wildfires occurring in the state. This incident in many areas was coupled with strong wind gusts reaching 80 miles per hour, as well as high temperatures, low humidity and dry conditions. Thick blankets of smoke covered much of the State. The fire burned over 30,000 acres, injured 14 firefighters, destroyed about 200 structures, and forced evacuations of thousands of residents from their homes. Thick blankets of toxic smoke blanketed much of the State, causing health advisories to be issued for children, the elderly and people with health and respiratory issues.

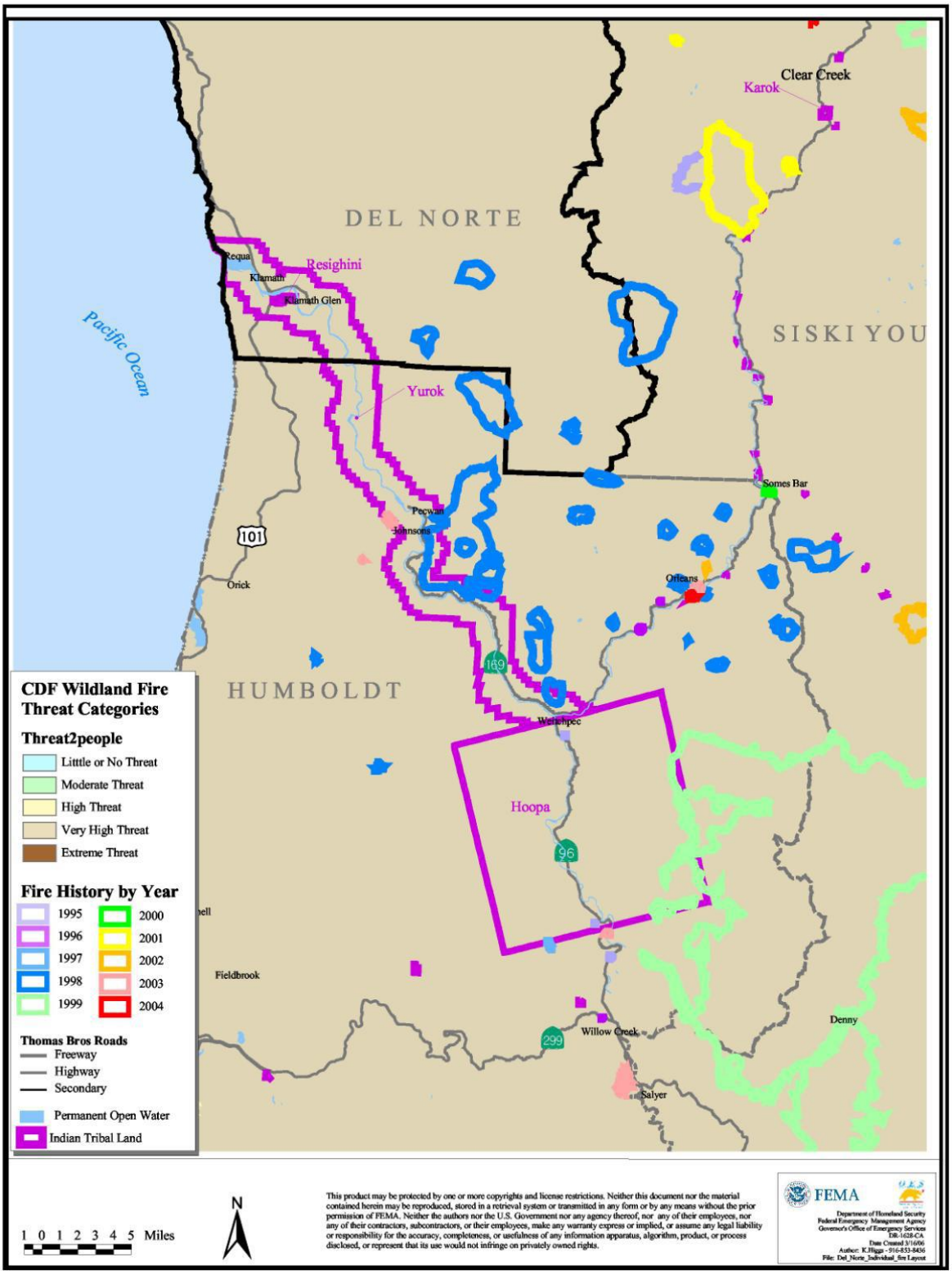

Figure 13-23. Planning Area Wildfire Map

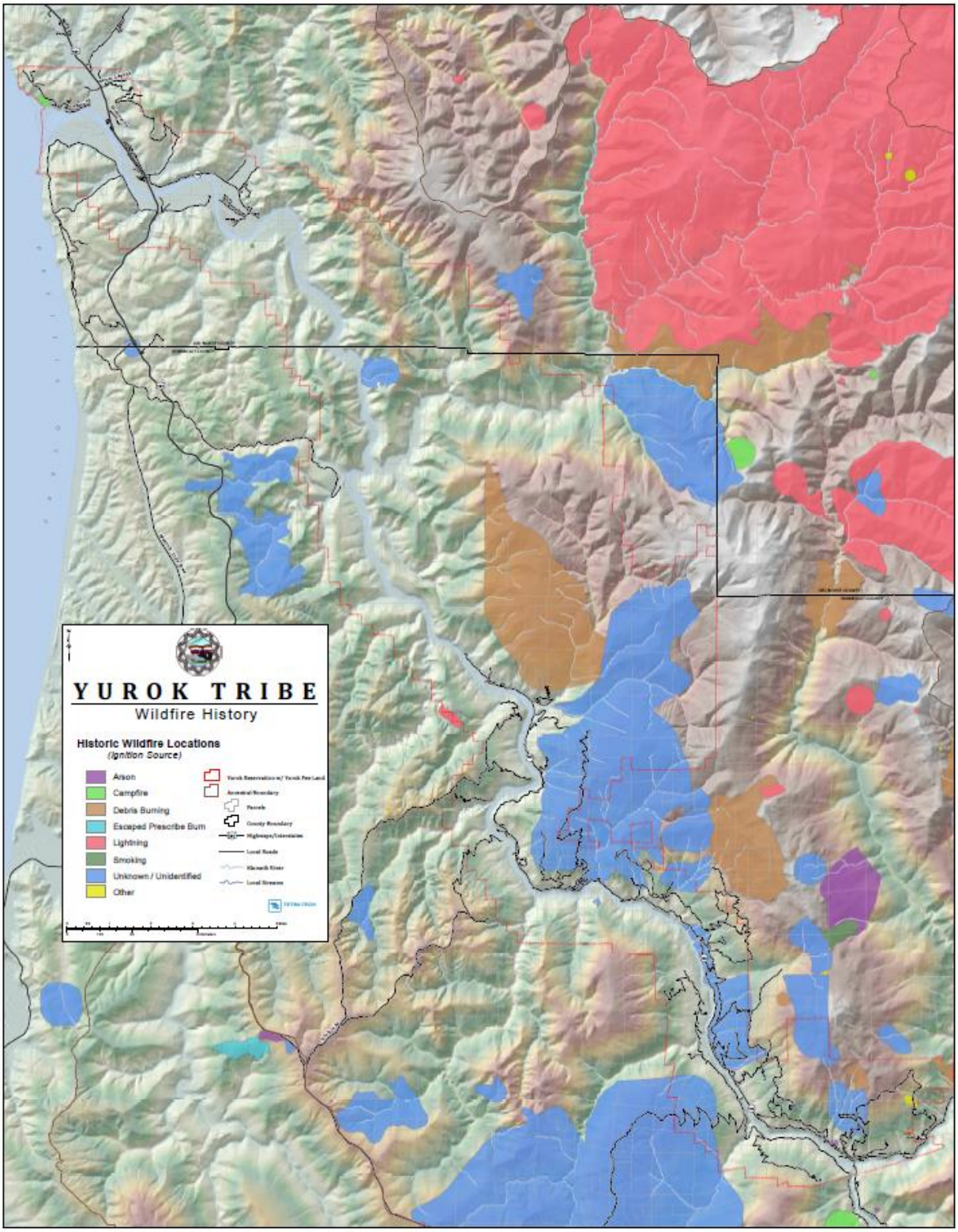

Figure 13-24. Wildfire History Data within the Yurok Planning Region

Figure 13-107. Pine Creek Fire, September 2012

13.4.3 Frequency

The Fire and Resource Assessment Program (FRAP) developed and maintained by CAL FIRE includes an historical record of all wildfires in the state. According FRAP statistics, 581 wildfires burned in Humboldt County between 1908 and 2004 and 220 wildland fires burned in Del Norte County between 1901 and 2008. Estimates suggest a 50 to 100-year fire cycle for the redwoods in Del Norte County, and 12 to 50 years in Humboldt County (CAL FIRE, 2005). On average, there are between 10 and 12 brush fires on the Yurok Reservation annually.

13.4.4 Severity

Potential losses from wildfire include human life, structures and other improvements, and natural resources. Given the immediate response times to reported fires, the likelihood of injuries and casualties is minimal. Smoke and air pollution from wildfires can be a health hazard, especially for sensitive populations including children, the elderly and those with respiratory and cardiovascular diseases. Wildfire may also threaten the health and safety of those fighting the fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke. In addition, wildfire can lead to ancillary impacts such as landslides in steep ravine areas and flooding due to the impacts of silt in local watersheds.

According FRAP statistics, wildfires in Humboldt County between 1908 and 2004 ranged from less than 1 acre to greater than 5,000 acres. Nearly 25 percent of these fires were smaller than 1 acre, and over 50 percent were less than 25 acres. Less than 10 percent of Humboldt County's wildfires have exceeded 100 acres. Wildland fires in Del Norte County between 1901 and 2009 ranged from 2 acres to more than 500,000 acres.

13.4.5 Warning Time

Wildfires are often caused by humans, intentionally or accidentally. There is no way to predict when one might break out. Since fireworks often cause brush fires, extra diligence is warranted around the Fourth of July when the use of fireworks is highest. Dry seasons and droughts are factors that greatly increase fire likelihood. Dry lightning may trigger wildfires. Severe weather can be predicted, so special attention can be paid during weather events that may include lightning. Reliable National Weather Service lightning warnings are available on average 24 to 48 hours prior to a significant electrical storm.

Figure 13-108. California Fire Threat Statewide

As indicated, the Bureau of Indian Affairs has an agreement with CAL FIRE to protect trust lands. When a fire is reported to 911, the call is routed through the Fortuna CAL FIRE dispatch. Fortuna CAL FIRE will immediately dispatch the Yurok Volunteers, as well as the CAL FIRE engine from Elk Camp on Bald Hills Road or Orick. It takes at least an hour for an engine and crew to get to Martin's Ferry Bridge in Weithpec and another 45 to 60 minutes to get to Wautec at the end of U.S. 169.

If a fire does break out and spread rapidly, residents may need to evacuate with little notice. A fire's peak burning period generally is between 1 p.m. and 6 p.m. Once a fire has started, fire alerting is reasonably rapid in most cases. The rapid spread of cellular and two-way radio communications in recent years has further contributed to a significant improvement in warning time. However, due to limited cell coverage and landlines on the Reservation, this has the potential to significantly impair the ability to report a fire.

13.5 SECONDARY HAZARDS

Wildfires can generate a range of secondary effects, which in some cases may cause more widespread and prolonged damage than the fire itself. Fires can cause direct economic losses in the reduction of harvestable timber and indirect economic losses in reduced tourism. Wildfires cause the contamination of reservoirs, destroy transmission lines and contribute to flooding. They strip slopes of vegetation, exposing them to greater amounts of runoff. This in turn can weaken soils and cause failures on slopes. Major landslides can occur several years after a wildfire. Most wildfires burn hot and for long durations that can bake soils, especially those high in clay content, thus increasing the imperviousness of the ground. This increases the runoff generated by storm events, thus increasing the chance of flooding.

13.6 CLIMATE CHANGE IMPACTS

Fire in western ecosystems is determined primarily by climate variability, local topography, and human intervention. Climate change has the potential to affect multiple elements of the wildfire system: fire behavior, ignitions, fire management, and vegetation fuels. Hot dry spells create the highest fire risk. Increased temperatures may intensify wildfire danger by warming and drying out vegetation. When climate alters fuel loads and fuel moisture, forest susceptibility to wildfires changes. Historical Climate change also may increase winds that spread fires. Faster fires are harder to contain, and thus are more likely to expand.

Historically, drought patterns in the West are related to large-scale climate patterns in the Pacific and Atlantic oceans. The El Niño–Southern Oscillation in the Pacific varies on a 5- to 7-year cycle, the Pacific Decadal Oscillation varies on a 20- to 30-year cycle, and the Atlantic Multidecadal Oscillation varies on a 65- to 80-year cycle. As these large-scale ocean climate patterns vary in relation to each other, drought conditions in the U.S. shift from region to region. El Niño years bring drier conditions to the Pacific Northwest and more fires.

Climate scenarios project summer temperature increases between 2ºC and 5°C and precipitation decreases of up to 15 percent. Such conditions would exacerbate summer drought and further promote high-elevation wildfires, releasing stores of carbon and further contributing to the buildup of greenhouse gases. Forest response to increased atmospheric carbon dioxide—the so-called "fertilization effect"—could also contribute to more tree growth and thus more fuel for fires, but the effects of carbon dioxide on mature forests are still largely unknown. High carbon dioxide levels should enhance tree recovery after fire and young forest regrowth, as long as sufficient nutrients and soil moisture are available, although the latter is in question for many parts of the western United States because of climate change.

13.7 EXPOSURE

The geography of wildfire depends on topography and the geography of vegetation. It does not depend on the geography of land ownership or political jurisdiction. Compared to the typical wildland-urban interface property, wildfire is significant. Large fires burn on a wide front, threatening many properties at essentially the same time. Scattered properties with defensible space make only a little difference in firefighters' abilities to save property. When properties in a neighborhood have been treated and preparations are integrated with each other, firefighters can hope to save most homes and the landscape from serious damage in a large fire under most conditions. Within the Yurok planning area, the lands are composed more of an intermix that interface, which is a cultural norm for the residents of the reservation, as historically, preservation of their natural resources has been, and continues to be, of paramount importance. This customary style of living has resulted in residents living within the natural boundaries of the landscape, with minimal interference. Through the development of this Community Wildfire Protection Plan, tribal members hope to sustain their practice of living within the natural landscape while embracing the practices of fire suppression which will reduce their levels of exposure.

13.7.1 Population

Population could not be examined by WUI area because census block group areas do not coincide with the fire risk areas. However, population was estimated using the structure count of buildings in the WUI area and applying the census value of 3 persons per household for the Yurok Tribe. These estimates are shown in Table 13-10.

TABLE 13-10.
POPULATION WITHIN WILDFIRE HAZARD AREAS

		Population	
	Number of Buildings	Number	% of Total
Low	342	1026	
Moderate	47	141	
High	65	195	
Extreme	112	336	
Total	**566**	**1698**	

13.7.2 Property

Property damage from wildfires can be severe and can significantly alter entire communities. Table 13-11 displays the number of homes in the various wildfire hazard zones within the planning area and their values. The planning area has exposure to wildfire hazards to some degree.

13.7.3 Critical Facilities and Infrastructure

Table 13-12 identifies critical facilities exposed to the wildfire hazard in the planning area. Of additional concern are hazardous material sites in wildfire risk zones. During a wildfire event, these materials could rupture due to excessive heat and act as fuel for the fire, causing rapid spreading and escalating the fire to unmanageable levels. In addition they could leak into surrounding areas, saturating soils and seeping into surface waters, or become airborne, creating toxic air quality – all having a disastrous effect on the environment.

TABLE 13-11.
EXPOSURE AND VALUE OF STRUCTURES IN WILDFIRE HAZARD AREAS

	Low	Moderate	High	Extreme	**Total**
Number of Buildings Exposed	**388**	**51**	**73**	**118**	**580**
Value Exposed					
Structure	$67,704,846	$10,564,894	$17,742,100	$24,702,506	$120,714,346
Contents	$45,450,053	$6,102,447	$11,240,110	$13,502,520	$76,295,130
Total	**$113,154,899**	**$16,667,341**	**$28,983,001**	**$38,205,034**	**$197,010,275**
Exposed Value as % of Total Assessed Value	39.21%	5.78%	10.04%	13.24%	68.27%

TABLE 13-12.
CRITICAL FACILITIES AND INFRASTRUCTURE IN WILDFIRE HAZARD AREAS

	Number of Critical Facilities in Hazard Zone			
	Low	Moderate	High	Extreme
Tribal Facility	8	0	4	2
Government Non-Tribal	9	1	2	2
Non-Residential	29	3	2	2
Single Family Residential	342	47	65	112
Total	**388**	**51**	**73**	**118**

In the event of wildfire, based on the limited infrastructure on portions of the Reservation, even the smallest impact would be significant to the sustainability of the Reservation. While most paved roadways would have limited damage except in the worst scenarios, much of the Tribe has non-paved access roads, which could be potentially impacted due to increased water runoff from destruction of vegetation. Power lines are the most at risk to wildfire because most are made of wood and susceptible to burning. In the event of a wildfire, while limited in nature, any pipelines running through the Reservation could provide a source of fuel and lead to a catastrophic explosion.

13.7.4 Environment

Fire is a natural and critical ecosystem process in most terrestrial ecosystems, dictating in part the types, structure, and spatial extent of native vegetation. However, wildfires can cause severe environmental impacts:

- Damaged Fisheries—Critical fisheries can suffer from increased water temperatures, sedimentation, and changes in water quality.
- Soil Erosion—The protective covering provided by foliage and dead organic matter is removed, leaving the soil fully exposed to wind and water erosion. Accelerated soil erosion occurs, causing landslides and threatening aquatic habitats.

- Spread of Invasive Plant Species—Non-native woody plant species frequently invade burned areas. When weeds become established, they can dominate the plant cover over broad landscapes, and become difficult and costly to control.
- Disease and Insect Infestations—Unless diseased or insect-infested trees are swiftly removed, infestations and disease can spread to healthy forests and private lands. Timely active management actions are needed to remove diseased or infested trees.
- Destroyed Endangered Species Habitat—Catastrophic fires can have devastating consequences for endangered species.
- Soil Sterilization—Topsoil exposed to extreme heat can become water repellant, and soil nutrients may be lost. It can take decades or even centuries for ecosystems to recover from a fire. Some fires burn so hot that they can sterilize the soil.
- Destruction of Watershed – Fires have the potential to significantly impact watersheds. Given the significance of the watersheds within the planning area, destruction of any of these ecosystems would have a devastating impact, including increasing landslide susceptibility and impact to streams, streambeds and fisheries.

Many ecosystems are adapted to historical patterns of fire occurrence. These patterns, called "fire regimes," include temporal attributes (e.g., frequency and seasonality), spatial attributes (e.g., size and spatial complexity), and magnitude attributes (e.g., intensity and severity), each of which have ranges of natural variability. Ecosystem stability is threatened when any of the attributes for a given fire regime diverge from its range of natural variability.

13.8 VULNERABILITY

Structures, above-ground infrastructure, critical facilities and natural environments are all vulnerable to the wildfire hazard. There is currently no validated damage function available to support wildfire mitigation planning. Except as discussed in this section, vulnerable populations, property, infrastructure, natural resources and environment are assumed to be the same as described in the section on exposure.

13.8.1 Population

As a result of the 2008 wildfires, it is believed that two elderly members of the Yurok Tribe died of respiratory infections. Both of the Tribal members resided in the areas significantly impacted by the smoke from the 2008 event. Similarly, children have also been significantly impacted with respiratory ailments as a result of continued exposure to smoke from fires. As a result of the 2008 fires, much of Northern California was covered in a thick blanket of smoke. The Yurok Reservation endured high levels of air pollution, along with hazardous concentrations of particulate matter.

Smoke from fires occurring on and around the planning area has historically caused significant health concerns, especially for the elderly, very young, and those with health hazards. There are Previous fires occurring within other counties has had adverse impact on residents living on the reservation. Also, given the limited response times to reported fires, the likelihood of injuries and casualties is significantly increased both for first responders and individuals living on or passing through the Reservation.

As indicated, smoke and air pollution from wildfires can be a severe health hazard, especially for sensitive populations, including children, the elderly and those with respiratory and cardiovascular diseases. Smoke generated by wildfire consists of visible and invisible emissions that contain particulate matter (soot, tar, water vapor, and minerals), gases (carbon monoxide, carbon dioxide, nitrogen oxides), and toxics (formaldehyde, benzene). Emissions from wildfires depend on the type of fuel, the moisture content of the fuel, the efficiency (or temperature) of combustion, and the weather. Public health impacts

associated with wildfire include difficulty in breathing, leading to repertory infections or even failures; eye irritation; odor, and reduction in visibility, increasing the risk to (vehicle) accidents.

Wildfire may also threaten the health and safety of those fighting the fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke.

13.8.2 Property

Loss estimations for the wildfire hazard are not based on damage functions, because no such damage functions have been generated. Instead, loss estimates were developed representing 10 percent, 30 percent and 50 percent of the assessed value of exposed structures. This allows emergency managers to select a range of economic impact based on an estimate of the percent of damage to the general building stock. Damage in excess of 50 percent is considered to be substantial by most building codes and typically requires total reconstruction of the structure. Table 13-13 lists the loss estimates for the general building stock for jurisdictions that have an exposure to a fire hazard severity zone.

TABLE 13-13.
LOSS ESTIMATES FOR WILDFIRE

Exposed Value	197,010,275
Estimated Loss Potential from Wildfire	
10% Damage	$19,701,028
30% Damage	$59,103,083
50% Damage	$98,505,138

13.8.3 Critical Facilities and Infrastructure

Critical facilities of wood frame construction are especially vulnerable during wildfire events. In the event of wildfire, there would likely be little damage to most infrastructure. Most roads and railroads would be without damage except in the worst scenarios. Power lines are the most at risk from wildfire because most poles are made of wood and susceptible to burning. Fires can create conditions that block or prevent access and can isolate residents and emergency service providers. Wildfire typically does not have a major direct impact on bridges, but it can create conditions in which bridges are obstructed. Many bridges in areas of high to moderate fire risk are important because they provide the only ingress and egress to large areas and in some cases to isolated neighborhoods.

13.8.4 Response Capabilities

Fire response on the Reservation is very limited. While the Tribe does have a volunteer fire department which responds to incidents in the upper portion of the Reservation, due to its remote location, travel to areas where fires are occurring can take considerable response time. Likewise, some rural areas of the Reservation which fall inside of Del Norte County are not within any fire response area for structural protection, even though they have wildfire protection. USFS provides wildfire protection on Forest Service lands. CalFire provides wildland fire protection on the rest of the lands designated as State Responsibility Area (SRA), unless it is provided by local fire organizations.

Under the terms of an agreement, Klamath FD provides emergency medical and fire response to the portions of the YR which fall within Del Norte County—the lower reservation. The Yurok Volunteer Fire Department provides response capabilities on the Humboldt County portion of the Reservation – the

upper reservation. However, there are mutual aid agreements in place for services between the jurisdictions.

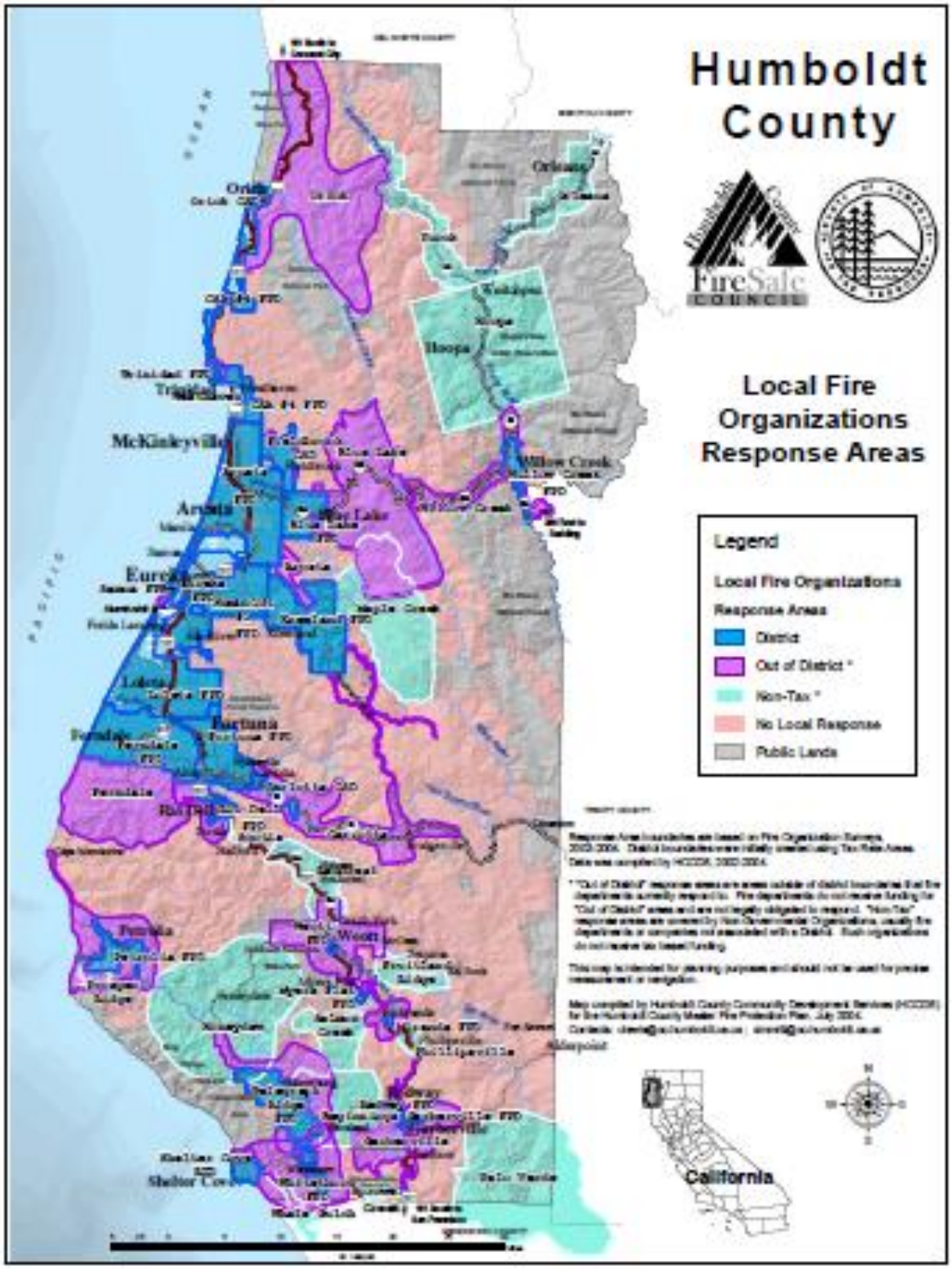

Figure 13-109. Humboldt County Local Fire Response Units

Figure 13-110. Humboldt County Local Fire Planning Units

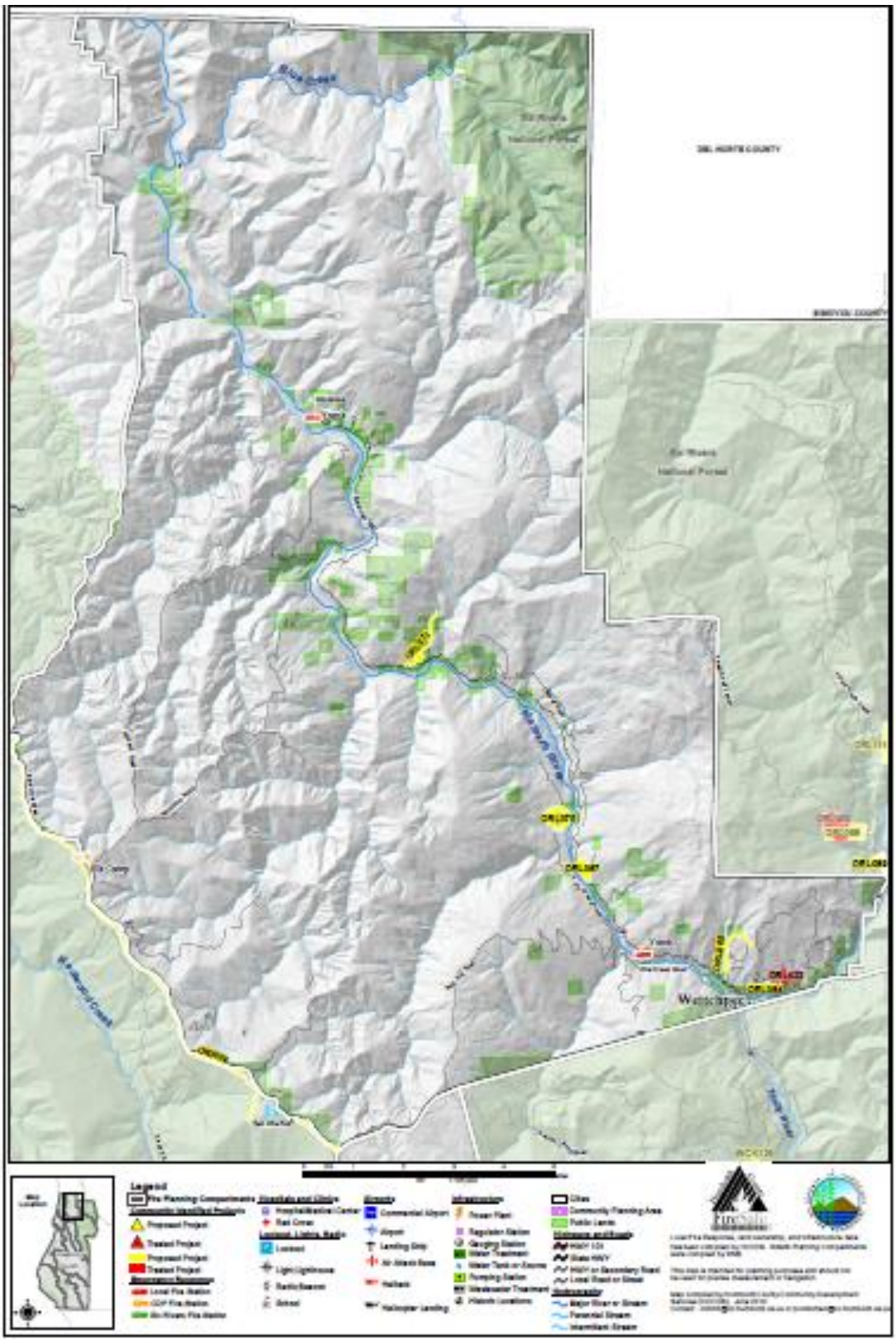

Figure 13-111. Lower Klamath Unit 2009-2010 Identified Projects

13.9 FUTURE TRENDS IN DEVELOPMENT

While the planning area has experienced limited growth over the past 10 years, the Yurok Tribe has made significant strides in expanding government functions and business opportunities, such as with the planned casino. The Tribe is optimistic that marginal, sustained growth will return to the planning area as its economy strengthens, and more infrastructure is made available to the Reservation to allow for continued growth.

Expansion of the Reservation within the planning area will continue to have the wildfire intermix risk exposure until more resources are available to provide firefighting capabilities. While the expansion of the Reservation into the intermix area can, to some degree, be managed with smart development practices, land use and building codes, the lack of critical infrastructure with respect to roadways and communication will continue to be a significant factor, as viewshed, response and notification will prohibit proactive activities, and in fact, impede development in significant portions of the Reservation. Until infrastructure can be provided and improved, residents living on the Reservation in many areas will continue to live with the increased fire risk, while taking whatever actions they can to ensure their safety, such as establishing defensible space and constructing new structures with materials which are more resilient to fires, and in such a manner that reduces the potential for ignition.

13.10 SCENARIO

A major fire in the planning area might begin with a wet spring, adding to fuels already present on the forest floor. Flashy fuels would build throughout the spring. The summer could see the onset of insect infestation. A dry summer could follow the wet spring, exacerbated by dry hot winds. Carelessness with combustible materials or a tossed lit cigarette, or a sudden lighting storm could trigger a multitude of small isolated fires.

The embers from these smaller fires could be carried miles by hot, dry winds. The deposition zone for these embers would be deep in the forests and intermix zones. Fires that start in flat areas move slower, but wind still pushes them. It is not unusual for a wildfire pushed by wind to burn the ground fuel and later climb into the crown and reverse its track. This is one of many ways that fires can escape containment, typically during periods when response capabilities are overwhelmed. These new small fires would most likely merge. Suppression resources would be redirected from protecting the natural resources to saving more remote subdivisions.

The worst-case scenario would include an active fire season throughout the American west, spreading resources thin. Firefighting teams would be exhausted or unavailable. Many federal assets would be responding to other fires that started earlier in the season. While local fire districts would be extremely useful in the urban interface areas, they have limited wildfire capabilities or experience, and they would have a difficult time responding to the ignition zones on the Reservation. Even though the existence and spread of the fire is known, it may not be possible to respond to it adequately, so an initially manageable fire can become out of control before resources are dispatched.

To further complicate the problem, heavy rains could follow, causing flooding and landslides and releasing tons of sediment into rivers, permanently changing floodplains and damaging sensitive habitat and riparian areas. Such a fire followed by rain could release millions of cubic yards of sediment into streams for years, creating new floodplains and changing existing ones. With the forests removed from the watershed, stream flows could easily double. Floods that could be expected every 50 years may occur every couple of years. With the streambeds unable to carry the increased discharge because of increased sediment, the floodplains and floodplain elevations would increase.

13.11 ISSUES

The major issues for wildfire are the following:

- Public education and outreach to people living in or near the fire hazard zones should include information about and assistance with mitigation activities such as defensible space, and advance identification of evacuation routes and safe zones.
- Firefighting capabilities – staffing and equipment levels need to be increased to provide adequate response capabilities within standardized timeframes.
- Roadways and infrastructure of appropriate style and size.
- Wildfires could cause landslides as a secondary natural hazard.
- Climate change could affect the wildfire hazard.
- Future growth into intermix areas should continue to be managed.
- Area fire districts need to continue to train on WUI events.
- Vegetation management activities—this would include enhancement through expansion of the target areas as well as additional resources.
- Regional consistency of higher building code standards such as residential sprinkler requirements and prohibitive combustible roof standards.
- Fire department water supply in high risk wildfire areas.
- Expand certifications and qualifications for fire department personnel. Ensure that all firefighters are trained in basic wildfire behavior, basic fire weather, and that all company officers and chief level officers are trained in the wildland command and strike team leader level.

13.12 DEVELOPING LOCAL AREA COMMUNITY ASSESSMENT

In addition to the assessment conducted by the Planning Team, additional community and local assessments are also vital in determining the hazard associated with wildfire. Community assessments conducted within the various areas which make up the Reservation should be maintained and developed as needed and as capabilities increase. As Tribal outreach continues to grow and additional Fire Safe Councils are established, this portion of the plan will continue to expand to incorporate the additional area-specific information. For those areas on the Reservation which wish to develop their own local area plans, the following is a sample process which may be followed. Once completed, the information contained within those local area plans can then be incorporated into the base information, or incorporated as a separate annex.

13.12.1 Establishing a Community Base Map

The base maps of Yurok Reservation defined above provide a description of the areas of concern with respect to Fire Regime, Slope-Aspect, historical fire data, all of which should be taken into consideration by the local communities involved in conducting. Each community conducting independent assessments may utilize this base map as their starting point, making modifications as they feel appropriate.

13.12.2 Community Based Wildland Urban Intermix

During public outreach, the community itself determines the designation of the community's WUI zone. While in general terms, the entire Reservation is considered a WUI, each specific defined area, community or village within the Reservation may designate itself as its own area within which prescribed

fire mitigation efforts will take place. Within each of those defined areas, consideration must be given to the location of the inhabited areas in relation to topographic features, road systems, vegetation patterns, critical human infrastructure, and the risk of wildfire, the community identifies a WUI zone around community assets – which include private residences. For these purposes, the WUI is divided into three separate categories:

- Around Residences: Properties with residences, regardless of the ownership, are within the WUI. The distance of the WUI boundary away from residences depends on the risk of wildfire surrounding the property, including topographical features, and vegetation patterns. The WUI boundary around properties with residences is broken into four sub-categories. Each sub-category has specific prescriptions associated with it, as follows:
  - *Defensible Space*—This buffer extends up to 1000 feet away from the residence, regardless of ownership.
  - *Property Buffers* – This buffer extends up to 1000 feet away from the property boundary, regardless of ownership. The property buffer focuses on creating functional fuel breaks along property boundaries with limited funding. Buffers may vary from 100 feet to 1000 feet based on fire risk.
  - *Quarter-Mile Buffers* – This buffer extends one fourth of a mile from the property boundary, regardless of ownership. This buffer provides for larger fuel breaks along property boundaries as funding becomes available.
  - *Extended WUI Areas* – This buffer varies in width depending on the properties position on the slope – often extending to the nearest ridge feature. Not all properties with residences have an extended WUI area.
- Watersheds or water bodies within the planning area.
- Emergency Access Routes: While maintaining emergency access routes does not guarantee that firefighters will be able to access an area under extreme fire conditions, these routes are critical for fire suppression and as escape routes. These roads, and associated road buffers, are within the WUI.

13.12.3 Areas of Community Importance or Value

As the local area communities begin the process of developing area-specific plans, public facilitation is critical. The community identifies areas that contain life, property and resources of concern, including residential areas, areas containing critical human infrastructure, and areas of community and cultural importance. The intent is to identify those areas most valued, and those areas which are a priority to protect from wildfire. This information can include:

- Private properties
- Areas of cultural or historical significance
- Emergency access routes or transportation corridors
- Health care facilities, schools, churches, community centers
- Businesses, manufacturing sites, or commercial service providers
- Watersheds or water bodies
- Water supply facilities
- Communications and utility infrastructure

- Community centers, camp grounds
- Wildlife areas, including those for rare and endangered species or habitats

13.12.4 Wildfire Hazard Areas

The community itself must determine the areas of impact from wildfire risk. Vegetation or fuel loading is measured in tons per acre. Grass is considered a light fuel with approximately 0.75 ton per acre. On the other end of the spectrum, thick brush, a heavy fuel, can have a volume of over 21 tons per acre. Fire intensity is directly related to fuel loading. Grass burns rapidly with a short period of intense heat output. Brush, on the other hand, has a long sustained high heat output making it more difficult to control. With this in mind, it is prudent to identify areas containing heavy concentrations of fuel and target these areas for hazard reduction. Timber has a high fuel loading based on tons per acre. However, fire intensity can be higher or lower based on the percentage of the vegetation that is available to the fire. Conifer and oak trees where there are few ladder fuels that carry flames into the canopy can often be immune to a fire in the understory. The fuel data incorporated into the vegetation map provides the basis upon which this hazard assessment can be made.

Additionally, historic fire data demonstrates the areas where fires have previously occurred, and the causes to ignition. Those areas are also considered in the hazard assessment. During the public outreach strategy, community members must determine what wildfire hazards exist within the immediate planning area. Utilizing the base map, information is confirmed or modified as appropriate. Items for consideration include, but are not limited to the following:

- Dead trees (insect or disease)
- Slash from logging or thinning
- Fuel storage
- Chemical storage
- Abandoned wooden structures
- Power Lines

Transportation issues are significant on the YR. The lack of roadways large enough to allow for firefighting equipment to gain access to areas and lack of identifying address markers significantly increase the fire hazard. Based on the community, deficiencies not already identified should be added to the base map. These could include items such as:

- Road maintenance needs (outages, slides, brushed over, narrow or dead-end roadways, or roadways that exist on maps but do not exist in reality, etc.)
- Bridges and/or locked gates, especially bridges too small or weak to carry a fire truck
- Power lines

13.12.5 Response Capabilities and Resources

Response capabilities are a vital element in determining the ability to reduce the wildfire hazard. Determining where and what resources are available for firefighting purposes helps communities to determine areas of focus with respect to developing programs such as volunteer fire departments, or gaining funds through government resources (bond measures, taxes, etc.), or to seek granting funding. Items to be considered in this element of the community risk assessment include, but are not limited to:

- Fire department personnel – volunteer or full time paid positions
- Firefighting equipment, including wildland fire equipment and apparatus
- Memorandums of Understanding/Agreement with surrounding jurisdictions for services

- Water storage: tanks, ponds, pools, water bodies which have pumping capabilities;
- Access route/evacuation
- Response times
- Communications as much of the YR is without land-line phone systems and/or cell phone coverage, the ability to report a fire due to lack of communications systems is severely hampered
- Signage
- Water storage: tanks, ponds, pools

13.13 MITIGATION ACTIVITIES

For community outreach purposes, the prioritization method for mitigation efforts must be determined in a uniform methodology to allow for over-all prioritization. Based on that premise, the following process is established: the total number of identified projects is divided by 3; each participant at the local-level community meeting is provided the opportunity to prioritize the determined number of priority projects based on their own assessment. Each participant denotes their priority project(s) independently, casting only one vote per project. The projects identified by the top 3-5 "votes" is noted as the top priorities for the group. The exercise as outlined results in a J-curve of the group's prioritization preferences.

13.13.1 Prioritized Fuel Reduction

Within the general mitigation strategies defined within Chapter 17, this plan identifies and prioritizes areas of hazardous fuel reduction treatments and recommendations for the type and methods of treatments Reservation wide that will be used within the YR to protect one or more of the Communities at Risk and their essential infrastructure within its boundaries.

This portion of the assessment will be updated based on the availability of new information from ongoing research and monitoring efforts and/or changes in community values following the process of adaptive management. Prescriptions vary by category based on the level of fire risk (high, medium, and low). Previous mitigation efforts are reviewed to determine whether activities have been completed, and whether the projects are still a priority, or even viable options.

The community should develop and prioritize fuel treatment and fuel reduction around areas of concern, including, but not limited to: residential properties, emergency access routes, municipal watersheds and areas of historic and cultural importance, etc.

Existing or proposed projects on federal lands should be assessed for compatibility with the priorities and prescriptions outlined in this plan. The goal of these fuel reduction activities is to allow for the reintroduction of fire through wildland fire management and prescribed burning to effectively protect life, property and resources over the long term. Hazardous fuels management is one of the most significant factors in managing wildfires.

13.13.2 Hazardous Fuels Management

Hazardous fuel is any kind of living or dead vegetation that is flammable. To meet desirable management goals, managers can modify the structure, distribution and vegetation type on a landscape. Prescribed fire, mechanical treatments and the careful use of natural fire are tools to help land managers meet the goals, objectives and desired conditions for the Tribe's hazardous fuel reduction efforts.

Fuels management activities take place either in the Wildland Urban Interface (WUI), or outside of it. The WUI is essentially where wildland fuels begin to interface with urbanized areas. Most emphasis is now on managing activities in the WUI. These activities are of primary focus because reducing hazardous fuels around the urban interface increases public and firefighter safety, and reduces the risk of unwanted wildfire to communities. Mitigating the risk of hazardous fuels around important infrastructure like radio towers, transportation networks, watersheds and utilities is another reason fuels management is important. In Indian Country, hazardous fuel reduction projects also strengthen rural economic sustainability and increase opportunities for economic diversification.

While there is an emphasis of treating fuels near the WUI, most hazardous fuel projects take place outside of the WUI. Restoring and maintaining healthy fire-adapted ecosystems keeps natural systems balanced and also reduces the risks to cultural and historic places. Deserts, grasslands, tundra, scrublands, forestlands, estuaries and riparian zones are all ecosystems where fire naturally occurs. Natural Resource Management in Indian Country has historically been associated within the wildlands.

The intent of the mitigation activities is to reduce the risk of catastrophic wildland fire while restoring forest and rangeland ecosystems to closely match their historical structure, function, diversity, and dynamics. Hazardous fuels are reduced through a variety of treatments which remove or modify wildland fuels, thereby reducing the potential for severe wildland fire behavior, lessening post-fire damage, and limiting the spread of invasive species and diseases. Treatments can include, but are not limited to:

- Mechanical treatments: These are most often used in areas where fire has been excluded for long periods of time, or around communities where prescribed fire or smoke management may have unintended consequences. It includes the manual or mechanical removal or modification of fuels. Examples include: chipping, regeneration cuts, pruning, seeding, biomass removal, mowing, crushing, and piling. Managing surface fuels allows communities to assist in keeping the fire-line intensity below critical levels. This can be done by trimming low hanging branches to reduce the potential for fire to spread to higher levels and become a crown fire.
- Other treatments: Methods other than prescribed burns or mechanical treatments, such as application of herbicides, introduction of biological controls, or grazing.

13.13.3 Treatment of Structural Ignitability

This plan recommends measures that homeowners and communities can take to reduce the ignitability of structures throughout the Unit. Information drawn from a variety of sources were included in this plan to help educate the public as to what they can do to help mitigate potential problems associated with living in the Wildland Urban Interface.

13.13.4 Prescribed Fire Treatments

Various types of prescribed fire treatments are available, many of which are endorsed and supported by the tribe due either to their high level of cultural significance or the benefit which they provide to cultural activities. All of these treatments are potential methods to reduce the impact of fires. The following sections describe examples of some of these treatments which would be beneficial within the planning area.

Prescribed Fires

This entails the deliberate burning of wildland fuels in either a natural or modified state and under specified environmental conditions, which allows the fire to be confined to a predetermined area. Each treatment requires specific burn plans with measureable burn objectives that clearly defined operational

procedures for implementation, monitoring, escapes and contingency resources. Prescribed burning is a tool managers may use as a singular event, or in combination with other mechanical treatments to reduce fuel buildup. The natural role of fire is an essential part of the ecological process. Using fire as a tool to achieve resource management objectives may be the only effective tool natural resource managers have to restore the natural balance of the wildland on a large-scale. In fire-adapted systems, fire should be present on a recurring cycle that is consistent with the natural fire regimes to sustain ecosystem functionality. Examples include broadcast burns (burns within well-defined boundaries), jackpot burns (burns of natural or modified concentrations of fuels), and pile burns (burns of hand- or machine-piled fuels, confined to the perimeter of the pile.) Fire managers cannot perform any kind of prescribed burn without first attending to national interagency policy for prescribe fire, NEPA, and other environmental compliance requirements.

Shaded Fuel Breaks

Construction of shaded fuel breaks that break up fuel continuity and fuel ladders, while maintaining canopy cover. According to Green (1977), "a fuel break is a strategically located wide block, or strip, on which a cover of dense, heavy or flammable vegetation has been permanently changed to one of lower fuel volume or reduced flammability." It must be understood that a shaded fuel break may not stop a fire, but will give suppression forces and landowners more opportunities for safely fighting the fire and accessing or evacuating the fire area. Shaded fuel breaks retain forest canopy. More open canopies will result in a ground surface with lower moisture content and increased wind speeds (van Wagtendonk 1996, Agee et al. 2000). Furthermore, maintaining canopy cover limits brush regrowth, increasing the ease of fuel break maintenance.

Fuel breaks can be prioritized as initial fuel treatments. After prioritized fuel breaks are created and funding is secured for maintenance, the intent is to follow up with more extensive landscape fuel treatments integrating natural and human potential control features.

Surface Fuel Management

Manage surface fuels and raise crown base heights to avoid crown fire initiation (Agee and Skinner 2005). Once a crown fire is initiated, it can continue to spread through the canopy. This spread is dependent on crown rate of spread, canopy bulk density and crown foliage ignition energy. In some cases, decreasing canopy bulk density (i.e. thinning of the canopy) is a strategy that can be used to decrease the chances of a spreading crown fire. However, canopy bulk density is just one factor that influences the spread of a crown fire.

Control Features

Potential control features that can be used to modify fire behavior (e.g. ridges, ridge roads, and major streams). These fuel breaks are designed to be used as anchor points for prescribed fire as well as backfiring operations during wildfires. Not all fuel breaks will be connected to one another. The Klamath River and its tributaries, roads, ridges, trails, substrate/soil types, existing fire lines and creeks can be identified as potential control features. Features such as these can be located both within and outside of the WUI area.

Reduction of Fuel Ladder

Trimming the branches six to eight feet up the stem of trees can reduce a future fire's ability to climb the "fuel ladder" and burn the crowns of the remaining trees (Agee et al. 2000, Agee and Skinner 2005). Trees and shrubs are thinned based on density and flammability in preparation for fire being reintroduced. The goal is to maintain diversity of species and age classes (where feasible) while reducing the risk of

future stand replacing fire (DellaSalla et al. 2003, Brown et al. 2003). In areas with structures, or other high value areas, more vegetation would be removed (with higher maintenance) than in outlying areas.

Snag Removal

Snags can greatly increase fire behavior and potential for spread across containment features (roads, streams, fuel breaks). Snags also have ecological and cultural importance that must be balanced with their potential negative impacts to fire suppression efforts and safety. In general, recommended prescriptions suggest complete snag removal in areas directly around homes and within buffers along emergency access routes, except in special circumstances. Snag removal may entail removal from area if felled snags would significantly impact fuel loading. Snags should be felled, piled and burned, or cut up for firewood. Alternately, a tradeoff between wildlife use and fuel loading danger would be to remove finer fuels adjacent to or on downed snags (foliage and limbs removed) and existing large woody material (e.g. logs, stumps) and have a fire line constructed around them. This prescription policy does not apply to areas of importance to endangered species, historical sites, or cultural-use areas. These areas shall be analyzed on a site-specific basis with input from all appropriate federal, state, and tribal agencies that have responsibility for the resources at risk. Also, the prescriptions for residences and high-value areas (e.g. water tanks, water lines, springs, communication systems, fuel storage) are recommendations that should be customized on an individual basis with the landowner(s).

Fire-Resistant Vegetation

In areas without consistent overstory canopy cover, less flammable vegetation species should be encouraged to promote future shading.

Residential Efforts

The majority of properties with residences, regardless of the ownership, are within the wildland urban interface. The distance of the WUI boundary away from the property boundary depends on the potential control features present, topographical and geologic complexity, vegetation patterns and risk of wildfire surrounding the property. Basic facts to remember when determining mitigation activities at a residential level include:

- Heavy accumulations of vegetation let a fire get larger and hotter, increasing the risk of home ignition due to thermal radiation.
- Fires do not ‘flow’ like a tsunami, but rather ‘select’ based on ignitability.
- Woodpiles next to the house provide a hiding place for firebrands to start a glowing combustion that can generate enough heat to ignite a fire.
- Radiant heat beneath an overhanging deck or floor can trap heat, allowing for combustion that can ignite a fire.
- Flammable furniture or cushions on decks or porches increase the likelihood of fire.
- Unscreened eave vents or chimneys allow embers to enter – the embers can go undetected for hours.
- Flammable roofing/siding/decks/porches/fences increase the threat of wildfire spread.
- If it is attached to the house, it is part of the house where fire can travel and spread.
- Dead or downed vegetation up close or next to the home can allow for radiant or combustion ignition of your residence.

- It is the *condition* of the Home Ignition Zone (e.g., type of material) that influences the survivability of a home or structure more than its location. Firebrands (embers) can be carried a relatively far distance by winds, up to a mile or more, but, if the condition of the home ignition zone (e.g., roof) is a metal structure versus a shake roof, the potential for ignition is much, much lower.
- It is not always *where* the home is located that necessarily determines ignition risk, rather it is *how ignitable* the home is as determined by the home ignition zone.

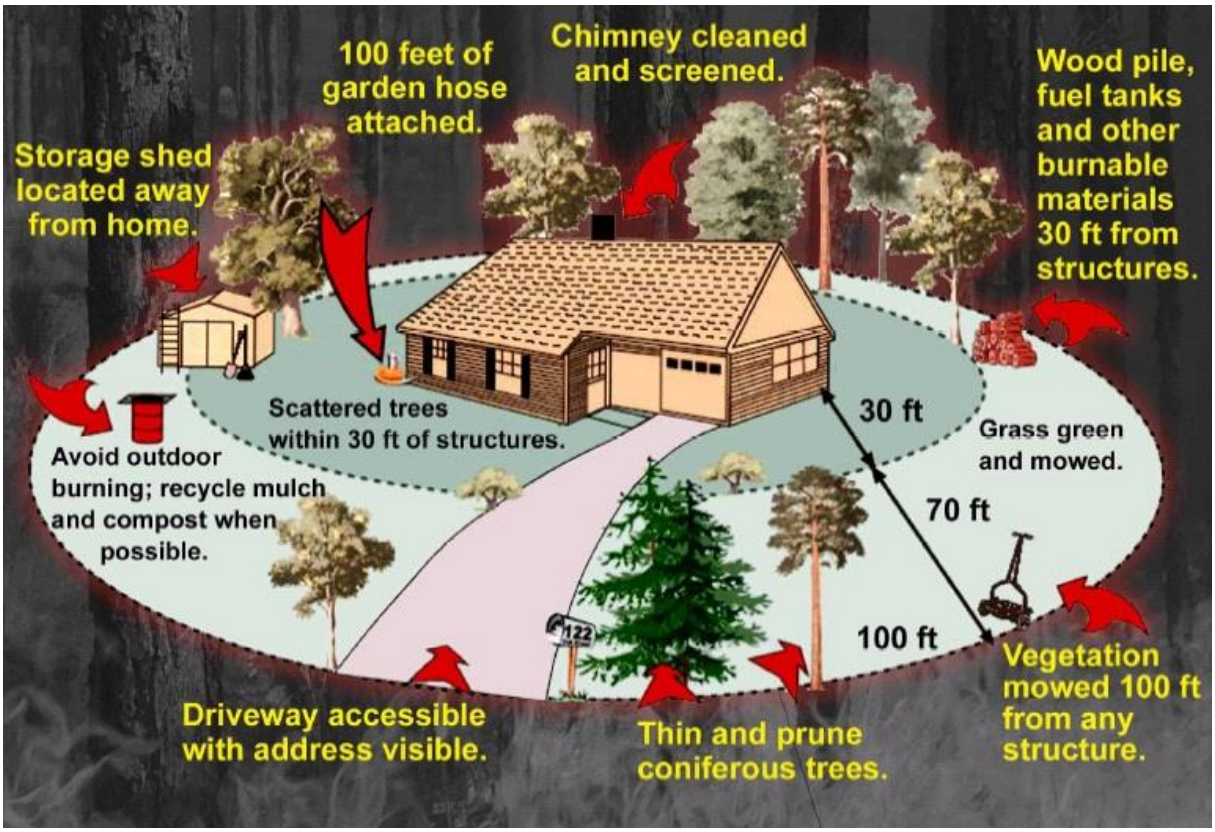

Figure 13-112. Fire Mitigation for Residential Structures

Potential Mitigation Activities for Residential Structures include:

- Establishing a "fuel-free zone" that immediately encircles the structure and its attachments out 3'
- Regulate the type of roofing, siding and decking materials
- Remove dead or down vegetation and accumulations of leaves and needles around/on/or under homes (gutters, in the roof valleys, around the base of the structure)
- Remove large/ dense amounts of live vegetation in the Home Ignition Zone by changing the character of the Zone by altering the path of the fire approaching a home – usually 100'.
- Hardscaping – use of stone walkways or driveways
- Develop a Fire Safe Council. A Fire Safe Council is a coalition of public and private sector organizations that share a common, vested interest in wildfire prevention and loss mitigation. Councils are dedicated to saving lives and reducing fire losses by making their communities fire safe.

- Identify safe zones as well as evacuation routes, mark them on maps and locate homes in forested areas for emergency personnel and potential development of a firefighters' atlas using geographic information system (GIS), which will be given back to emergency agencies and governmental agencies for use in disaster preparedness and emergencies.

Enhanced Fire Response

Firefighting capabilities are one of the most significant factors in determining the risk associated with the hazard. With limited response capabilities, the potential exists for the spread of fire which engulf a large part of the YR. Some general mitigation efforts which enhance both individual and department-wide efforts can include:

- Signage (both road and house numbers)
- Brush back roads for easier evacuation, access, and identification of residential areas.
- Educational outreach regarding burn piles, including clearing areas of flammable debris
- Having water/shovel/rake on-site, supervising fire, and making sure fire is completely out (when fire is reduced to minimal embers, douse with water and rake)
- Clear dead wood, brush, and weeds, especially near roadways and homes
- Put more water hydrants along the road closer to homes
- River water pumping stations
- Widen roadways to allow better ingress and egress to the area by firefighters and allow residents to get out of the area
- Additional firefighting (wildfire) gear
- Pursue grants for: firefighting equipment and training; structural fire-resistant enhancements; water storage structures; etc.
- Community-Connections Program – provide volunteer or summer-intern program to help elderly or those with disabilities assistance in site-hardening their residences and properties

13.13.5 Previous Mitigation Strategies

Previous planning efforts with Humboldt and Del Norte Counties have provided mitigation strategies which Yurok communities have identified during the planning process. Table 13-14 is an excerpt from the 2010 Humboldt County CWPP, and provides examples of what other fire planning units within the area may consider as they develop fire plans within their immediate area.

TABLE 13-14.
FIRE MITIGATION TREATMENT EFFORTS FOR THE YUROK RESERVATION

Location Number on Map	Community, Structure, or Area (Value at Risk)	Description	Status	Year	Type	Acres	Veg Type	Maintenance (actual or proposed)	Funding Source (actual or possible)
WCK017a	Kimtu Road /Gower Ln	Kimtu Area Fuel Reduction—Fuel Reduction and defensible space—Remove Biomass	Treat-Med	2010	Landscape		Brush	yearly	grant-landowner-neighborhood or road association
WCK110	Willow Creek (South/West side)	West of Willow Creek fuel break—Fuel Reduction as needed buffering West side of Willow Creek from forest lands	Treat-Med	2010	Landscape				grant-landowner-neighborhood or road association
WCK119	Baldwin Ridge area	clearance around repeater on Baldwin Ridge	Treat-Med	2010	Defensible Space				grant-landowner-neighborhood or road association
WCK122	Baldwin Creek road	Fuel Reduction on Roadway for Evacuation (Baldwin Creek Road)	Treat-Med	2010	Roadside Clearance				grant-landowner-neighborhood or road association
WCK131	Patterson Road /Private Roads past Oak Lane	Fuel Reduction on Patterson Road / Oak Lane for Evacuation – Chipping	Initiated	2009	Roadside Clearance	10.00	Brush	Evaluate yearly	WCFSC – Hum Co Sheriff
WCK162	Salyer—Oden Flat	Oden Flat Fuels Reduction—Fuels reduction, buffer behind high concentration of houses, break up fuel continuity	Treat-Med		Landscape	29.90			

TABLE 13-14.
FIRE MITIGATION TREATMENT EFFORTS FOR THE YUROK RESERVATION

Location Number on Map	Community, Structure, or Area (Value at Risk)	Description	Status	Year	Type	Acres	Veg Type	Maintenance (actual or proposed)	Funding Source (actual or possible)
WCK163	Salyer—Ammonville	Ammonville—Break up continuity, Thin Understory Fuels reduction, buffer behind high concentration of houses	Treat-Med		Landscape	188.65			
WCK164	Salyer—Rails Road	Rails Road Fuels Reduction Homes at the top of the hill needing defensible space	Treat-Med		Defensible Space	270.81			
WCK165	Salyer—Sign Tree Lane	Sign Tree Lane Fuels Reduction—Maintenance, fuels reduction (need to find out when last burned from USFS)—Understory burn & Roadside Brushing	Treat-Med		Roadside Clearance	125.05			

CHAPTER 14.
HUMAN-CAUSED HAZARDS

14.1 GENERAL BACKGROUND

Although the DMA does not require an assessment of human-caused hazards, the Steering Committee decided to include human-caused hazards in this hazard mitigation plan for the following reasons:

- The Tribe takes a proactive approach to disaster preparedness, especially in an effort to protect the public safety of all citizens.
- Preparation for and response to a human-caused disaster will involve many of the same staff training, critical decisions, and commitment of resources as a natural hazard.
- The hazard mitigation planning effort is an opportunity to inform the public about all hazards, including human-caused hazards.
- There is a likelihood of a human-caused hazard on the Reservation.

Human-caused hazards fall into the following categories:

- Acts of terrorism, which are intentional, criminal, malicious acts.
- Technological hazards, which are incidents that arise from human activities such as the manufacture, transportation, storage and use of hazardous materials. These incidents are assumed to be accidental in nature with unintended consequences.

DEFINITIONS

Acts of Terrorism—The unlawful use or threatened use of force or violence against people or property with the intention of intimidating or coercing societies or governments. Terrorism is either foreign or domestic, depending on the origin, base, and objectives of the terrorist or organization.

Technological Hazards—Hazards from accidents associated with human activities such as the manufacture, transportation, storage and use of hazardous materials.

Weapons of Mass Destruction—Chemical, biological, radiological, nuclear, and explosive weapons associated with terrorism.

Hazardous Material—A substance or combination of substances that, because of quantity, concentration, physical, chemical, or infectious characteristics, may cause or contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness, or pose a present or potential hazard to human life, property, or the environment. Hazardous waste is included in the City's working definition.

This report does not address human-caused hazards to the Tribe's water treatment facilities, as those facilities require a separate report per EPA requirements. Information on that evaluation is available from the Yurok Tribe Environmental Department, Water Quality Division..

14.1.1 Terrorism and Weapons of Mass Destruction

The Federal Bureau of Investigation (FBI) categorizes terrorism in the United States primarily as one of two types:

- Domestic terrorism involves groups or individuals whose terrorist activities are directed at elements of our government or population without foreign direction. The bombing of the Alfred P. Murrah federal building in Oklahoma City is an example of domestic terrorism. The FBI is the primary response agency for domestic terrorism. The FBI coordinates domestic

preparedness programs and activities of the United States to limit acts posed by terrorists including the use of weapons of mass destruction (WMDs).

- International terrorism involves groups or individuals whose terrorist activities are foreign-based and/or directed by countries or groups outside the United States, or whose activities transcend national boundaries. Examples include the 1993 bombing of the World Trade Center, the U.S. Capitol, and Mobil Oil's corporate headquarters and the attacks of September 11, 2001 at the World Trade Center and the Pentagon.

The three key elements to defining a terrorist event are as follows:

- Activities involve the use of illegal force.
- Actions are intended to intimidate or coerce.
- Actions are committed in support of political or social objectives.

At least three important considerations distinguish terrorism hazards from other types of hazards.

- In the case of chemical, biological, radiological, nuclear and improvised explosive devices (IEDs) (combined CBRNE), their presence may not be immediately obvious, making it difficult to determine when and where they may have been released, who has been exposed, and what danger is present for first responders and emergency medical technicians.
- There is limited scientific understanding of how these agents affect the population at large.
- Terrorism evokes very strong emotional reactions, ranging from anxiety, to fear, to anger, to despair, to depression.

Those involved with terrorism response, including public health and public information staff, should be trained to deal with the public's emotional reaction swiftly as response to the event occurs. The area of the event must be clearly identified in all emergency alert messages to prevent those not affected by the incident from overwhelming local emergency rooms and response resources therefore reducing service to those actually affected. The public will be informed clearly and frequently about what government agencies are doing to mitigate the impacts of the event. The public will also be given clear directions on how to protect the health of individuals and families.

According to FEMA 386-7, terrorism refers to the use of weapons of mass destruction, including: CBRNE weapons; arson; armed attacks; industrial sabotage and intentional hazardous materials releases; agro-terrorism and cyber-terrorism. The following are potential methods used by terrorists that could affect the Reservation as a direct target or collaterally:

- Conventional bomb
- Biological agent
- Chemical agent
- Nuclear bomb
- Radiological agent
- Arson/incendiary attack
- Armed attack
- Cyber-terrorism
- Agro-terrorism
- Intentional hazardous material release.

For each type of hazard, the following factors are addressed:

- **Application Mode**—Application mode describes the human acts or unintended events necessary to cause the hazard to occur.

- **Duration**—Duration is the length of time the hazard is present. For example, the duration of a tornado may be just minutes, but a chemical warfare agent such as mustard gas, if un-remediated, can persist for hours or weeks under the right conditions.
- **Dynamic or Static Characteristics**—These characteristics of a hazard describe its tendency, or that of its effects, to either expand, contract, or remain confined in time, magnitude, and space. For example, the physical destruction caused by an earthquake is generally confined to the place in which it occurs, and it does not usually get worse unless aftershocks or other cascading failures occur; in contrast, a cloud of chlorine gas leaking from a storage tank can change location by drifting with the wind and can diminish in danger by dissipating over time.
- **Mitigation and Exacerbating Conditions**—Mitigating conditions are characteristics of the target and its physical environment that can reduce the effects of a hazard. For example, earthen berms can provide protection from bombs; exposure to sunlight can render some biological agents ineffective; and effective perimeter lighting and surveillance can minimize the likelihood of someone approaching a target unseen. In contrast, exacerbating conditions are characteristics that can enhance or magnify the effects of a hazard. For example, depressions or low areas in terrain can trap heavy vapors, and a proliferation of street furniture (trash receptacles, newspaper vending machines, mail boxes, etc.) can provide hiding places for explosive devices.

Most terrorist events in the United States have been bombing attacks, involving detonated and undetonated explosive devices, tear gas, pipe bombs, and firebombs. The effects of terrorism can vary from loss of life and injuries to property damage and disruptions in services such as electricity, water supplies, transportation, or communications. Any of the methods above may have an immediate effect or a delayed effect. Terrorists often choose targets that offer limited danger to themselves and areas with relatively easy public access. Foreign terrorists look for visible targets where they can avoid detection before and after an attack such as international airports, large cities, major special events, and high-profile landmarks.

In dealing with intentional human-caused hazards, the unpredictability of human beings must be considered. People with a desire to perform criminal acts may seek out targets of opportunity that may not fall into established lists of critical areas or facilities. The Tribe's Public Safety Officers train not only to respond to organized terrorism events, but also to respond to random acts by individuals who, for a variety of reasons ranging from fear to emotional trauma to mental instability, may choose to harm others and destroy property.

While education, heightened awareness, and early warning of unusual circumstances may deter crime and terrorism, intentional acts that harm people and property are possible at any time. Public safety entities would then react to the threat, locating, isolating, and neutralizing further damage and investigating potential scenes and suspects to bring criminals to justice.

Table 14-1 provides a hazard profile summary for terrorism-related hazards.

TABLE 14-1.
EVENT PROFILES FOR TERRORISM

Hazard	Application Mode	Hazard Duration	Static/Dynamic Characteristics	Mitigating and Exacerbating Conditions
Conventional Bomb	Detonation of explosive device on or near target; delivery via person, vehicle, or projectile.	Instantaneous; additional "secondary devices, and/or diversionary activities may be used, lengthening the time duration of the hazard until the attack site is determined to be clear.	Extent of damage is determined by type and quantity of explosive. Effects generally static other than cascading consequences, incremental structural failure, etc.	Overpressure at a given standoff is inversely proportional to the cube of the distance from the blast; thus, each additional increment of standoff provides progressively more protection. Terrain, forestation, structures, etc. can provide shielding by absorbing and/or deflecting energy and debris. Exacerbating conditions include ease of access to target; lack of barriers and shielding; poor construction; and ease of concealment of device.
Chemical Agent	Liquid/aerosol contaminants can be dispersed using sprayers or other aerosol generators; liquids vaporizing from puddles/ containers; or munitions.	Chemical agents may pose viable threats for hours to weeks depending on the agent and the conditions in which it exists.	Contamination can be carried out of the initial target area by persons, vehicles, water, and wind. Chemicals may be corrosive or otherwise damaging over time if not remediated.	Air temperature can affect evaporation of aerosols. Ground temperature affects evaporation of liquids. Humidity can enlarge aerosol particles, reducing inhalation hazard. Precipitation can dilute and disperse agents but can spread contamination. Wind can disperse vapors but also cause target area to be dynamic. The micro-meteorological effects of buildings and terrain can alter travel and duration of agents. Shielding in the form of sheltering in place can protect people and property from harmful effects.
Arson/ Incendiary Attack	Initiation of fire or explosion on or near target via direct contact or remotely via projectile.	Generally minutes to hours.	Extent of damage is determined by type and quantity of device, accelerant, and materials present at or near target. Effects generally static other than cascading consequences, incremental structural failure, etc.	Mitigation factors include built-in fire detection and protection systems and fire-resistive construction techniques. Inadequate security can allow easy access to target, easy concealment of an incendiary device, and undetected initiation of a fire. Non-compliance with fire and building codes, as well as failure to maintain existing fire protection systems, can substantially increase the effectiveness of a fire weapon.

TABLE 14-1.
EVENT PROFILES FOR TERRORISM

Hazard	Application Mode	Hazard Duration	Static/Dynamic Characteristics	Mitigating and Exacerbating Conditions
Armed Attack	Tactical assault or sniping from remote location, or random attack based on fear, emotion, or mental instability.	Generally minutes to days.	Varies based on the perpetrators' intent and capabilities.	Inadequate security can allow easy access to target, easy concealment of weapons, and undetected initiation of an attack.
Biological Agent	Liquid or solid contaminants can be dispersed using sprayers/ aerosol generators or by point or line sources such as munitions, covert deposits, and moving sprayers.	Biological agents may pose viable threats for hours to years depending on the agent and the conditions in which it exists.	Depending on the agent used and the effectiveness with which it is deployed, contamination can be spread via wind and water. Infection can spread via human or animal vectors.	Altitude of release aboveground can affect dispersion; sunlight is destructive to many bacteria and viruses; light to moderate wind will disperse agents but higher winds can break up aerosol clouds; the micro-meteorological effects of buildings and terrain can influence aerosolization and travel of agents.
Cyber-terrorism	Electronic attack using one computer system against another.	Minutes to days.	Generally no direct effects on built environment.	Inadequate security can facilitate access to critical computer systems, allowing them to be used to conduct attacks.
Agro-terrorism	Direct, generally covert contamination of food supplies or introduction of pests and/or disease agents to crops and livestock.	Days to months.	Varies by type of incident. Food contamination events may be limited to specific distribution sites, whereas pests and diseases may spread widely. Generally no effects on built environment.	Inadequate security can facilitate adulteration of food and introduction of pests and disease agents to crops and livestock.
Radiological Agent	Radioactive contaminants can be dispersed using sprayers/ aerosol generators, or by point or line sources such as munitions.	Contaminants may remain hazardous for seconds to years depending on material used.	Initial effects will be localized to site of attack; depending on meteorological conditions, subsequent behavior of radioactive contaminants may be dynamic.	Duration of exposure, distance from source of radiation, and the amount of shielding between source and target determine exposure to radiation.

TABLE 14-1.
EVENT PROFILES FOR TERRORISM

Hazard	Application Mode	Hazard Duration	Static/Dynamic Characteristics	Mitigating and Exacerbating Conditions
Nuclear Bomb	Detonation of nuclear device underground, at the surface, in the air, or at high altitude.	Light/heat flash and blast/shock wave last for seconds; nuclear radiation and fallout hazards can persist for years. Electromagnetic pulse from a high-altitude detonation lasts for seconds and affects only unprotected electronic systems.	Initial light, heat, and blast effects of a subsurface, ground, or air burst are static and determined by the device's characteristics and employment; fallout of radioactive contaminants may be dynamic, depending on meteorological conditions.	Harmful effects of radiation can be reduced by minimizing the time of exposure. Light, heat, and blast energy decrease logarithmically as a function of distance from seat of blast. Terrain, forestation, structures, etc. can provide shielding by absorbing and/or deflecting radiation and radioactive contaminants.
Intentional Hazardous Material Release (fixed facility or transportation)	Solid, liquid, and/or gaseous contaminants may be released from fixed or mobile containers	Hours to days.	Chemicals may be corrosive or otherwise damaging over time. Explosion and/or fire may be subsequent. Contamination may be carried out of the incident area by persons, vehicles, water, and wind.	As with chemical weapons, weather conditions directly affect how the hazard develops. The micro-meteorological effects of buildings and terrain can alter travel and duration of agents. Shielding in the form of sheltering in place can protect people and property from harmful effects. Non-compliance with fire and building codes, as well as failure to maintain existing fire protection and containment features, can substantially increase the damage from a hazardous materials release.

Source: FEMA 386-7

14.1.2 Technological Hazards

Technological hazards are associated with human activities such as the manufacture, transportation, storage and the use of hazardous materials; utility shortages or blackouts, transportation accidents which can disrupt commodity shortages or have hazardous materials consequences. Incidents related to these hazards are assumed to be accidental with unintended consequences. Technological hazards on the Yurok Reservation can be categorized as follows:

- Hazardous materials incidents
- Utility losses
- Data and telecommunications disruptions

- Water/wastewater disruption
- Air and transportation accidents
- Infrastructure threats

Hazardous Materials Incidents

Hazardous materials are present in nearly every community nationwide in facilities that produce, store, or use them. For example, water treatment plants use chlorine on-site to eliminate bacterial contaminants. Hazardous materials are transported along interstate highways and railways daily. Even the natural gas used in every home and business is a dangerous substance when a leak occurs.

Title 49 of the CFR lists thousands of hazardous materials, including: gasoline, insecticides, household cleaning products, and radioactive materials. State regulated substances that have the greatest probability of adversely impacting the community are listed in the CCR, Title 19.

The following are the most common type of hazardous material incidents:

- **Fixed-Facility Hazardous Materials Incident**—This is the uncontrolled release of materials from a fixed site capable of posing a risk to health, safety and property as determined by the Resource and Conservation Act. It is possible to identify and prepare for a fixed-site incident because federal and state laws require those facilities to notify state and local authorities about what is being used or produced at the site.
- **Hazardous Materials Transportation Incident**—A hazardous materials transportation incident is any event resulting in uncontrolled release of materials during transport that can pose a risk to health, safety, and property as defined by Department of Transportation Materials Transport regulations. Transportation incidents are difficult to prepare for because there is little if any notice about what materials could be involved should an accident happen. Hazardous materials transportation incidents can occur at any place within the country, although most occur on the interstate highways or major federal or state highways, or on the major rail lines.

  Hazardous materials are transported via ground along highways and railways. According to a February 20, 2005 *Sacramento Bee* article, "Union Pacific carried 9.2 million carloads of freight in 2003…throughout the West and part of the South and Midwest." The article quotes a Union Pacific spokeswoman as estimating that "Less than 5 percent of cargo that moves through our West Coast operations is hazardous material."

  In addition to materials such as chlorine that are shipped throughout the country by rail, thousands of shipments of radiological materials, mostly medical materials and low-level radioactive waste, take place via ground transportation across the United States. Many incidents occur in sparsely populated areas and affect very few people. There are occasions, however, when materials are involved in accidents in areas with much higher population densities, such as the January 6, 2005 train accident in Graniteville, South Carolina that released chlorine gas killing nine, injuring 500, and causing the evacuation of 5,400 residents. Fortunately, such events are rare.
- **Interstate Pipeline Hazardous Materials Incident**—There are a significant number of interstate natural gas, heating oil, and petroleum pipelines running through the State of California. These are used to provide natural gas to the utilities in California and to transport these materials from production facilities to end-users.

Utility Losses

Loss of utility services due to technological or man-made incidents could mean a potential life-threatening situation. In the case of the loss of electricity, such loss could have devastating impacts on medically dependent residents, and a public health threat if the services are disrupted for some time.

A power failure is any interruption or loss of electrical service due to disruption of power generation or transmission caused by an accident, sabotage, natural hazards, equipment failure, or fuel shortage. These interruptions can last anywhere from a few seconds to several days. Power failures are considered significant only if the local emergency management organization is required to coordinate basic services such as the provision of food, water, and heating as a result. Power failures are common with severe weather and winter storm activity.

As previously indicated, a large portion of the Reservation (primarily up-river) is without a power supply system. Those portions of the Reservation which do have power receive their energy from two different electrical companies who provide its electricity: PacifiCorp (Pacific Power & Light), and Pacific Gas and Electric (PG&E).

These companies provide for the operation and maintenance of the Tribe's electrical transmission and distribution systems. Unfortunately, because of the remoteness of the Reservation, reliability with respect to distribution is very low, as there are no redundant systems in place, with limited interconnection between facilities and notifications of failure should one occur along distribution systems. Outages, and potentially brownouts as occurred in some parts of California in 2000 and 2001, can leave the area without power for extended periods of time, well beyond the timeframe experienced by surrounding communities. During summer months, as a result of increased tourism and travel down the highway system, 8,000 people can be expected to be in the vicinity on a daily basis. As power outages and potential brownouts occur, impacts to life safety has the potential to increase significantly.

As a result of historic power failures, the Tribe has taken a proactive approach to maintaining functionality of some of its critical facilities through the purpose of generators, and a surplus supply of fuel to power those generators. However, the number of generators is limited, and only certain facilities are currently wired for back-up power supplies of this nature.

Data and Telecommunications

The loss of data and/or telecommunications is often a secondary hazard to natural and other human-caused hazards. Data and telecommunications provide a primary method for service to the community by the government and the private sector. A loss of data and telecommunications could result in loss of emergency dispatch capabilities, emergency planning services, infrastructure monitoring capabilities, access to statistical data, and loss of financial and personnel records.

Water/Wastewater Disruption

Water, water treatment and distribution, and wastewater collection and treatment services are provided to citizens and businesses on the Reservation by a combination of tribal and non-tribal service districts. Water and/or wastewater disruption is normally a secondary impact from a natural disaster or intentional act. The Yurok Reservation receives surface water from various dams and well sources surrounding the area. A breach in any of the surrounding dams or the pipelines that carry water to the Reservation's water treatment facility would have significant impacts on the Reservation until alternative water sources, including water from other regional purveyors and groundwater, are pumped and treated. Long-term disruption of the water source would have significant impacts on residences and businesses on the

Reservation should demand exceed secondary supplies and water conservation measures not provide enough relief to reduce demand to equal the secondary supplies.

Disruption of the Tribe's wastewater collection and wastewater treatment plants would also have significant Reservation-wide impacts should the system be overwhelmed by a significant incident or discharge of materials in such quantities that the treatment plant cannot adequately treat the waste. Natural hazards such as earthquake, flood damage or major power outages, or terrorism directed at the facilities and systems, could disrupt the process of treating millions of gallons of waste.

Wastewater treatment plants may also have emergencies internal to the plant such as chlorine gas leaks or oxygen deficiencies that render them incapable of treating waste. The disruption of service may also have significant environmental impacts on the waterways adjacent to the treatment plants.

Air, Water and Transportation Accidents

Air, water and transportation accidents are incidents resulting in death or serious injury. Major transportation corridors increase the potential for accidents, including accidents occurring during the transportation of hazardous materials.

Infrastructure Threats

Infrastructure threats include threats to telecommunications, utility transportation, economic, information and other systems that allow society to function as it is accustomed to. This threat will increase in the future, and an event directed at any one of these systems could affect the ability of the Tribe's population to go about life in a normal manner.

14.1.3 Civil Disorder

Civil disorder refers to incidents that disrupt a community to the degree that law enforcement intervention is required to maintain public safety. These incidents are generally associated with controversial political, judicial, or economic issues and may occur at any time of the year, although statistics indicate that they are more frequent during summer.

The effects of civil disorders vary with the type, severity, scope, and duration of event. Essential services (e.g., electricity, water, public transportation, communications), may be disrupted, or property damage, injuries, and loss of life may occur. Certain facilities most at risk are government buildings, schools, utilities and Yurok Villages.

14.2 HUMAN-CAUSED HAZARD PROFILE

14.2.1 Past Events

State of California

Terrorism Events

According to the Governor's Office of Emergency Services Terrorism Response Plan, the State of California has had a long history of defending the public against domestic and foreign terrorists. Domestic terrorist groups in California have been focused on political or social issues, while the limited internationally based incidents have targeted the state's immigrant communities due to foreign disputes. Advanced technologies and communication have allowed these groups to become more sophisticated and better organized, with remote members linked electronically.

Technological Hazard Incidents

No comprehensive source was found in state websites or through personal contact with the Sacramento Regional Office of Homeland Security for technological hazard incidents in the State of California. Given the complex system of transportation networks, the large population, and the number of businesses in California, incidents occur on a regular basis throughout the State as reported by the news media.

Region

Terrorism Events

Eco-terrorism: Development projects in Placer County were the subject of arson activity by an individual who claimed to be from the Earth Liberation Front or ELF, a splinter group of Earth First!, a radical environmental activist movement. ELF is a somewhat active domestic terrorism group that says it uses eco-sabotage to protect the Earth and to seek revenge on "those who are destroying the Earth and its inhabitants."

Domestic terrorism: On December 3, 1999, the FBI arrested two anti-government militia members who planned a bomb attack at the Suburban Propane facility in Elk Grove, CA. The alleged plot involved a plan to blow up the Suburban Propane site, which stores about 24 million gallons of liquefied propane and is located one mile from residential homes. According to the Sacramento Bee, the plot resulted in heightened on-site security and a year-long investigation resulting in the two arrests.

Technological Hazard Incidents

The State Secretary for Environmental Protection designated the Hazardous Materials Program of the Humboldt County Division of Environmental Health as the Certified Unified Program Agency (CUPA) The CUPA is charged with the responsibility of conducting compliance inspections of over 800 facilities in Humboldt County. These facilities handle hazardous materials, generate or treat a hazardous waste and/or operate underground storage tanks. The CUPA forwards important facility information to local fire prevention agencies that enables them to take appropriate protective actions in the event of an emergency at regulated facilities.

The Eureka Fire Department Regional Hazardous Material Response Team (HMRT) was established in 1993 to provide for response to emergencies involving hazardous materials. The HMRT is funded primarily through a Joint Powers Agreement (JPA) between Humboldt County, the Tribe, Del Norte County, City of Eureka, City of Crescent City, City of Arcata, City of Blue Lake, City of Ferndale, City of Rio Dell, and City of Trinidad. The JPA establishes the Humboldt/Del Norte Hazardous Material Response Authority (HMRA). The HMRA Board consists of elected officials of each member agency and meets quarterly to provide oversight to the Team.

Both Humboldt and Del Norte Counties have experienced many accidental hazardous materials incidents. While no deaths have been experienced, property damage, environmental impact and fish loss are of significant concern.

Local

Arson Events

While arson events have occurred on the Reservation, to date, those have been limited most often to small fires in the Upriver portion of the Reservation set by arsonists attempting to burn trash or tires.

Terrorism Events

Fortunately, there have been no terrorism-related incidents to occur on the Reservation.

Civil Disorder

The Tribe is many times viewed with hostility from non-tribal organizations and individuals. Racial discrimination is something which Tribal Members have experienced through time immemorial. These racial indignations have led to acts of violence against the tribe, with desecration of culturally sensitive areas, looting of gravesites, and other random acts of retaliation. Civil disorders have ensued as a result the Tribe enforcing its sovereign rights in instances such as farmers illegally diverting water above the numerous dams on the reservation, causing water levels to drop, raising temperature of the waters, which, when released by the dam operators, have caused fish kills mounting in the thousands of fish. This practice continues today, and is of significant concern to the Yurok People.

Hazardous Materials Incidents

The Yurok Tribe has experienced a number of hazardous materials incidents, including fuel spills as a result of car accidents, maritime incidents, sewage leaks/spills, and the illegal dumping of hazardous materials substances in remote areas of the Reservation.

In 2006, the dredge M/V Stuyvesant spilled an estimated 2100+/- gallons of Intermediate Fuel Oil 180 into the Pacific Ocean near the mouth of Humboldt Bay near the Yurok Reservation, impacting the Reading Rock Murre Re-Colonization Project. Reading Rock is of cultural significance to the Yurok Tribe, which has traditionally hunted sea lions in the area. The oil spill is believed to have killed thousands of wildlife, birds and aquatic creatures, as well as impacting beach and intertidal habitats, and causing economic impact from loss of recreational services which the Tribe normally provides to tourists. This was not the first of such type of incident to occur in this vicinity – several other vessels have spilled fuel in the same area.

Mercury spills have also occurred on the Reservation. Mercury is used by gold miners to extract gold during mining activities, so it is not uncommon for many households. A 2007 incident involving a small amount of mercury occurred in a remote area of the Reservation. Even small amounts of mercury, when spilled, require trained hazardous material professionals to clean the site. Vapors from the chemical are extremely hazardous, and can quickly cause serious respiratory issues.

Marijuana grow operations generate a high environmental footprint in numerous ways. One area of impact is from spilled fuels used to operate generators. Depending on the size of the generator, calculations range from 75 to 120 gallons per pound of marijuana grown. This equates to 4.5-7.5 gallons per ounce. This fuel, when spilled, seeps into the ground, spreading into water aquifers. The impact of spilled fuel can take years to naturally degrade. Fertilizers used by operators of these sites also seep into ground water, causing significant environmental impact to water, wildlife and aquatic life. As previously indicated, the diversion of water from the riverbeds has also resulted in significant fish kills.

With growth in the region and in trips through the Reservation to various tourist destinations, the number of traffic accidents has been steadily increasing. Truck with trailer accidents account for a very small percentage of the Reservation's reported traffic accidents yet represent the highest potential for hazardous materials incidents on roadways passing through the Reservation.

Due to the remote location of the Tribe, there has historically been issues with methamphetamine labs being set up. These types of labs use extremely toxic chemicals and cause significant impact to the environment; pose a significant risk to the first responders and clean-up crews on scene, but also are a

significant health hazard to citizens who inadvertently pass through the area before the labs are discovered, carrying the contaminated chemicals out on their shoes and person.

Air, Water and Transportation Accidents

The surrounding area has a number of airports, including the McNamara Airport in Crescent City, Medford and Eureka Airports, as well as a small landing strip (McBeth Airport) on the Reservation that enhance the potential for an air disaster. At present, the runways at McNamara Airport are too small for newer model airplanes and will require expansion to accommodate aircrafts. While there are a number of airports in the general area, there are no reports of any issues involving injuries or fatalities as a result of air transportation accidents.

Several major transportation routes run through the Reservation. The potential for transportation accidents that block ingress, egress, and movement through the Reservation is significant, as well as the likelihood of hazardous materials incidents resulting from a traffic accident. As most of the highway systems are reduced lanes, the blockage of the roadways would have significant impact, especially given the limited resources to provide assistance and supplies to individuals potentially trapped within the Reservation boundaries as a result of an incident occurring on a major roadway. The potential hazardous materials spill impacting the environment would also have devastating impacts, especially if any type of spill entered any of the water bodies on the Reservation. Mutual aid allows for Tribal Police and/or County Police to respond both on and off the Reservation to provide assistance.

Because of the remoteness of much of the Reservation, the use of the Klamath River for emergency response is also an option. In the event interregional connecting routes become impassable for vehicles, transport by river for the purpose of emergency response, evacuation, and relief supply delivery will be a viable alternative. This has previously occurred during a flood event when a ferry transported vehicles from one area of the reservation to another as a result of bridge failure. However, this alternative will be less feasible for emergency response in an incident in which substantial amounts of large floating debris would be expected to pose a safety concern to those on the river. Debris floating on the river is a common occurrence, and during periods of significant flow, the river has carried dead livestock downstream. This causes additional concern as this floating debris can also strike water vessels, causing them to capsize or to take on water and sink.

On the Klamath River, drowning and capsizing boats unfortunately occur on an annual basis throughout the river system. This is especially true during the winter months, when traditional hunting and eeling occurs during the nighttime hours. Increased river flows, accompanied by high surf significantly increase the danger associated with this Yurok tradition. The Yurok Department of Public Safety, the Del Norte and Humboldt County Sheriffs' Departments, and the US Coast Guard respond on these occasions by boat or helicopter.

During summer time low-flows, the existence of large river bars throughout the Yurok Reservation aid in emergency response by helicopter, as these large flat areas have sufficient clearance and are easily identifiable. River rescue, another emergency resource in which the utility of the Klamath River is used as an emergency response route, is often hampered during low-flows and when large amounts of debris accumulated.

14.2.2 Location

The State of California and Office of Homeland Security have identified numerous high profile targets for potential terrorists in California. Large population centers, high visibility tourist attractions, and critical infrastructure accessible to the public present security challenges of an ongoing nature in California. The network of highways, waterways, railways, ports and airports used to transport significant amounts of

hazardous materials poses a significant technological hazards threat. Hazardous materials incidents may occur anywhere on the Reservation. However, depending upon the type of incident occurring, incidents occurring in surrounding jurisdictions also have the potential to impact the Reservation as wind and water can carry air- and water-borne chemicals. Likewise, vehicles traveling from other areas also act as potential carriers. Therefore, surrounding high-profile areas should also be taken into consideration in this context.

Transportation Routes

The following transportation facilities all have the potential for human-caused hazards:

- The principle State Routes that serve the Yurok Reservation are: 101, 169, and 96. State route 169 is the principle artery for the 'up river' section of the reservation and no other viable alternative exists for the daily interregional travel needs of local residents. Route 169 collects traffic from every point throughout this region and provides access to Bald Hills road via Martin's Ferry Bridge and access to the highway 96 corridor. Due to the inherent geologic instability of the region, the road's substandard construction relative to modern design standards, deferred maintenance, and extensive storm damage, the entire length of this route throughout the 'up river' reservation area is in a compromised condition. This road has been identified as the most important and vulnerable emergency access route. Any major failure of 169 would pose a serious jeopardy to local residents and would inhibit the ability of emergency responders to be able to access this region.
- State Route 96 serves the vital corridor that links the Yurok Reservation with Hoopa, Orleans, Willow Creek, and the coast. This highway is subject to hazardous materials incidents, slides, bridge failures, landslides and large falling rocks during heavy winter storms. A bridge failure along this corridor, such as those previously occurring on Terwer Creek and Pecwan Creek, have the potential to cause isolation for many families living in these areas. While customarily CalTrans sustains a high level of maintenance throughout the 96 corridor and road closures are most often limited to a period of a few hours, there have been occasions where families have been isolated for extended periods of time
- Highway 101 has a high level of importance for CalTrans due to the interregional nature of its connection between Oregon and California and the counties on the North Coast. This level of importance mandates a high level of maintenance and timely action on identified damages. The 101 corridor through Klamath provides dependable access to the 'lower' reservation except in times of extreme flooding, at which time the roadway may become inundated for an extended period of time. To alleviate this problem, CalTrans is undertaking a grade raise project for the affected area.
- SR 169 serves as an established truck route, which has a higher potential for hazardous material incidents to occur as a result of traffic incidents. State Route 169 is also the major ingress-egress onto the Reservation – both the up-river and down-river locations. This is the only two-way, single highway system within California. Any incidents which occur on SR 169 can have devastating impacts. Of significant concern, is the northeastern section of upper Yurok Reservation, which has only one arterial route for local residents to ingress and egress. The concern is that California State Route 169 is extremely vulnerable to various emergency conditions or natural disasters which could block this vital escape and response route. This situation transfers significant risks and dangers the surrounding communities.
- Information has been relayed to tribal staff by life-long local residents and tribal members of episodic incidents. In response to these events, people at risk have been forced to seek any available routes away from danger. These alternative escape routes most commonly lead into the high country where Six Rivers National Forest lands are located. The local road systems

on and adjacent to the Yurok Reservation lead up to the main Forest Service arterial collector, 13N01, known as Lonesome Ridge Road, whereby affected residents can escape out to Highway 96 between Orleans and Weitchpec. Should a fire erupt (either human caused or naturally occurring), residents would be trapped in these areas.

- Bald Hills Road is the primary route connecting the upper and lower portions of the Yurok Reservation. The road is a primary, vital route connecting residents for the reservation. Bald Hills Road is also the primary access road to the Bald Hills portion of the Redwood National Park, and provides access to private property, including both residences and timberlands. The road also provides connectivity between the coast and the inland communities of Weitchpec, Orleans and Hoopa. Impact to this roadway would cause islands of isolation for those traveling and living within the area. Given the limited resources in the area, those isolated would have very limited resources available to them.
- Tulley Creek Road is the only ingress/egress route serving both scattered and clustered housing sites in the Tulley Creek area. No known vehicular alternatives exist to this route, posing a high risk of isolation in the event of emergency situations. In addition to significant damage that was inflicted to this road by the 2005/06 'New Year's Storm', there are significant potential hazard posed by inadequate drainage of the numerous creeks and springs that cross the road. Due to these high risk factors, this road has been identified as having a high level of importance as an emergency route for this area.
- Capell Road serves as an important alternative to state route 169 in the event of a failure to that route. Due to the failure of the Coon Creek Bridge in the middle section of Capell road which prevents through access, this one route is essentially split into two sections, known locally as 'upper' and 'lower' Capell roads. In 2001-2005, the BIA sponsored a geotechnical study to determine the feasibility of replacing the bridge in the same location. The results of this study determined that the inherent geological conditions present at this location would prevent replacement of the bridge at this location. To date, no additional study has been performed to propose an alternative passage structure or location. Capell road is a gravel surface road in fair to good condition of adequate width for the passage of heavy equipment.
- Martin's Ferry Bridge is the only bridge that crosses the Klamath River between the confluence with the Trinity River in Weitchpec and the 101 bridge in Klamath. This bridge can be considered one of the most vital links for the purpose of interregional connectivity and emergency response on the Yurok Reservation. Significant problems compromising the bridge's structural integrity have been identified by Humboldt County and Caltrans geotechnical and civil engineering experts. In 2005, Humboldt County began the contracting process for a seismic retrofit project on this bridge, which project is still on-going.
- Johnson's Road provides an escape route for residents living in the Johnson's area. In the event of a major failure of State Route 169 or the blockage of that route due to fire or other natural disasters, such as that which occurred in 2005 when several trees fell across the roadway, trapping residents from the village of Wautec and surrounding areas, residents have reported crossing the river by boat to escape danger. Due to the lack of a bridge across the Klamath at this point, the use of this route for emergency response and/or relief purposes is limited to the Johnson's and Mettah areas on the south-west bank of the river.
- The most common use of BIA routes throughout the Yurok Reservation is as access to scattered and clustered housing sites. Deferred maintenance is the most common problem associated with failures to these roads. During cyclical storm events, local residents are often isolated and unable to receive deliveries of heating fuel, food, water, and any other emergency relief. Several BIA routes also serve community water systems on which local residents depend. Dowd road is the major BIA route that serves as an interregional connector

between the Yurok Reservation and the Hoopa valley. This road is also one of the few inland alternatives to the Highway 96 corridor in the event of its failure. During the 2005/06 'New Years' Storm', the roadway experienced a major failure rendering the road impassable.

- In several locations throughout the Yurok Reservation, allotment and tribal trust lands, as well as free properties owned by Yurok tribal members and other reservation residents, exist along the Klamath River. Many of these parcels are accessible only by right-of-way covenants or informal agreements with the largest land owner on the Yurok Reservation, the Green Diamond Resource Company. In the event of an incident that may impact the road system or may render interregional connecting routes impassable for vehicles, transport by river for the purpose of emergency response, evacuation, and relief supply delivery will be a viable alternative. This alternative route will be less feasible for emergency response in the event of a flood, where substantial amounts of large floating debris would be expected to poses a safety concern to those boating.
- Andy McBeth Airport is situated 0.20 miles from Klamath Glen, and 3.05 miles from Klamath. It is a publicly-owned airport (Del Norte County), with two runways, operating an average of 29 weeks per year, with 73% of its operations consisting of transient general aviation, and 20% local aviation, with 7% military.
- McNamara Airport located in Crescent City is the next nearest airport to the Yurok Reservation. The airport is publicly owned with four runways. 49% of its operations consists of local general aviation, 1% military, 27% air taxi, and 22% transient general aviation.
- The only additional airport within a 50-mile radius of the Reservation is the Arcata Airport (48 miles south).

Pipelines

Presently there are no existing pipelines on the Reservation. While Pacific Gas and Electric does provide electrical services to the up-river part of the Reservation, they do not supply gas.

Business and Industrial Areas

Retail, manufacturing and light industrial firms within the area and traveling along State Route 169 are areas of concern. These facilities have the highest concentration of hazardous materials at fixed facilities on or near the Reservation due to their manufacturing operations. Each business is required to file a detailed, confidential plan with either the Humboldt or Del Norte Fire Departments regarding materials on-site and safety measures taken to protect the public.

Agricultural

Accidental releases of pesticides, fertilizers, and other agricultural chemicals may be harmful to both humans and the environment. Agricultural pesticides are transported daily in and around the Yurok Reservation en route to their destination either on the Reservation, or to areas within Humboldt or Del Norte Counties.

Illegal Drug Operations

Illegal operations such as marijuana grown operations and laboratories for methamphetamine (including traveling meth labs in the back of vehicles) pose a significant threat on the Reservation. Laboratory residues are often dumped along roadways or left in rented hotel rooms, creating a serious health threat to unsuspecting individuals and to the environment. Drug grow operations use large amounts of fertilizer which seep into waterways. River flows are diverted by grow operators, depleting water levels, which ultimate increase water temperatures, causing significant fish kills.

Source: CA Dept. of Conservation; Available at: ftp://ftp.consrv.ca.gov/pub/oil/maps/Map_S-2.pdf

Figure 14-1. California Pipeline Locations

Illegal Dumping Sites

Hazardous wastes such as used motor oil, solvents, or paint are frequently dumped on the Reservation, or along roadways, creating a potential health threat to unsuspecting individuals and to the environment.

In October 2009, the Yurok Tribe met the many challenges posed by a remote and inaccessible illegal dump site when the tribe closed the Johnsons Road dump. Due to its large size and position on an extremely steep slope, closing the dump was a major effort. Tribal staff joined forces with a contract crew and members of the California Department of Resources Recycling and Recovery (Cal-Recycle) to construct a rail track on the site. Excavators were cabled to winches and lowered down the slope to load waste into rail cars, which were winched up and down on the rails. Hand crews, sometimes roped and harnessed for safety, rappelled down the slope to collect debris that could not be reached by excavators. The project took more than six weeks to complete, but was finished under budget and removed approximately 138 tons of waste (EPA, 2010).

Figure 14-2. Joint Tribal-State-Federal Dump Cleanup on Steep Slope at Yurok Reservation

Radioactive Materials

Licensed carriers transport radioactive materials along various transportation routes, including SR 169 which travels through the Reservation. While the Tribe should be notified in advance of these shipments, advanced notifications do not always occur.

Power Suppliers

Utility power is not available on the entire reservation. Presently, electrical power is available near Klamath, provided by PacifiCorp (Pacific Power & Light), a Northwest utility. In the "upriver" area, the main town of Weitchpec and surrounding areas have access to utility power from Pacific Gas and Electric (PG&E). PG&E power extends down the river to the vicinity of McKinnon Hill. There are approximately 50 households farther down the river, in the communities of Pecwan, Notchko, Wautec, and others without utility power.

14.2.3 Frequency

Terrorism

In 2011, the Yurok Tribe conducted a Chemical, Biological, Radiological, Nuclear and Improvised Explosive Device Plan to review, in part, terrorism vulnerabilities, personnel available to respond, and equipment needed. The resulting information is classified and available only to first responders at the time of an emergency (per federal laws).

The geographic area in which the Tribe is located increases the level of tourists traveling into and through the state by air, water and roadway, thereby increasing not only the potential for victims, but also

increasing accessibility by potential terrorists. Also given its remote location and limited resources, accessibility by potential terrorists is also more favorable. Combined, these unique conditions could potentially increase the risk for terrorist attacks. The transportation, energy, and communications systems that cross both Humboldt and Del Norte Counties also has an impact on the local, regional, and even national economy. In general the risks of a terrorist event involving a WMD are as follows:

- **Chemical**—The risk of a chemical event is present on the Reservation. The agricultural community uses and stores significant amounts of chemicals for peaceful and productive means that could be used in destructive ways. Mercury is used by gold miners to separate gold during mining activities. Illegal grow operations use excessive amounts of fertilizers to enhance productivity.
- **Explosives**— While no events have been specifically identified as a WMD, the elements necessary to construct a WMD are readily available on the Reservation. Additionally, the agricultural communities maintain sufficient products and quantities for use in explosive events.
- **Radiological/Nuclear**—The major transportation arteries for vehicles that cross through or near the Reservation contribute to the risk of a radiological event. Such products can unknowingly pass through any one of the regional transportation corridors.
- **Biological**—Anthrax incidents that occurred in the U.S. in October 2001 demonstrate the potential for spreading terror through biological WMDs. The introduction of Newcastle disease in the United States demonstrates how an agent can be introduced to livestock, causing harm to public health and the economy.
- **Combined Hazards**—WMD agents can be combined to have a greater total effect. When combined, the impacts of the event can be immediate and longer-term. Casualties will likely suffer from both immediate and long-term burns, contamination, etc. Given the risks associated with chemical agents, the possibility exists for such a combined event to occur.
- **Tribal Terrorism –** Tribes have many times been the victim of hate crimes which have included the destruction of tribal resources, destruction of culturally sensitive artifacts and destruction of geographic areas considered sacred, and the looting of graves.

Technological

Hazardous material incidents may occur at any time on the Reservation. When taken into consideration, given the remoteness of the area, the presence of transportation routes bisecting the reservation, the location of businesses and industry that use hazardous materials, the presence of scattered illegitimate dump sites and businesses such as clandestine drug laboratories at any given time, and the improper disposal of hazardous waste materials, the potential for a hazardous material incident is significantly increased.

14.2.4 Severity

The severity of human-caused hazards is challenging to measure. Severity could range from a minor transportation accident or power outage to a full-scale terrorist attack.

The term multi-casualty incident (MCI) is often applied to transportation accidents involving air and rail travel, as well as multi-vehicle highway accidents. However, MCIs may also result from hazardous materials incidents or acts of violence, such as shootings or hostage situations. Effects may include serious injuries, loss of life, and associated property damage – which could have long-term consequences.

Because large numbers of patients may be involved, significant MCIs may tax local emergency medical and hospital resources, and therefore require a regional response. Given the remoteness of the Reservation, the nearest hospital for airlifts is St. Joseph's hospital in Eureka. By vehicle, the closest hospitals would be either in the Redding or Medford areas. MCIs may occur throughout the Reservation, day or night, at any time of the year: US 101, US 96 and State Route 169 offer the potential for MCIs because of the heavy volume of traffic, although no roadway on the Reservation is exempt from this hazard. Of additional concern is the fact that many of the roadways on the Reservation are not paved, are 10-foot-wide travel lanes with minimal, if any, shoulders. This provides insufficient space for motorists to adjust to emergency situations, bicyclists or pedestrians to travel adjacent to vehicle travel lanes. Additionally, unpaved roads are a major source of dust, which has an impact on safety, aesthetics, health, vegetation, soils and aquatic resources. The accident potential associated with unpaved roads increases due to increased number of potholes; loss of visibility; decreased traction causing skidding and swaying of vehicles; less positive steering response; longer stopping distances, and broken windshields with flying aggregates.

Adverse weather may also play a role in roadway or air accidents. MCIs may also result from acts of violence or terrorism, which could include a chemical, biological or radiological incident, contaminating persons and requiring mass decontamination.

Humboldt County has indicated that they will rely on United Indian Health Services to provide medical services to the tribal community in the event of a pandemic or any other type of disaster. Mutual aid agreements are in place and will be requested should the Tribe be unable to respond appropriately with available personnel and equipment.

14.2.5 Warning Time

Few incidents of terrorism are preceded by a warning, and in the case of a technological hazard, accidents occur without predictability under circumstances that give responders little time to prepare.

14.3 SECONDARY HAZARDS

Human-caused hazards are not like natural hazards that have measurable secondary impacts. The largest secondary impact caused by human-caused hazards would be economic. Economic impacts from human-caused hazards could be significant:

- The cost of a terrorist act would be felt in terms of loss of life and property, disruption of business activity and long-term emotional impacts. Recovery would take significant resources and expense at the local level.
- Utility losses could cause a reduction in employment, wholesale and retail sales, utility repairs, and increased medical risks. Given the limited amount of businesses currently on the Reservation, any disruption could have a devastating impact.
- The economic impact computer security breaches associated with data and telecommunications losses can be staggering as lost data may be unrecoverable, and theft of financial data incapacitating.
- The economic impacts should a transportation facility be rendered impassable would be significant. The loss of a roadway would have serious effects on the Tribe's economy and ability to provide services. Loss of travel routes on US 101, 96 or State Route 169 would result in loss of commerce, and would impact the Tribe's ability to provide emergency services to its citizens by delaying response times or limiting routes for equipment such as fire apparatus, police vehicles, and ambulances. The ability to receive fuel deliveries would

also be impacted, as would the ability for much of the Reservation to gain access to food and water.

- The effects of re-routed traffic would also have a serious impact on Reservation. Many of the roadways are unpaved or in extremely poor condition, and increased traffic could have serious negative implications through increased accidents and gridlock. For example, the closure of any of the major roadways on the Reservation could cause the closure of businesses due to lack of patrons and lack of ability to gain merchandise. Mass transit services would also be impacted as routes may be delayed or forced to be detoured causing not only economic impacts, but also significant hardship upon its users.

14.4 EXPOSURE

The human-caused hazard risk assessment is based on a system that measures a facility's criticality and physical vulnerability. Criticality is a measure of the potential consequence of an accidental or terrorist event as well as the attractiveness of the facility to a potential adversary or threat. The criticality for each critical facility is based on the factors shown in Table 14-2. The criticality for each critical facility is based on the following:

- Awareness—How aware is the public of the existence of the facility, site, system, or location?
- Hazardous Materials—Are flammable, explosive, biological, chemical and/or radiological materials present on site?
- Collateral Damage Potential—What are the potential consequences for the surrounding area if the asset is attacked or damaged?
- Site Population—What is the potential for mass causalities, based on the capacity of the facility.
- Public or Emergency Functions—Does the facility perform a function during an emergency? Is this facility or function capable of being replicated elsewhere?

TABLE 14-2.
CRITICALITY FACTORS

Criterion	Low	Medium	High
Awareness	Not known/Neighborhood	City/Region/County	State/National
Hazardous Materials	None / limited & secure	Moderate—Large Secure	Large/Minimum or no Security
Collateral Damage Potential	None or low	Moderate/Immediate Area or within 1 mile radius	High/Immediate Area or within 1 mile radius
Site Population	0—300	301-1,000	1,001 or greater
Public/ Emergency Function	No emergency function, or could be used in the future for emergency function	Support Emergency Function—Redundant Site	Emergency Function—Critical Service with or without redundancy

Vulnerability is a measure of the physical opportunity for an accident or an adversarial attack. This assessment takes into consideration physical design, existing countermeasures, and site layout. The

vulnerability for each critical facility is based on the criteria shown in Table 14-3. The vulnerability for each critical asset is based on the following:

- Accessibility—How accessible is the facility or site to the public?
- Automobile Proximity—How close can an automobile get to the facility? How vulnerable is the facility to a car bomb attack?
- Asset Mobility—Is the facility or asset's location fixed or mobile? If mobile, how often is it moved, relocated, or repositioned?
- Proximity to other critical facilities—If the facility is close to other critical facilities then there could be an increased probability of the facility receiving collateral damage.
- Secure design—General evaluation of areas of obstruction, air intake locations, parking lot and road design and locations and other site design aspects.

TABLE 14-3.
VULNERABILITY CRITERIA

		Ratings		
Criterion	Description	Low	Medium	High
Accessibility	How accessible is the facility or site to the public?	Remote location, secure perimeter, tightly controlled access	Controlled access, protected or unprotected entry	Open access, unrestricted, patrolling security, sign restrictions
Automobile Proximity	How close can an automobile get to the facility? How vulnerable is the facility to a car bomb attack?	Not within 75'—100'	Not within 25'—50'	Adjacent or not within 10'
Asset Mobility	Is the facility location fixed or mobile? If mobile, how often is it moved, relocated, or repositioned?	Moves or is relocated frequently	Moves or is relocated occasionally	Permanent/Fixed
Proximity to other Critical Facilities	If the facility is close to other critical facilities, there is an increased chance of the facility receiving collateral damage.	Greater than 1.5 – 2 miles	Greater than 3/4—1 mile	Within 1/2 – 3/4 mile
Secure Design	General evaluation of areas of obstruction, air intake locations, parking lot and road design and locations and other site design aspects.	No areas for concealment of packages, air intakes are on roof, access ways are not under the structure.	Area of concealment present, greater than 25' from the structure; Air intakes located at least 10' above ground, may have under structure access drives.	Areas of concealment within 25', air intakes at ground level, under structure access drives.

14.4.1 Population

A human-caused hazard event could range from an isolated accident to a highly coordinated act of destruction by multiple agents upon multiple targets. Large-scale incidents have the potential to kill or injure many citizens in the immediate vicinity, and may also affect people a relative distance from the initial event. This report does not consider a set distance to determine those more or less at risk. Variables affecting exposure for a WMD attack and a hazardous material accident include the type of product, the

physical and chemical properties of the substance, the physical state of the product (solid, liquid, or gas), the ambient temperature, wind speed, wind direction, barometric pressure, and humidity.

Computer models may be an option for use for the Tribe's Hazardous Materials team to provide general data to first responders to advise evacuations or sheltering in place. However, with so many variables to determine "toxic endpoints" as defined by the California Environmental Protection Agency, distances are difficult to forecast. In general, those close to the Reservation's transportation corridors or businesses with acutely hazardous materials are more at risk for some sort of effect; but again, each chemical incident will be different and the scenarios are too numerous to describe in this plan.

Hazardous materials pose a significant risk to emergency response personnel. The Tribe currently has a hazmat team associated with its Environmental Division. All potential responders and follow-on emergency personnel on the Reservation currently are and will be properly trained to the level of emergency response actions required of their individual position at the response scene. Hazardous materials also pose a serious long-term threat to public health and safety, property and the environment.

14.4.2 Property

According to the Tribe's GIS data, there were 692 housing units on the Reservation. Single-family detached residential units account for 407 structures of the total developed residential units. The total number of units by type of dwelling unit is shown in Table 14-4.

TABLE 14-4.
RESIDENTIAL DWELLING UNITS ON THE YUROK RESERVATION AS OF 2012

Type of Unit	Existing Reservation-wide Units
Single Family	407
Multi-Family	45
Mobile Homes and Travel Trailers	240
Total	**692**

Source: Yurok Tribe GIS

14.4.3 Critical Facilities and Infrastructure

The Klamath Administration Building, which houses 300 employees and administers $25 million in grant programs would be a potential high target for events addressed within this section. Additionally, this facility also serves as a Red Cross Shelter. Impact to this structure would have a devastating impact on the Tribe.

In addition, because of the cultural significance and poor economic condition of the Reservation, all structures within the Tribal boundary are considered critical facilities. Unique to the Yurok Reservation is the large amount of land owned by non-tribal members. However, because of the remoteness the Reservation, and limited response capabilities, even those structures which are non-tribal or tribal-member owned, are considered within this analysis, as responsibility for response activities and infrastructure re-development would rest heavily upon the Tribe.

The Reservation's civic facilities are designed to welcome the public, with convenient parking and customer service areas. There are limited secure areas that are restricted to the public. Based on the criticality factors and vulnerability criteria described above, most facilities are at risk because of their accessibility, automobile accessibility, and lack of a secure or hardened design.

Several of the Tribe's critical emergency response facilities are located adjacent to roadways which carry hazardous materials. This is also true of the Tribe's primary location for Tribal staff and services, and the Tribe's EOC.

The Hazard Mitigation Plan Steering Committee and tribal staff assessed the number of large gathering places on the Reservation. These sites are defined as follows:

- Any facility which has an assembly room with an occupant load of 50 or more (<5 locations)
- All buildings used for educational purposes for more than 12 hours per week, four hours in any one day, or for pre- or after-school care, or day care (7 facilities)
- Any facility likely to have an occupancy greater than 100 such as a large employment center, retail center, cultural center, or place of worship.

The large gathering places are vulnerable to a human-caused hazard due to several factors:

- All are accessible to the general public (such as the Klamath Tribal Administration Building), to accommodate aesthetically pleasing urban design and customer service.
- Design features, including types of building materials, and screened enclosures for mechanical equipment and solid waste, limit visibility and may contribute to the damage incurred should an intentional or accidental event occur.
- Automobile access is required in the design of most buildings, with disabled access parking and easily accessible parking a valued feature.
- Most high population centers do not feature any limitations to access by the public or vehicles, although restricted access to large employment center sites with acutely hazardous materials is built into the design at these facilities.

14.4.4 Environment

The risk of human-caused hazards to the environment is considerable. Hazardous materials spilled along roads or railways could easily pollute rivers, streams, wetlands, riparian areas and adjoining fields. Other hazardous materials released into the air could severely impact plant and animal species. The Tribe recognizes this risk and has taken steps to reduce the risk exposure to the natural environment through the development of an Environmental Department which monitors air and water quality, as well as serves as a HAZMAT response team for the area. By reducing the risk exposure to the built environment, the Tribe will also mitigate potential losses to the natural environment.

14.5 VULNERABILITY

14.5.1 Population

Although human-caused hazards have not resulted in a large number of deaths in this area, this type of hazard can be deadly and widespread. Injuries and casualties were not estimated for this hazard. Any individuals exposed to human-caused hazards are considered to be at risk, particularly those working as first responder professionals.

14.5.2 Property

All structures on the Reservation are physically vulnerable to a human-caused hazard. The emphasis on accessibility, the opportunity for roof access, driveways underneath some structures, unmonitored areas, the proximity of many structures to transportation corridors and underground pipelines, and the potential for a terrorist to strike any structure randomly all have an impact on the vulnerability of structures.

14.5.3 Critical Facilities and Infrastructure

Most critical facilities and infrastructure on the Reservation would be vulnerable to human-caused hazards, including utilities, data and telecommunications systems, and transportation facilities. As previously indicated, telecommunications and utilizes are not even provided to the entire Reservation. Impact to any level on what limited infrastructure is available would be of significant concern to the Tribe. Transportation corridors are also of significant concern. Impact to any one of the Tribe's 24 bridges could cause significant impact, cutting off access to entire villages.

14.5.4 Environment

The environment vulnerable to a human-caused hazard is the same as the environment exposed to the hazard. While human-caused disasters have caused significant damage to the environment, estimating damage can be difficult. Loss estimation platforms such as HAZUS are not equipped to measure environmental impacts of these types of hazards. The best gauge of vulnerability of the environment would be a review of damage from past human-caused hazard events. Loss data for damage to the environment were not available at the time of this plan update. Capturing this data from future events could be beneficial in measuring the vulnerability of the environment for future updates.

14.6.5 Economic impacts

Economic impacts from human-caused hazards could be significant. The cost of a terrorist act would be felt in terms of loss of life and property, disruption of business activity and long-term emotional impacts. Recovery would take significant resources and expense at the local level.

Utility losses could cause a reduction in employment, wholesale and retail sales, utility repairs, and increased medical risks. The economic impact of data and telecommunications losses can be staggering as computer security breaches, crime conducted via the world wide web such as identify theft, and many more forms of human-caused economic losses occur daily. Millions of dollars are lost each year as criminals and cyber-terrorists steal sensitive information and funds from individuals and organizations.

The economic impacts should a transportation facility be rendered impassable would be significant. The loss of a roadway or railway would have serious effects on the Tribe's economy and ability to provide services. Loss of travel routes would result in loss of commerce, including tourism, and may impact the Tribe's ability to provide emergency services to its citizens by delaying response times or limiting routes for equipment such as fire apparatus, police vehicles, and ambulances. The ability to receive fuel deliveries would also be impacted. Of significant concern would be impact to the Highway 101 bridge. Damage or destruction to that structure would not only cause significant impact to Tribal economy (and its ability to get supplies), but would also have a statewide economic impact.

The effects of re-routed traffic could also have a serious impact on local roadways. Heavy traffic on routes through the Reservation already occur at peak times, especially during summer months when tourism is highest. Traffic control may burden the Tribe's Public Works Department. Mass transit services would also be impacted as routes may be delayed or forced to be detoured, causing economic impacts on transit providers and on those who ride public transportation to and from the Reservation.

14.6 FUTURE TRENDS IN DEVELOPMENT

While there are no specific numbers delineating potential growth on the Reservation, with the economic development efforts which the tribe is currently undertaking, as well as working towards resiliency of the Reservation, population is expected to grow over the next 5-10 years. Residential development is also anticipated to increase during the next few years. Significant non-residential development will occur as well with development of a casino and hotel in the near future. The potential for human-caused hazards on the Yurok Reservation is not likely to lessen or prohibit development within the Tribal boundaries.

The threat of human-caused hazards and the availability of Homeland Security Funds will influence future development of the Tribe's critical facilities. For example, a redundant or backup EOC is a critical need, as are tribal police and fire facilities. The design of multi-purpose use facilities would best serve the needs of the Tribe as resources – both human and capital, are very limited.

14.7 REVIEW OF EXISTING ORDINANCES, PROGRAMS, AND PLANS

14.7.1 Yurok Tribe Emergency Operations Plan

Adopted in 2008, the current Yurok Emergency Operations Plan addresses the planned response to emergency situations associated with natural disasters, technological (human-caused) emergencies, and war emergency operations in or affecting the Yurok Reservation. The plan is both an operational plan as well as a reference document for pre-emergency planning and emergency operations. It establishes the following:

- An Emergency Management Organization to mitigate any significant emergency or disaster affecting the Tribe
- Policies, responsibilities and procedures to protect the health and safety of citizens, public and private property, and the environment from the effects of natural and human-caused emergencies and disasters
- Operational concepts and procedures associated with field response to emergencies, EOC activities, and the recovery process

The Emergency Operations Plan also outlines the natural and human-caused hazards most likely to occur on the Reservation. It provides significant detail for each responding section assigned to Tribal staff and (some) mutual aid agencies prior to an emergency—management, operations, planning, logistics and finance. The Tribe's Public Safety Department conducts periodic simulated exercises both independently and in conjunction with state and local program exercises (such as earthquake and tsunami drills) to ensure that staff is prepared and adequate resources are in place prior to any incident.

Each department has developed an emergency response document within the Tribe's comprehensive plan, and reviews the plan as required. After completion of this mitigation plan, a more detailed review will occur to ensure information is updated with respect to new information discovered during this planning process. Any changes resulting from the review will be published and distributed to Tribal Departments and surrounding jurisdictions and agencies holding copies of the plan.

14.7.2 Yurok Tribe Chemical, Biological, Radiological, Nuclear/ Improvised Explosive Device Plan

The Tribe's Chemical, Biological, Radiological, Nuclear/Improvised Explosive Device Plan (CBRNE) was prepared in 2006. This plan is also viewed, to some degree, as a part of the Tribe's Terrorism plan.

Information contained within the 2006 CBRNE report has been incorporated, where applicable, within this planning document .

The CBRNE Plan provides an overview of potential threats related to CBRNE incidents of concern, utilizing the initial 15 National Scenario Events as the basis upon which planning elements are determined. With the development of CPG 201 and PPD 8, those scenarios are no longer the basis upon which readiness is determined; therefore, the Tribe will again review the CBRNE plan with the intent of updating it to meet the requirements of CPG 201 and PPD #8.

Hazard Specific Response Plans Hazardous Materials Contingency Plan

The Tribe has established several response plans for several of its hazards of concern. Based on new data captured during this planning process, many of those plans will be reviewed and updated as necessary. Those plans in place provide information necessary for the response and recovery from a disaster incident. The objectives of the Hazardous Materials Plan are as follows:

- Establish policies and responsibilities for protecting the health and safety of the general population and visitors to the Reservation and the surrounding communities, the environment, and public and private property to the extent possible from the effects of the incident.
- Identify the emergency response organizations beyond just Tribal departments that are responsible for managing incidents in or near the Reservation.
- Establish operational concepts for staffing, training, operating and supporting the various response teams, such as the Hazard Materials team.
- The plans, when appropriate, coordinate with the surrounding jurisdiction's operational interagency response teams and incorporate mutual aid agreements.
- Direct all individuals, agencies, and departments referenced in the various plans to develop standard operating procedures and emergency response checklists that are consistent with the Tribe's Emergency Operations Plan. Most of these SOPs are already in place.

14.7.3 Yurok Police Department

Following the provisions and emergency response, mitigation, and recovery structure of the State Emergency Management System (SEMS) (to the extent integrated by the Tribe as discussed in section 5.3.2), the federally mandated National Incident Management System, and the National Response Plan, the Yurok Police Department is prepared to meet the challenge of intentional criminal acts, including acts of terrorism, as well as technological, accidental, or natural hazards in the following ways:

- Activation of local emergency response plans using multi-disciplinary resources, including but not limited to regional municipal and county law enforcement, the Joint Terrorism Task Force overseen by the FBI, the Department of Justice Anti-terrorism Information Center, state and federal military personnel, and private resource agencies
- Deployment of local tactical resources to mitigate human-caused acts of terrorism or intentional business disruption. While capabilities are not fully maintained solely within the Yurok Police Department because of the limited resources available, the Tribe works with the various Humboldt and Del Norte Counties' police departments as tactical responders, which include SWAT, hostage negotiators, rapid containment team, the tactical communications team, and explosive ordnance personnel as necessary if the requirement exceeds the Tribe's capabilities.

- Use of the Crime Scene Investigations Unit for post-incident evidence collection and investigation
- Intake, processing, analysis, and investigation of all incidents with the potential for large-scale impact in a professional, timely manner.

14.7.4 Yurok Public Safety Communications

Communications on the Reservation is a significant issue, as much of the Tribe is not accessible through regular forms of police communications. This is based on several factors, including the terrain of the Reservation, and the lack of communication towers, causing dead sports in locations. Dispatching duties for the Tribal police is accomplished through either Del Norte or Humboldt County dispatching. This includes:

- Appropriately recognize and document citizens' reports of suspicious activity.
- Deploy appropriate resources to prevent, investigate, mitigate, and provide recovery services following incidents of human caused hazards, as well as natural and technological disasters.
- Coordinate resource management of personnel, equipment, and facilities during established crisis incidents.
- Work within the framework of the State Emergency Management System to provide emergency communications to field units and emergency operations personnel during emergency events (recognizing the restrictions referenced above).
- Deploy mutual aid assistance in support of local, state, and national entities during crisis incidents.
- Provide life-saving pre-arrival instructions on emergency medical incidents, both large-scale and of an individual nature.

14.7.5 Yurok Fire Department

Due to the remote location of the Reservation and the difficulties in traveling from the two areas (up-river and down-river locations), the Reservation is basically divided into two distinct areas with respect to fire response. The down-river portion of the tribe is protected by the Klamath Volunteer Fire Protection District, which is non-tribal. The District provides fire, rescue, and medical aid services to all of the Del Norte portions of the Reservation.

The up-river portion of the Reservation is protected by the Yurok Volunteer Fire Department, who services approximately 350 residents (not inclusive of tourists who may be in the area), covering approximately 80 square miles. The Yurok Volunteer Fire Department consists of ten personnel, which are highly trained to handle all aspects of emergency service. Two of volunteers are wildland certified, one is a Class B Driver, and there is one training officer. All first response personnel are trained in incident command, firefighting skills, basic life support, essential rescue skills, and basic hazardous materials response. Presently, the Department has limited PPE, but is actively seeking opportunities to obtain better equipment. The department provides fire, rescue and medical aid services.

Response Time and Mutual Aid

The Yurok Volunteer Fire Department is a fully functional volunteer agency that primarily provides fire suppression for the up-river portion of the Tribe. As they are a volunteer organization, many of its members require a considerable amount of time to enable response to fire activities to the remoteness of the Reservation. The Department currently maintains two Type II Engines.

The Klamath Fire Protection District operates with 15 volunteer members. The district has three engines, three Squad/Utility vehicles, and one air support trailer. Response times for the lower portion of the Reservation, while much quicker, still requires the volunteer firefighters to travel from home/work to the fire station, and then respond to the scene.

Due to response capacity, standards within the fire industry state that it takes three volunteer firefighters to equal one full-time paid position. This is due to the fact that response times and capabilities vary in reporting to the fire station and then to the scene of the fire. In addition, general assumptions are response times average ~5 minutes for volunteer personnel to respond. Unfortunately, that is not the case on the Yurok Reservation.

Time is critical when responding to both fire response and medical aid. The burn point of a standard structure is 2 minutes 30 seconds. This allows little time for travel to the scene of a fire. Because of the remoteness of the Reservation, travel time is much greater for the volunteer fire fighters to respond. Enhanced capabilities in this respect are critical on the Reservation.

While the Tribe has mutual aid agreements with local fire departments and districts in the surrounding counties, response times are still limited. In addition, the Bureau of Indian Affairs also has mutual aid agreements in place with the State of California to provide response on tribal trust lands. If this level of aid does not meet the incident needs, the Tribe participates in the statewide mutual aid system to bring additional resources from anywhere in California, other tribe, and if needed, the nation.

Hazardous Materials Response

Hazardous Materials Listing

All hazardous materials handlers that store in excess of 55 gallons, 500 pounds, or 200 cubic feet of gas are required to submit Hazardous Materials Management Business Plans. From these plans, emergency responders are provided emergency contact information, site-specific chemical inventories, and vicinity as well as facility maps. Facilities storing materials that are “acutely” hazardous and in excess of the quantities in CCR, Title 19, Tables 1, II or III must submit a more comprehensive Risk Management Plan, which includes off-site consequences analysis, maintenance, and training programs, and an executive summary. Owners/operators of aboveground tanks containing in excess of 660 gallons of petroleum hydrocarbons (or an aggregate quantity of 1,320 gallons) must comply with the state Aboveground Petroleum Storage Act, which requires the preparation of a Spill Prevention, Control, and Countermeasure Plan.

The State Secretary for Environmental Protection designated the Hazardous Materials Program of the Humboldt County Division of Environmental Health as the Certified Unified Program Agency (CUPA) The CUPA is charged with the responsibility of conducting compliance inspections of over 800 facilities in Humboldt County. These facilities handle hazardous materials, generate or treat a hazardous waste and/or operate underground storage tanks. The CUPA forwards important facility information to local fire prevention agencies that enables them to take appropriate protective actions in the event of an emergency at regulated facilities.

The Eureka Fire Department Regional Hazardous Material Response Team (HMRT) was established in 1993 to provide for response to emergencies involving hazardous materials. The HMRT is funded primarily through a Joint Powers Agreement (JPA) between Humboldt County, Del Norte County, City of Eureka, City of Crescent City, City of Arcata, City of Blue Lake, City of Ferndale, City of Rio Dell, and City of Trinidad. The JPA establishes the Humboldt/Del Norte Hazardous Material Response Authority (HMRA). The HMRA Board consists of elected officials of each member agency and meets quarterly to provide oversight to the Team.

Both Humboldt and Del Norte Counties have experienced many accidental hazardous materials incidents. While no deaths have been experienced, property damage, environmental impact and fish loss are of significant concern.

Development Review Process

A Hazardous Materials Management Plan and if necessary, a Risk Management Prevention Plan is required as part of the development process per state law. Currently, the Tribe does not provide permitting on tribal lands, but instead adheres to the regulatory authority as imposed by the State and Humboldt and Del Norte Counties, who collect the fees associated with the permitting process. Regulatory authority administered by the state and both counties establishes the requirements for the use of toxic or hazardous materials, which includes a requirement for the filing of a business plan for emergency response pursuant to Section 25503.5 of the California Health and Safety Code or materials identified in Section 5194, Title 8 of the CCR. Accordingly, all users submit a list of hazardous and toxic materials with a qualified discussion of potential chronic and acute long-term health effects, including those on children, from acute short-term or chronic long-term exposure. In addition, a plan shall be submitted specifying procedures for mitigating the emissions of toxic substances and groundwater monitoring and for identifying methods of hazardous waste disposal.

Intergovernmental Coordination

The Yurok Volunteer Fire Department and Environmental Department works cooperatively with other local and state agencies in a coordinated effort to inform and educate the public regarding the storage, handling, and disposal of household hazardous materials. This includes continued coordination with the Eureka Fire Department and California Highway Patrol Hazardous Materials Response Teams.

Hazardous Materials Database

Both Humboldt and Del Norte Counties maintain databases that include chemical inventory disclosure, emergency contacts, and facility maps for all business plans within the area, including five businesses with acutely hazardous materials for the Humboldt County portion of the Reservation. All businesses are subject to the California Accidental Release Prevention Program.

Hazardous Materials Truck Route

The Yurok Tribe does not have specific truck routes for hazardous materials. Routes for hazardous materials are coordinated with the California Department of Transportation (Caltrans) and the California Highway Patrol. Because of the highway system bisecting the Reservation, hazardous materials spills (as well as illegal dumping and drug manufacturing using hazardous materials) is of significant concern to the Tribe.

14.8 SCENARIO

Two human-caused hazard scenarios could have a significant impact on the Yurok Reservation. The first scenario would involve hazardous materials being transported via the highway systems (and potentially waterways) that bisect the planning area. The release of hazardous materials via intentional or unintentional means could impact the population centers on the Reservation. Advance knowledge of these shipments and their contents would play a role in preparedness for this scenario, thus reducing its potential impact. The biggest issues in response to hazardous material are the material identification and containment, as well as exhausting the capabilities of the Tribe’s limited resources.

The second scenario that could have a significant impact on the planning area would be a terrorist event, either at a gathering place or through intended illicit ingress from the waterways. Terrorist events happen

with little or no warning. With a potential population in excess of 8,000 people per day (including transient populations which daily travel through the Reservation on its roadways and waterways), there does exist the potential targets for terrorist activities. The Tribe has taken steps to assess high vulnerability sites as well as probable scenarios in its planning efforts.

14.9 ISSUES

Important issues associated with human caused hazards on the Yurok Reservation that support future mitigation actions include, but are not limited to the following:

- Participate in regional, state and federal efforts to gather terrorism information at all levels and keep public safety officials briefed at all times regarding any local threats. Staff will then further develop response capabilities based on emerging threats.
- Continue all facets of emergency preparedness training for Tribal Council, Police, Fire, Public Works, Planning, and Public Information staff in order to respond quickly in the event of a human-caused disaster. Enhance awareness training for all city employees to recognize threats or suspicious activity in order to prevent an incident from occurring.
- Continue all facets of the Tribe's fire and hazardous materials team training and response through commitment of resources to the Fire Department budget and the addition of funding through various grant opportunities.
- Continue to improve response times for public safety throughout the Reservation so as to reduce exposure to human-caused incidents. While staffing levels are at issue, the Tribe may seek additional grant opportunities through Homeland Security to address vulnerabilities identified in this chapter.
- Train first responders and all appropriate Tribal staff to implement protocols contained in the Tribe's various Response Plans.
- Conduct exercises to maintain skill levels of trained personnel.
- Develop additional MOUs as needed to address limited assistance Tribe can provide to further enhance capabilities.
- Data collection for impacts and responses to hazards in this section is lacking, as much of the data is not provided to the Tribe. As other response agencies may respond onto the Reservation and those response activities may go unreported to the Tribe, true impact numbers are not known. The Tribe is in the process of working to develop a methodology for more accurate tracking of this data.

The Tribe's participation in **regional efforts** to prevent human-caused hazards includes the following:

- Commit support to the surrounding Counties and jurisdictions by continuing to dedicate fire and police personnel to the counties, especially if additional funding becomes available through Homeland Security grants
- Participate in the State of California's Governor's Office of Emergency Services Disaster Resistant California annual conference and other training sessions sponsored by regional, state and federal agencies.
- Utilize Crime Prevention Through Environmental Design (CPTED) in future planning efforts as well as enhancing existing infrastructure and buildings to prevent or mitigate human-cause incidents. CPTED is an urban planning design process that integrates crime prevention with neighborhood design and community development. CPTED is based on the theory that the proper design and effective use of the built environment can reduce crime and the fear of

crime and improve the quality of life. CPTED creates an environment where the physical characteristics, building layout, and site planning allow inhabitants to become key agents in ensuring their own security.

- Participate in regional training exercises in support of national preparedness. These training exercises will test and evaluate the ability to coordinate the activities of tribal, county and state government first responders, volunteer organizations and the private sector in responding to terrorism and technological hazards. The trainings will enhance interagency coordination, provide training to staff, test response and recovery capabilities, and activate the National Incident Management System and the mutual aid system.
- Develop Continuity of Government/Operations Plans for the Tribal Government and work with the private sector to enhance and create Business Continuity Plans in the event of an emergency.
- Review existing automatic/mutual aid agreements with other public safety agencies to identify opportunities for enhancement.
- Construct a redundant Emergency Operations Center in a more resilient area of the Reservation (potential grant opportunity).
- Maintain an emergency services information line that the public can contact 24 hours a day during an emergency incident to ask questions of emergency staff.
- Coordinate with all local-area school districts within the general vicinity of the Reservation to ensure that their emergency preparedness plans include preparation for human-caused incidents.
- Encourage local businesses to adopt Information Technology and telecommunications recovery plans.
- Promote 72-hour self-sufficiency through the Emergency Preparedness efforts.
- Continue to share the human-caused hazard risk and preparedness information as part of this preparedness effort.

CHAPTER 15.
HUMAN HEALTH HAZARDS

15.1 GENERAL BACKGROUND

Human health risks include diseases that are communicated by animals, insects, people and other vectors; as well as environmental risks, such as extreme weather. This section discusses human health hazards that occurred recently or are an endemic risk to the Upper Reservation, where the risk of spreading is increased by a lack of emergency care; the upriver area also has little or no ambulance service.

15.1.1 Influenza

Epidemics of the flu typically occur in the fall and winter. Because flu seasons fluctuate in length and severity, a single estimate cannot be used to summarize influenza-associated deaths. The U.S. Centers for Disease Control (CDC) estimates that from the 1976-1977 flu season to the 2006-2007 season, flu-associated deaths ranged from a low of about 3,000 to a high of about 49,000. Yearly vaccination is the primary method for preventing influenza.

H1N1

In 2009, an outbreak of influenza-like illness caused by a new subtype of influenza A, (A/H1N1) occurred in April in Mexico and the United States. By April 24 and the World Health Organization (WHO) issued a health advisory on the outbreak.

The disease spread rapidly, with the number of confirmed cases rising to 2,099 by May 7, despite aggressive

DEFINITIONS

Anthrax—A disease caused by the bacteria *Bacillus anthracis*. Most forms of the disease are lethal, and it affects both humans and other animals. There are effective vaccines against anthrax, and some forms of the disease respond well to antibiotic treatment.

Epidemic—The spread of an infectious disease beyond the local population, reaching people in a wider geographical area. Several factors determine whether an outbreak will become an epidemic: the ease with which the disease spreads from vectors, such as animals, to people and the ease with which it spreads from person to person.

Influenza—A viral infection that attacks the respiratory system; commonly called flu.

H1N1 "Swine Flu"—A subtype of the Influenza A virus that has mutated into various strains including the Spanish Flu strain, mild human flu strains, endemic pig strains, and various strains found in birds.

H5N1 "Bird Flu"—A subtype of the Influenza A virus that is the causative agent of H5N1 flu, commonly known as "avian influenza" or "bird flu.

Plague—A disease caused by the bacterium Yersinia pestis, which is found in fleas in many areas around the world. There are three types of plague-bubonic, septicemic and pneumonic.

Pandemic—A worldwide epidemic.

Tularemia—A disease caused by the bacterium Francisella tularensis which is found in ticks, fleas and biting flies. It can also be spread by eating contaminated meat of wild game, such as rabbits. The disease is named after Tulare County, California.

Viral Hemorrhagic Fever (VHF)-—A group of illnesses caused by a viral infection (usually restricted to a specific geographic area); fever and gastrointestinal symptoms are followed by capillary hemorrhage.

Severe Acute Respiratory Syndrome (SARS)-—An infectious respiratory illness characterized by fever, dry cough, and breathing difficulties, often accompanied by headache and body aches; believed to be caused by a coronavirus.

Smallpox—An infection caused by the variola virus, a member of the poxvirus family. Throughout history, smallpox has been responsible for epidemics that resulted in large numbers of deaths. The last outbreak was in 1977 and it was declared eradicated in 1980.

measures taken against the disease by the Mexican government. On June 11, the WHO declared an H1N1 pandemic, marking the first global pandemic since the 1968 Hong Kong flu. On October 25, the U.S. declared H1N1 a national emergency. On August 10, 2010, the WHO International Health Regulations Emergency Committee declared an end to the 2009 H1N1 pandemic globally.

H1N1 viruses and seasonal influenza viruses are co-circulating in many parts of the world. It is likely that the 2009 H1N1 virus will continue to spread for years to come, like a regular seasonal influenza virus.

H5N1

The highly pathogenic avian influenza A (H5N1) virus is an influenza A virus subtype that occurs mainly in birds, causing high mortality among birds and domestic poultry. Outbreaks of highly pathogenic H5N1 among poultry and wild birds are ongoing in a number of countries (see Figure 15-1).

Source: World Health Organization

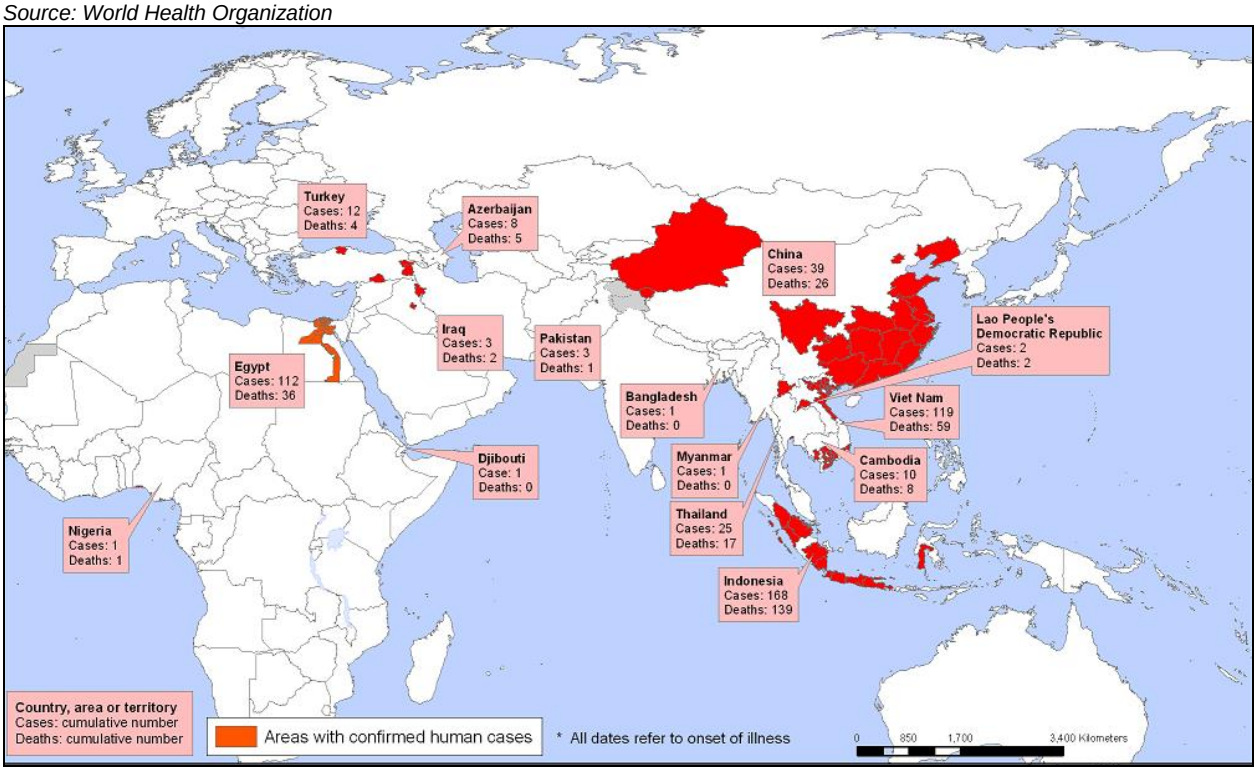

Figure 15-1. Areas with Confirmed H5N1 2003 – August 2010

H5N1 virus infections of humans are rare and most cases have been associated with direct poultry contact during poultry outbreaks. While the H5N1 virus does not now infect people easily, infection in humans is much more serious when it occurs than H1N1. More than half of people reported infected with H5N1 have died. Rare cases of limited human-to-human spread of H5N1 virus may have occurred, but there is no evidence of sustained human-to-human transmission. Nonetheless, because all influenza viruses have the ability to change and mutate, scientists are concerned that H5N1 viruses one day could be able to infect humans more easily and spread more easily from one person to another, potentially causing another pandemic.

15.1.2 Smallpox

Smallpox is a sometimes fatal infectious disease. There is no specific treatment, and the only prevention is vaccination. Symptoms include raised bumps on the face and body of an infected person. The oldest

evidence of smallpox was found on the body of Pharaoh Ramses V of Egypt who died in 1157 BC. Outbreaks have occurred from time to time for thousands of years, but the disease is now eradicated after a successful worldwide vaccination program. The last case of smallpox in the United States was in 1949. The last naturally occurring case in the world was in Somalia in 1977. Currently only two locations in the world have samples of smallpox: the CDC in Atlanta and the Ivanovsky Institute of Virology in Russia. After the disease was eliminated, routine vaccination among the general public was stopped. Therefore, any cases of smallpox in the world would be considered an immediate international emergency.

In 2003, the Wisconsin Division of Public Health conducted an investigation of state residents who became ill after having contact with prairie dogs. The cases appeared in May and June of 2003, and symptoms in the human cases included: fever, cough, pox-like rash and swollen lymph nodes. CDC laboratory test results indicated that the cause of the human illness was Monkeypox, an orthopox virus that could be transmitted by prairie dogs. This outbreak, and the potential use of smallpox as a weapon of bioterrorism, brought the fear of smallpox back to the forefront of the population. A detailed nationwide Smallpox Response Plan created at the end of 2002 is designed to quickly contain a potential outbreak and vaccinate the population.

15.1.3 Viral Hemorrhagic Fevers

Viral hemorrhagic fevers (VHFs) refer to a group of illnesses caused by several distinct families of viruses. VHF describes a multisystem syndrome (multiple systems in the body are affected). Characteristically, the overall vascular system is damaged and the body's ability to regulate itself is impaired. These symptoms are often accompanied by hemorrhage (bleeding); however, the bleeding itself is rarely life-threatening. While some types of hemorrhagic fever viruses can cause relatively mild illnesses, many cause severe, life-threatening disease.

The viruses that cause VHFs are distributed over much of the globe. However, because each virus is associated with one or more particular host species, the virus and the disease it causes are usually seen only where the host species live. Some hosts, such as the rodent species carrying several of the New World arenaviruses, live in geographically restricted areas. Therefore, the risk of getting VHFs caused by these viruses is restricted to those areas. Other hosts range over continents, such as the rodents that carry viruses which cause various forms of the hantavirus pulmonary syndrome in North and South America, or the rodents that carry viruses which cause hemorrhagic fever with renal syndrome in Europe and Asia.

Hantavirus was discovered in 1993 in the southwestern U.S. Initial fatality rates were above 50 percent; it is currently down to 33 percent. It has been identified in over half of the states of the U.S. and it was determined that it had been present, but unrecognized, at least as early as 1959. Hantavirus has also been detected in the local Sierra Nevada region. There have been two major hantavirus incidents in the past two years, involving one human death and one acute hospital stay. The hantavirus spreads when individuals touch or eat something contaminated with infected rodent urine, droppings or saliva. It can also be transmitted through aerosolization, which occurs when dried materials contaminated by infected rodent droppings or saliva are disturbed and brought up into the air and inhaled.

15.1.4 Plague

Plague is a potentially fatal infectious disease of animals and humans caused by a bacterium named *Yersinia pestis*. People usually get plague from being bitten by a rodent flea that is carrying the plague bacterium or by handling an infected animal. Today, modern antibiotics are effective against plague, but if an infected person is not treated promptly, the disease is likely to cause illness or death.

Plague is an ancient disease but its continued outbreaks throughout the world attest to its tenacious presence. Major plague epidemics occurred in 540 in Egypt (reaching Constantinople in 542 and

spreading to Europe and Asia in the following decade); during the 14th century in Europe, following caravan routes; in Austria in 1711 and the Balkans from 1770-1772; and from 1855 to 1896 worldwide (but mostly in China and India). Manchuria in 1910–1911 witnessed about 60,000 deaths due to pneumonic plague with a repeat in 1920–1921; and a minor outbreak occurred as recently as the summer of 1994 in Surat, India closely following an earthquake in September 1993. Globally, the WHO reports 1,000 to 3,000 cases of plague every year (see Figure 15-2).

Source: Centers for Disease Control

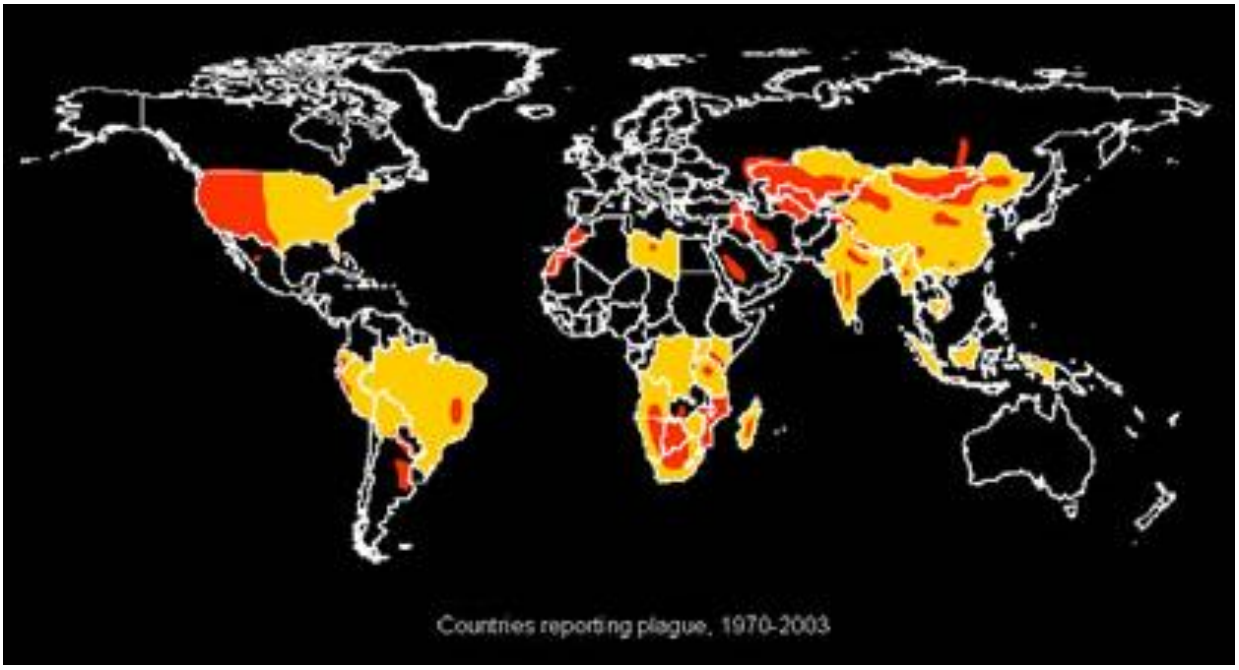

Figure 15-2. Distribution of Plague from 1970-2003

In North America, plague is found in certain animals and their fleas from the Pacific Coast to the Great Plains, and from southwestern Canada to Mexico. In the United States, the last urban plague epidemic occurred in Los Angeles in 1924-25. Since then, human plague in the U.S. has occurred as mostly scattered cases in rural areas (an average of 10 to 15 persons each year per the CDC). Most human cases in the United States occur in two regions:

- Northern New Mexico, northern Arizona, and southern Colorado
- California, southern Oregon, and far western Nevada.

15.1.5 Tularemia

Tularemia, named after Tulare County in California where it was first described in 1911, is a disease of animals and humans caused by the bacterium *Francisella tularensis*. Tularemia is similar to plague, but is typically spread by a different arthropod. While plague is usually spread to humans by fleas, humans usually become infected with Tularemia by tick and deer fly bites, skin contact with infected animals, ingestion of contaminated water or meat, or inhalation of contaminated dusts or aerosols. In addition, humans could be exposed as a result of bioterrorism. Symptoms vary depending upon the route of infection.

Rabbits, hares, and rodents are especially susceptible and often die in large numbers during outbreaks. Although Tularemia can be life-threatening, most infections can be treated successfully with antibiotics. Steps to prevent Tularemia include use of insect repellent, wearing gloves when handling sick or dead

animals, and not mowing over dead animals. In the United States, naturally occurring infections have been reported from all states except Hawaii.

15.1.6 Mosquito-Borne Disease

Many of the 48 species of mosquitoes in California can carry disease. Three mosquito-transmitted illnesses most affecting the human population are encephalitis, malaria and the West Nile Virus. The easiest and best way to avoid mosquito-borne illnesses is to prevent mosquito bites. The County health departments actively support public outreach campaigns and task force about the potential for mosquito-borne disease.

Encephalitis

There are four main viral agents of encephalitis in the United States:

- Eastern Equine Encephalitis
- Western Equine Encephalitis
- St. Louis Encephalitis
- La Crosse Encephalitis.

All of these viral encephalitides can be transmitted by mosquitoes. The most common types of mosquito-borne encephalitis in California are the Western Equine and the St. Louis. Most cases of mosquito-borne encephalitis occur from June through September, when arthropods are most active. In milder parts of the country, such as California, where arthropods are active late into the year, cases can occur into the winter.

The majority of human infections are asymptomatic or may result in a nonspecific flu-like syndrome. Onset may be insidious or sudden with fever, headache, myalgias, malaise and occasionally prostration. Infection may, however, lead to encephalitis, with a fatal outcome or permanent neurologic sequelae. Only a small proportion of infected persons progress to encephalitis. Experimental studies have shown that invasion of the central nervous system generally follows initial virus replication.

Because the encephalitides are viral diseases, antibiotics are not effective for treatment and no effective antiviral drugs have yet been discovered. Treatment is supportive, attempting to deal with problems such as swelling of the brain, loss of the automatic breathing activity of the brain and other treatable complications like bacterial pneumonia.

Malaria

Malaria is a sometimes fatal disease caused by a parasite that commonly infects the *Anopheles* mosquito, which feeds on humans. People who contract malaria are typically very sick with high fevers, chills, and flu-like illness. Although malaria can be fatal, illness and death can usually be prevented.

On average 1,500 cases of malaria are diagnosed in the United States each year. The vast majority are in travelers and immigrants returning from countries where malaria transmission occurs, many from sub-Saharan Africa and South Asia. Although rare, cases of malaria have been reported in California. In many temperate areas, such as western Europe and the United States, economic development and public health measures have succeeded in eliminating malaria. However, most of these areas have *Anopheles* mosquitoes that can transmit malaria, and reintroduction of the disease is a constant risk.

West Nile Virus

West Nile virus (WNV) is a potentially serious illness that may affect residents in the planning area. Experts believe WNV is established as a seasonal epidemic in North America that flares up in the summer and continues into the fall. WNV is a fairly recent disease to affect California. Mosquitoes transmit the virus to birds, livestock and humans. Figure 15-3 shows recent distribution of the disease in the U.S.

Source: Centers for Disease Control

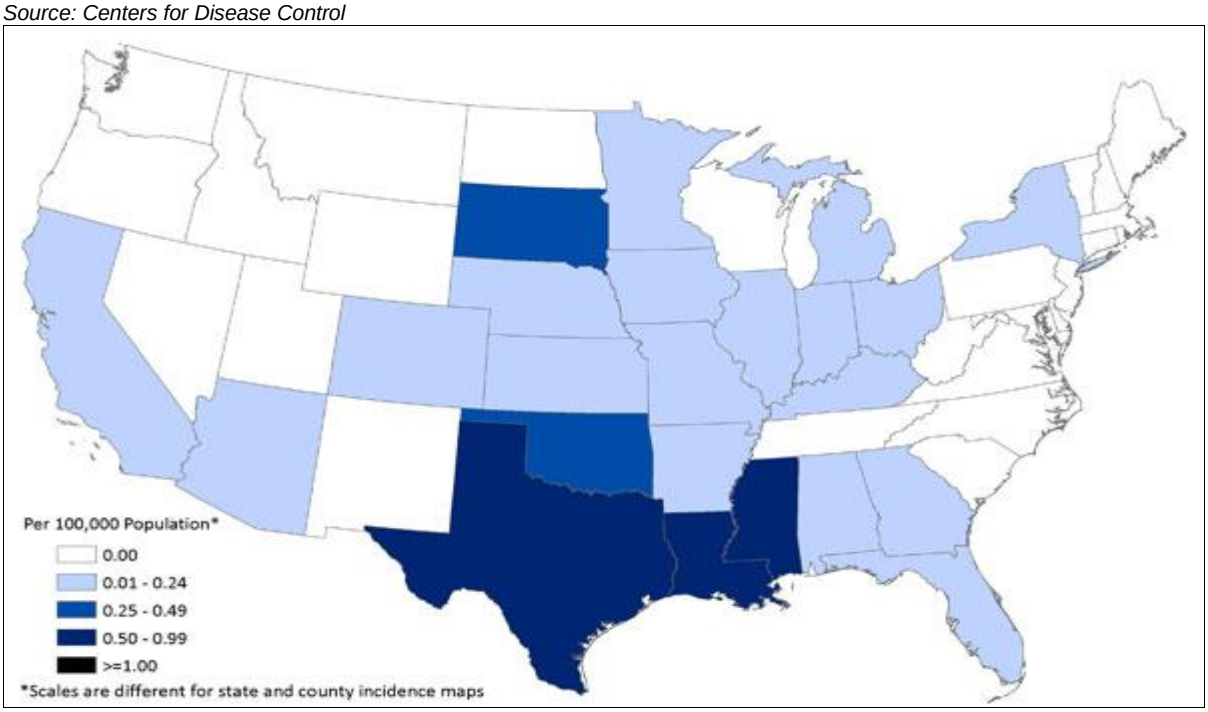

Figure 15-3. Distribution of West Nile Virus by State, 2012

Per the CDC, approximately 80 percent of people who are infected with WNV will show no symptoms. Up to 20 percent have symptoms such as fever, headache, and body aches, nausea, vomiting, and sometimes swollen lymph glands or a skin rash on the chest, stomach and back. Symptoms can last for as short as a few days, though even healthy people have become sick for several weeks. About 1 percent of people infected with WNV will develop severe illness, with symptoms that can include high fever, headache, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, vision loss, numbness and paralysis. These symptoms may last several weeks, and neurological effects may become permanent. There is no specific treatment for WNV infection. In more severe cases, people may need to go to the hospital where they can receive supportive treatment including intravenous fluids, help with breathing and nursing care.

15.1.7 Lyme Disease

Lyme disease, named after the city in Connecticut where it was first identified in 1975, is caused by the bacterium *Borrelia burgdorferi* which normally lives in mice, squirrels and other small animals. It is transmitted among these animals – and to humans – through the bites of certain species of ticks. In the northeastern and north-central United States, the black-legged tick (or deer tick, *Ixodes scapularis*) transmits Lyme disease. In the Pacific coastal United States, the disease is spread by the western black-legged tick (*Ixodes pacificus*). Other major tick species found in the United States have not been shown to transmit *Borrelia burgdorferi*.

Typical symptoms include fever, headache, fatigue, and a characteristic skin rash. If left untreated, infection can spread to joints, the heart, and the nervous system. Lyme disease is diagnosed based on symptoms, physical findings (e.g., rash), and the possibility of exposure to infected ticks. Laboratory testing is helpful in the later stages of disease. Most cases of Lyme disease can be treated successfully with a few weeks of antibiotics. Steps to prevent Lyme disease include using insect repellent, removing ticks promptly, landscaping, and integrated pest management. The ticks that transmit Lyme disease can occasionally transmit other tick-borne diseases as well.

15.1.8 Anthrax

Anthrax is a disease caused by *Bacillus anthracis*, a bacterium that forms spores (a spore is a cell that is dormant but may come to life with the right conditions). There are three forms of anthrax: skin (cutaneous); lungs (inhalation); and digestive (gastrointestinal).

The name derives from the Greek word *anthrakis*, which means coal, because the cutaneous form of the disease turns the skin black. Anthrax is a naturally occurring illness and isolated cases occur all over the world yearly. Humans can become infected with anthrax by handling products from infected animals or by breathing in anthrax spores from infected animal products (such as wool). People can become infected with gastrointestinal anthrax by eating undercooked meat from infected animals. Anthrax does occur in California and animals have tested positive; however, there have been no positive human cases of anthrax in California in the last 10 years. Anthrax can be treated successfully with antibiotics. The symptoms of anthrax are different depending on the type of the disease:

- Cutaneous: The first symptom is a small sore that develops into a blister. The blister then develops into a skin ulcer with a black area in the center. The sore, blister and ulcer do not hurt.
- Inhalation: The first symptoms of inhalation anthrax are like cold or flu symptoms and can include a sore throat, mild fever and muscle aches. Later symptoms include cough, chest discomfort, shortness of breath, tiredness and muscle aches.
- Gastrointestinal: The first symptoms are nausea, loss of appetite, bloody diarrhea, and fever, followed by bad stomach pain.

Anthrax can be used as a weapon, as happened in the United States in 2001, when anthrax was spread through the postal system by sending letters with powder containing anthrax spores. This caused 22 cases of anthrax infection and brought anthrax back into the public eye.

15.1.9 Severe Acute Respiratory Syndrome

Severe Acute Respiratory Syndrome (SARS) is a viral respiratory illness caused by a coronavirus (SARS-CoV). SARS was first reported in Asia in February 2003. Over the next few months, the illness spread to more than two dozen countries in North America, South America, Europe, and Asia before the global outbreak was contained. According to the WHO, a total of 8,098 people worldwide became sick with SARS during the 2003 outbreak. Of these, 774 died. In the United States, only eight people had laboratory evidence of SARS-CoV infection. All of these people had traveled to parts of the world where SARS was present. SARS did not spread more widely in the United States.

In general, SARS begins with a high fever, headache, an overall feeling of discomfort and body aches. Some people also have mild respiratory symptoms at the outset. About 10 percent to 20 percent of patients have diarrhea. After two to seven days, SARS patients may develop a dry cough. Most patients develop pneumonia.

SARS primary source of contamination is by close person-to-person contact. The virus that causes SARS is thought to be transmitted most readily by respiratory droplets produced when an infected person coughs or sneezes. Droplet spread can happen when droplets from the cough or sneeze of an infected person are propelled a short distance (generally up to 3 feet) through the air and deposited on the mucous membranes of the mouth, nose, or eyes of persons nearby. The virus also can spread when a person touches a surface or object contaminated with infectious droplets and then touches his or her mouth, nose, or eyes. It is also possible that the SARS virus might spread more broadly through the air or by other ways that are not now known.

As of May 2005, according to the CDC, there was no remaining sustained SARS transmission anywhere in the world. However, CDC has developed recommendations and guidelines to help public health and healthcare officials plan for and respond quickly to the reappearance of SARS if it occurs again. Lessons learned from the SARS outbreak helped healthcare facilities and communities successfully plan and respond to the 2009 H1N1 pandemic. The California Health and Safety Code lists SARS among the communicable diseases that must be reported to the proper health authorities. Both Humboldt and Del Norte Counties are authorized to collect records and data, initiate disease control measures, control property and manage persons (including isolation and quarantine) with respect for containment of communicable disease.

15.1.10 Extreme Weather

The western United States is subject to many weather extremes. From heavy rains in the spring, extreme heat in the summer and freezing storms in the winter. Severe spring storms and weather can lead to risk of traumatic injuries, mudslides, flooding and property damage. Severe heat and weather can lead to dehydration and heat related illness. Severe winter storms and weather can lead to risk of traumatic injuries, hypothermia and icy conditions.

Source: NOAA Hazardous Statistics, 2011

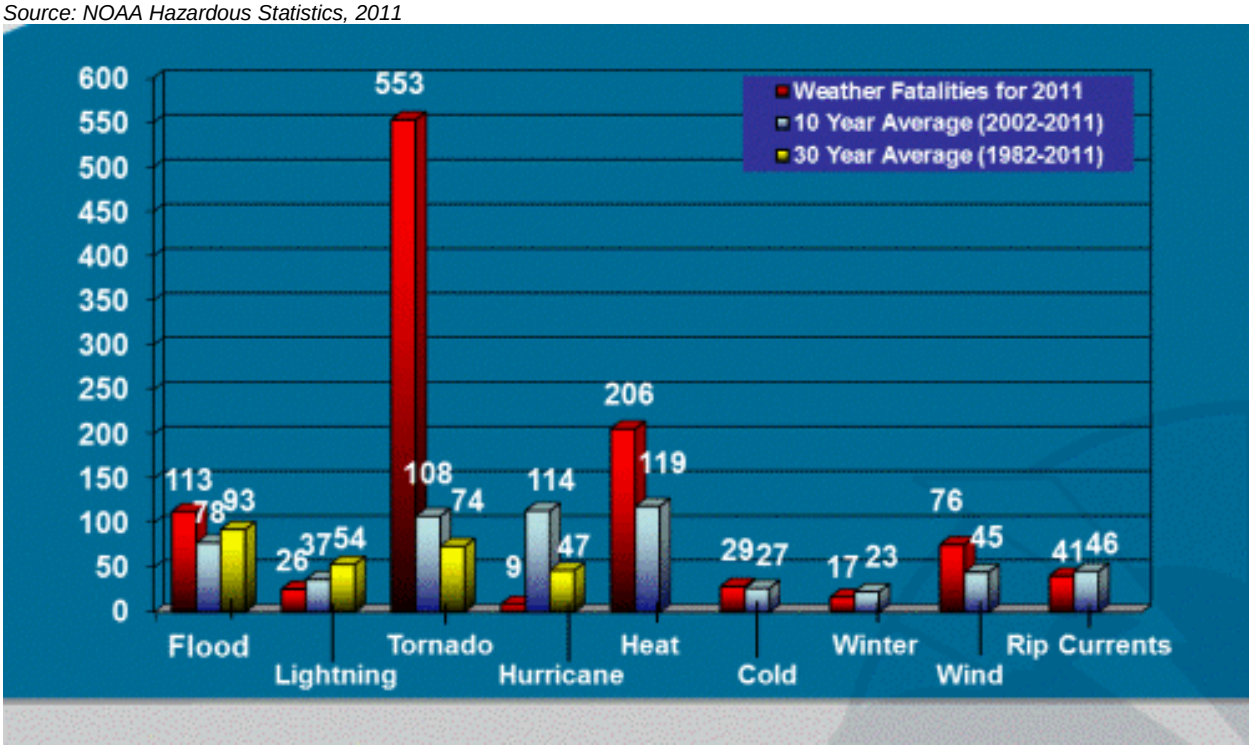

Figure 15-4. Weather-Related Fatalities in the U.S.

Severe Spring Storms

Thunderstorms and rain cause most of the severe spring weather. On average, the Tribe experiences 10 days of Thunderstorms annually. Tornados are rare in California, but can and have occurred. When these events occur unexpectedly, the risk of injury and death increases. Advance planning can decrease the risks. Citizens should pay close attention to changing weather conditions when there is a severe thunderstorm watch or warning.

Lightning strikes are also a danger during thunderstorms. A lightning bolt is 6 to 8 centimeters in diameter, carrying between 10 and 100 million volts in 20 to 50 thousand amps of direct current. The duration is approximately one millisecond. Volts of 2 billion and 500 thousand amps have been measured. A lightning strike can cause death or injury to one or several persons. Long-term injuries from lightning strike can include memory and attention loss, chronic numbness, muscle spasm, stiffness, depression, hearing loss and sleep disturbance. Seventy percent of all lightning injuries and fatalities occur in the afternoon; 85% of victims are children and young men (age 10-35) engaged in outdoor recreation and work activities. Hikers, campers, backpackers, skiers, fishermen, and hunters are especially vulnerable.

Extreme Heat

In 2011, 206 people died as a result of extreme heat, up significantly from 138 fatalities in 2010. This number is well above the 10-year average for heat related fatalities, 119. In 2011, the most dangerous place to be was in a permanent home, likely with little or no air conditioning, where a reported 119 deaths (58%) occurred. The next most dangerous identified locations were outside or in an open area, where 31 people (15%) succumbed to heat. Texas numbered the most heat victims, 46, followed by Pennsylvania, 36, and Illinois, 33. California suffered two deaths as a result of extreme heat during 2011 – none of these deaths occurred on the Reservation. Extreme heat most strongly affected older adults aged 50+, with 170 deaths (58%). Typically, older adults are the group most affected by heat. Many more males, 133 (64%), than females, 73 (35%), were killed by heat.

California, Nevada and Arizona experience very high temperatures in summer. Those susceptible to extreme heat may suffer from dehydration, heat exhaustion, heat cramps, heat stokes or even death. Air-conditioning is the number one protective factor against heat-related illness and death. If a home is not air-conditioned, people can reduce their risk for heat-related illness by spending time in public facilities that are air-conditioned. Unfortunately, 70% of the Tribe is without power, so these types of mitigation efforts are not a viable option for much of the Yurok population.

CalEMA has a comprehensive contingency plan for excessive heat emergencies. The plan describes state operations during heat-related emergencies and provides guidance for state agencies, local government, and non-governmental organizations in the preparation of heat emergency response plans and related activities. The Yurok Tribe has an emergency contingency plan and participates in the opening of local cooling centers if extreme heat continues for an extended period of time.

As much of the Reservation is without power (approximately 70%) many Tribal residents are even more susceptible because they have no method of cooling their residences due to lack of infrastructure.

Severe Winter Weather

When winter temperatures drop significantly below normal, staying warm and safe can become a challenge. Extremely cold temperatures often accompany a winter storm, which may also cause power failures and icy roads. Staying indoors as much as possible can help reduce the risk of car crashes and falls on the ice, but cold weather also can present hazards indoors. Many homes will be too cold, either due to a power failure or because the heating system isn’t adequate for the weather. When people must

use space heaters and fireplaces to stay warm, the risk of residential fires increases, as well as the risk of carbon monoxide poisoning. Additionally, many areas of the Reservation are without power, which further presents increased risk of exposure and health concerns. Exposure to cold temperatures, whether indoors or outside, can cause other serious or life-threatening health problems. Infants and the elderly are particularly at risk, but anyone can be affected. If extreme winter weather conditions are expected for an extended period, the Yurok Tribe has an emergency contingency plan to provide shelter and care areas to provide heating centers for those in need. Preventive action is the best defense against having to deal with extreme cold-weather conditions. Preparing homes and cars in advance for winter emergencies, and observing safety precautions during times of extremely cold weather can reduce the risk of weather-related health problems.

As previously indicated, the Tribe is located in a very remote location. Road connectivity includes roadways which are dirt roads. This is true of large portions of Bald Hills Road—the route of shortest distance between the upper and lower areas of the Reservation. During periods of extreme weather, Tribal members and employees travel over Bald Hills Road between the two areas of the Tribe. During winter months, this road becomes extremely hazardous. The roadway is very narrow, and travels along a ridgeline, leaving little room to maneuver. Snow can quickly accumulate on this road, making travel extremely dangerous. In many instances, the road may be passable in the morning hours, but be completely impassable by commuters a few hours later.

Hypothermia

Extreme cold can bring on health emergencies in susceptible people, such as those without shelter, who are stranded, or who live in a home that is poorly insulated or without heat. When exposed to cold temperatures, the body begins to lose heat faster than it can be produced. Prolonged exposure to cold will eventually use up the body's stored energy. The result is hypothermia, or abnormally low body temperature. Body temperature that is too low affects the brain, making the victim unable to think clearly or move well. This makes hypothermia particularly dangerous because a person may not know it is happening and will not be able to do anything about it. Warning signs of hypothermia include shivering, exhaustion, confusion, fumbling hands, memory loss, slurred speech, drowsiness, bright red cold skin, and very low energy.

Hypothermia is most likely at very cold temperatures, but it can occur even at cool temperatures (above 40°F) if a person becomes chilled from rain, sweat, or submersion in cold water. Victims of hypothermia are often elderly people, babies and infants sleeping in cold bedrooms, people who remain outdoors for long periods, or people who drink alcohol or use illicit drugs.

Frostbite

Frostbite is an injury to the body caused by freezing of the tissues. Frostbite causes a loss of feeling and color in affected areas. It most often affects the nose, ears, cheeks, chin, fingers, or toes. Frostbite can permanently damage the body, and severe cases can lead to amputation. The risk of frostbite is increased in people with reduced blood circulation and among people who are not dressed properly for extremely cold temperatures. A victim is often unaware of frostbite until someone else points it out because the frozen tissues are numb. Any of the following signs may indicate frostbite:

- A white or grayish-yellow skin area
- Skin that feels unusually firm or waxy
- Numbness.

15.2 HUMAN HEALTH HAZARD PROFILE

15.2.1 Past Events

Communicable Diseases

H1N1 Pandemic of 2009

In the United States during the 2009 H1N1 influenza pandemic, there were 59,979,608 confirmed cases of the disease, 270,435 people hospitalized due to the illness and 12,271 deaths. In California, there were 4,134 people hospitalized due to the illness and 596 deaths.

In October 2009, two U.S. states (Arizona and New Mexico) observed a disproportionate number of deaths related to H1N1 among American Indian/Alaska Natives (AI/ANs). These observations, plus incomplete reporting of race/ethnicity at the national level, led to formation of a multidisciplinary workgroup comprised of representatives from 12 state health departments, the Council of State and Territorial Epidemiologists, tribal epidemiology centers, the Indian Health Service, and CDC. The workgroup assessed the burden of H1N1 influenza deaths in the AI/AN population by compiling surveillance data from the participating states and comparing death rates. "The results indicated that, during April 15--November 13, AI/ANs in the 12 participating states [California was not one of the participating states] had an H1N1 mortality rate four times higher than persons in all other racial/ethnic populations combined. Reasons for this disparity in death rates are unknown and need further investigation; however, they might include a high prevalence of chronic health conditions (e.g., diabetes and asthma) among AI/ANs that predisposes them to influenza complications, poverty (e.g., poor living conditions), and delayed access to care" (CDC, 2009).

A total of 426 H1N1 deaths were reported by the 12 states during April 15--November 13. Forty-two deaths (9.9%) occurred among AI/ANs, although AI/ANs make up approximately 3% of the total population in the 12 states. The overall AI/AN H1N1-related death rate was 3.7 per 100,000 population, compared with 0.9 per 100,000 for all other racial/ethnic populations combined, resulting in a mortality rate ratio of 4.0. Age group--specific H1N1-related death rates were 3.5 for persons aged 0--4 years, 1.1 for persons aged 5--24 years, 4.2 for persons aged 25--64 years, and 7.2 for persons aged ≥65 years. In all age groups, the AI/AN death rate was higher than the rate for all other racial/ethnic populations combined" (CDC, 2009).

There is no specific data which discusses impact specifically on the Yurok Reservation. However, within Humboldt County there were 13 cases confirmed, with three deaths related to the pandemic. There were no reported cases within Del Norte County. In comparison, the H1N1 pandemic of 2009 was mild compared to the Spanish Flu pandemic of 1918, which caused 100 million deaths worldwide—a total of 3 percent of the world's total population.

West Nile Virus:

West Nile Virus first appeared in California in 2003, and by 2004, WNV had spread to all 58 counties. Between 2003 through 2011, the CDC reports that there have been 3,146 confirmed human cases of West Nile Virus (WNV) in California. While no data exists specifically for the Yurok Reservation, Humboldt County reports only two cases since 2003, while Del Norte has no reported cases for the same time period.

SARS:

There were 29 suspected cases of SARS in California during the worldwide outbreak in 2002-2003, but only two were confirmed as SARS. Most of these cases occurred in Los Angeles County.

Lyme:

Lyme disease is the most commonly reported vector-borne illness in the United States. In 2009, it was the 5th most common Nationally Notifiable disease. In 2010, 94% of the Lyme disease cases were reported to occur within 12 states. While no statistics specifically reference the Yurok Tribe, Humboldt County had approximately 45 cases of Lyme Disease from 2007-2011. Del Norte County had two reported cases.

Tularemia, Plague or Hantavirus:

No cases of tularemia, plague or hantavirus have been reported on the Reservation, but cases of these diseases have been reported in California and nearby counties. Even though these hazards may not be endemic to the area, they can be brought into the planning region and are still considered to be a risk.

Extreme Weather

From 1979-2003, excessive heat exposure caused 8,015 deaths in the United States. During this period, more people in this country died from extreme heat than from hurricanes, tornadoes, floods and earthquakes combined. In 2001 alone, 300 deaths were caused by excessive heat exposure. In July 2006, California experienced a heat wave impacting the entire state. Coroners attributed 140 deaths to hyperthermia, and it has been estimated from vital statistics data that in excess of 600 heat-related deaths may have occurred over a 17-day period. During the time period of 2000-2011, there were no reported weather-related deaths associated to health on the Yurok Reservation nor in either Del Norte or Humboldt Counties. Extreme weather is of significant concern on the Reservation as much of the reservation is without critical infrastructure to adequately address the hazard. Residents are without power to be able to provide any type of cooling or heating system, leaving them more vulnerable to the impacts from severe weather events. Roadways many times become impassable, further isolating residents and reducing their ability to seek shelter at other locations.

15.2.2 Location

All of the Yurok Reservation is susceptible to the human health hazards discussed in this chapter. While some hazards, such as the West Nile Virus and Lyme Disease, can have a geographic presence within the planning area, other diseases can cause exposure to the planning area from outside the local region. Tribal members, residents and tourists who travel can become exposed to diseases while abroad and bring the diseases back with them, potentially placing the region at risk for exposure. It is difficult to map the extent of human-health hazards compared to others, such as floods, wildfires and dam failures.

15.2.3 Frequency

Communicable Disease

Due to increased air travel, the growing population and the aging population, the probability of a communicable disease epidemic and pandemic is still a threat. With the continued threat of future pandemics, the Yurok Reservation supports the ongoing efforts of the collaboration and work of California Rural Indian Health Board, the United Indian Health Services, and the healthcare facilities in the region in efforts to prepare for the worst of situations.

California Rural Indian Health Board (CRIHB) is approved by Tribal Council Resolution to receive the Yurok funds directly from the Bureau of Indian Affairs for Yurok health and medical issues. They subcontract their dollars with United Indian Health Services (UIHS), which is the agency that provides the services to tribal members.

West Nile Virus

No cases of West Nile Virus have been recorded specifically on the Yurok Reservation, and only two cases have been reported within the planning region since 2003 (CDC, July 2012). The damp forest region and agricultural nature of the planning area, with the potential for standing water to be present throughout the Reservation, continues to put the planning area at risk from WNV and other mosquito-borne illnesses.

Extreme Weather

Trauma due to injures directly due to storms (falling trees, landslides and lightening) heat related illness and hypothermia are a factor of the weather and in some cases a technological hazard. Due to the fact that much of the Reservation does not have power for either heath or cooling, this increases the risk factor to individuals.

15.2.4 Severity

The severity of human health hazards is dependent upon the hazard and the population exposed to it. As the population increases, so does the risk of exposure to hazards. The key to reducing severity of exposure is to isolate and quarantine the exposure so that the population exposed does not continue to grow or spread the hazard to the uninfected population. Promoting education and promoting personal preparedness will help to mitigate and reduce the severity of the human health hazard.

15.3 SECONDARY HAZARDS

Human health hazards are not like natural hazards that have measurable secondary impacts, such as earthquakes, floods or wildfires. This is primarily due to the fact that human health hazards do not generally impact buildings and critical infrastructure as natural hazards do. The largest secondary impact caused by human health hazards would be economic. Large outbreaks of any human health hazard could reduce the workforce significantly, causing businesses and agencies to close or be greatly impacted.

Another secondary impact could be stigmatization. The fear of the human health hazard and fear of the unknown could lead to isolation, violence and self-inflicted injury. Hospitals and healthcare providers could be overwhelmed with the “worried well” seeking care and comfort. Education and providing key and critical information can reduce and mitigate this secondary risk.

15.4 CLIMATE CHANGE IMPACTS

Climate change has the potential to affect human health in a number of ways. For instance, it can alter the geographic range and seasonality of infectious diseases, disturb food-producing ecosystems, and increase the frequency of extreme weather events. Protecting health from global environmental change requires monitoring and management at many levels, from the social and economic drivers of environmental change, to the resulting hazards and exposures for human populations. Figure 15-5 shows potential health impacts of climate change and other environmental changes.

Source: World Health Organization

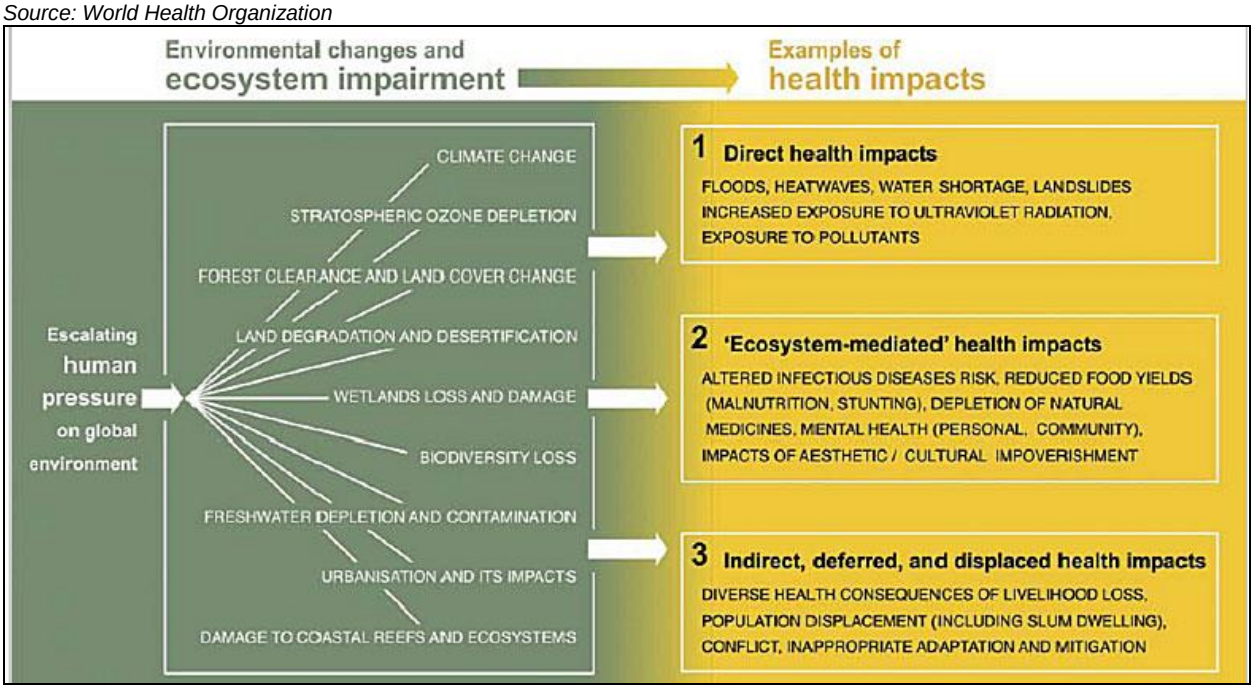

Figure 15-5. Environmental Changes and Health impacts

15.5 EXPOSURE

15.5.1 Population

All citizens in the planning area could be susceptible to the human health hazards discussed in this chapter. A large outbreak or epidemic, a pandemic or a use of biological agents as a weapon of mass destruction could have devastating effects on the population of Reservation. The Reservation has a large elderly community with a concentration of older residents in areas with limited access and infrastructure. The introduction of a disease such as the plague or influenza could rapidly impact those at risk, especially those without the infrastructure necessary for self-care, such as power, or even communication systems to call for help.

West Nile Virus and other mosquito-borne illnesses are a concern in the local wetlands and densely wooded areas where mosquitos have the tendency to live and breed.

15.5.2 Property

None of the health hazards discussed in this chapter are considered to have significant measurable impact on the structural environment and property of the planning area.

15.5.3 Critical Facilities and Infrastructure

None of the health hazards discussed in this chapter are considered to have significant measurable impact on the critical facilities and infrastructure of the planning area with the exception of potential staffing impacts as they relate to facility and infrastructure maintenance.

The acute care facilities and hospitals in the planning area have collaborated, trained and planned on a local, regional, state and national level to provide immediate and comprehensive medical care to the citizens of the Yurok Reservation, and both Humboldt and Del Norte Counties. Emergency management

and preparedness planning incorporates all response disciplines (fire, law, first responder ground and air ambulance agencies, public health, mental and spiritual health). Planning includes identifying shelters, alternate treatment facilities, isolation capacity and methods to immediately expand physical and human resources. The Tribe's Klamath Office serves as an approved Red Cross Shelter for the Reservation. However, in some instances, Tribal members are unable to travel to the shelters due to road conditions and isolation as a result of hazard impact.

15.5.4 Environment

None of the health hazards discussed in this chapter are considered to have significant measurable impact on the environment of the planning area.

15.6 VULNERABILITY

15.6.1 Population

While all of the population in the planning area is considered at risk to the human health hazards discussed in this chapter, the young and the elderly, those with compromised immune systems, and those with special needs are considered the most vulnerable. During summer months, population increases dramatically due to tourism (camp grounds, seasonal fishing and sport fishing). Reports speak to an increase of 8,000 tourists traveling through or near the reservation daily, although Tribal members feel that number is low. This increased number drains the limited resources and emergency response capabilities of the Tribe. Should an event occur, the Tribe would need to provide services to anyone trapped within the Reservation boundary. This would quickly deplete any excess resources (e.g., water, food, fuel, etc.) which may exist within any of the stores on the Reservation.

15.6.2 Property

None of the health hazards discussed in this chapter are considered to have significant measurable impact on the structural environment and property of the planning area.

15.6.3 Critical Facilities/Infrastructure

None of the health hazards discussed in this chapter are considered to have a significant measurable impact on the identified critical facilities and infrastructure elements of the planning area.

15.6.4 Environment

While many of the vectors of the health hazards discussed in this chapter (mosquitoes, rodents, fleas, ticks and deer flies) rely on local or regional environments for their survival, the human health hazard that they carry or potentially transmit would have no significant measurable impact on the environment of the planning area.

15.7 FUTURE TRENDS IN DEVELOPMENT

The economic impact of a human health hazard could be localized to a single region or population, or could be widespread. The impact could be significant, depending on the hazard, number of cases and the availability of resources to care for those affected by the hazard. Other financial impacts could be absorbed or managed by the organization affected.

The potential for the human health hazards is not likely to slow expected growth on the Reservation or the planning region. Unless a catastrophic incident occurs, it is estimated that the Tribe's population will

continue to grow. The potential for communicable diseases, vector-borne diseases or extreme weather in the planning area is not likely to lessen or prohibit the growth or the development on the Reservation.

15.8 REVIEW OF EXISTING ORDINANCES, PROGRAMS AND PLANS

15.8.1 Memorandums of Agreement

Currently the Reservation has Memorandums of Agreement with Humboldt and Del Norte Counties for fire, medical aid and police services. Medical aid transports patients to the closest area hospital. No emergency care facility is actually on the Reservation, although there is a health care facility, which is open part time. However, that facility is limited in space, and if any type of outbreak or mass causality incident (WMD) were to occur, limited resources would be available to provide isolation treatment in the event of a highly contagious and virulent disease.

15.8.2 Integrated Emergency Response

It is the expectation of the Joint Commission for Accreditation of Healthcare Organizations (JCAHO) and FEMA that acute care facilities will provide planning for an "all hazard" disaster response and care for mass casualties, whether the incidents and events are naturally occurring, human caused, or a combination of those. JCAHO requires the integration of emergency response planning with local response agencies, thereby ensuring that the community will receive the highest level of integrated response and protection available. These planning efforts are supported by local, regional, state, tribal and federal grant funding.

15.9 SCENARIO

A human health worst-case scenario for the planning area would be an epidemic or large scale incident of any of the human health hazards discussed in this chapter. Medical treatment facilities in the planning area would be overwhelmed and taxed beyond their capabilities as the numbers of patients begin to escalate. The impacts on the workforce within the planning area could have acute and long-term economic impacts on the primary employers within the planning area. First responders would be exposed to the human health hazards, which could deplete the medical workforce and could have profound impact on the potential escalation of the scenario.

15.10 ISSUES

Important issues associated with the human health hazards include, but are not limited to the following:

- Prevention and education—Prevention through vaccination and personal emergency and disaster preparation will help to reduce the impacts of human health hazards. This should include medicine and emergency supplies, and be able to sustain Residents for prolonged periods of time.
- Integration of medical and response personnel in unified command to provide care when needed—To have a successful response to human health hazards, medical and response personnel must work together for the community.
- Having adequately trained and supplied medical and response personnel.
- Up to date and functional all-hazard contingency planning.
- Informing the public with a unified message about the human health hazard.

CHAPTER 16.
RISK RANKING

A risk ranking exercise was performed for the hazards of concern described in this plan. In conformance with both 44 CFR 201.7 and the National Response Goal (NRG, 2012), this process provides a comprehensive approach to identifying and assessing the hazards and associated risk to which the Tribe is vulnerable. The results of this process as presented are used in establishing mitigation priorities for the Tribe.

This risk ranking exercise assesses the probability of each hazard's occurrence as well as its likely impact on the people, property, and economy of the planning area. Also of significant concern to the Yurok People is the impact of these hazards on the environment, and that factor was also taken into consideration during this process. The risk ranking process was conducted by Steering Committee members. For some hazards, estimates of risk were generated with data from HAZUS-MH, using methodologies promoted by FEMA. For other hazards, Steering Committee members with an extensive historic perspective and knowledge base concerning the impact of hazards on the Tribe provided invaluable information during this process. That information had a significant impact on the risk ranking process.

Several factors make the Yurok Tribe unique when compared to other jurisdictions and tribes. Most do not face many of the hardships faced by the Yurok People on a daily basis. The lack of infrastructure, including adequate transportation corridors, bridges with structural integrity to withstand hazard incidents, and lack of power and communication to 70% of the Reservation make the Yurok Tribe unique when attempting to utilized standard methods of risk assessment, as in many instances, normal efforts to mitigate impact are not a viable option for Tribal members, and residents living on the Reservation.

Of significant impact during this risk ranking exercise were the number of bridges which have the potential to impact evacuation. Many of the bridges, which are not owned by the Tribe, are in very poor condition, and are the only ingress and egress to many of the villages on the Reservation. Failure or impact to any of these bridges have the potential to cause what is now commonly referred to isolated islands of humanity – or in simpler terms, individuals cut-off from access to basic needs.

Also of significant impact were the secondary hazards of concern. In many instances, such as with Drought, while structures themselves may not be impacted by the drought event, the lack of infrastructure – and specifically power – again increases the significance of the secondary hazards. In the case of drought, water illegally diverted by marijuana grow operations have caused a significant number of fish kills on the Klamath. Likewise, due to the lack of firefighting resources, this increases the level of significance because of increased fire dangers.

It should be noted that while natural, man-made and technological hazards are identified within this document, 44 CFR 201.7(c)(2) requires a prioritization of natural hazards for mitigation planning purposes, and therefore, emphasis remains on the natural hazards.

16.1 PROBABILITY OF OCCURRENCE

The probability of occurrence of a hazard is indicated by a probability factor based on likelihood of annual occurrence:

- High—Hazard event is likely to occur within 25 years (Probability Factor = 3)

- Medium—Hazard event is likely to occur within 100 years (Probability Factor =2)
- Low—Hazard event is not likely to occur within 100 years (Probability Factor =1)
- No exposure—There is no probability of occurrence (Probability Factor = 0)

The assessment of hazard frequency is generally based on past hazard events in the area. Table 16-1 summarizes the probability assessment for each hazard of concern for this plan.

TABLE 16-1.
PROBABILITY OF HAZARDS

Hazard Event	Probability (high, medium, low)	Probability Factor
Dam Failure	Medium	2
Drought	Medium	2
Earthquake	High	3
Flood	High	3
Human-Caused Hazards	High	3
Human Health Hazards	High	3
Landslide	High	3
Severe Weather	High	3
Tsunami	High	3
Wildfire	High	3

16.2 IMPACT

Hazard impacts were assessed in three categories: impacts on people, impacts on property and impacts on the local economy. Numerical impact factors were assigned as follows:

- **People**—Values were assigned based on the percentage of the total ***population exposed*** to the hazard event. The degree of impact on individuals will vary and is not measurable, so the calculation assumes for simplicity and consistency that all people exposed to a hazard because they live in a hazard zone will be equally impacted when a hazard event occurs. It should be noted that planners can use an element of subjectivity when assigning values for impacts on people. Impact factors were assigned as follows:
  - High—50 percent or more of the population is exposed to a hazard (Impact Factor = 3)
  - Medium—25 percent to 49 percent of the population is exposed to a hazard (Impact Factor = 2)
  - Low—25 percent or less of the population is exposed to the hazard (Impact Factor = 1)
  - No impact—None of the population is exposed to a hazard (Impact Factor = 0)
- **Property**—Values were assigned based on the percentage of the total ***property value exposed*** to the hazard event:
  - High—30 percent or more of the total assessed property value is exposed to a hazard (Impact Factor = 3)

- Medium—15 percent to 29 percent of the total assessed property value is exposed to a hazard (Impact Factor = 2)
- Low—14 percent or less of the total assessed property value is exposed to the hazard (Impact Factor = 1)
- No impact—None of the total assessed property value is exposed to a hazard (Impact Factor = 0)

• **Economy**—Values were assigned based on the percentage of the total ***property value vulnerable*** to the hazard event. Values represent estimates of the loss from a major event of each hazard in comparison to the total assessed value of the property exposed to the hazard. For some hazards, such as wildfire, landslide and severe weather, vulnerability was considered to be the same as exposure due to the lack of loss estimation tools specific to those hazards. Loss estimates separate from the exposure estimates were generated for the earthquake and flood hazards using HAZUS-MH.

- High—Estimated loss from the hazard is 20 percent or more of the total assessed property value (Impact Factor = 3)
- Medium—Estimated loss from the hazard is 10 percent to 19 percent of the total assessed property value (Impact Factor = 2)
- Low—Estimated loss from the hazard is 9 percent or less of the total assessed property value (Impact Factor = 1)
- No impact—No loss is estimated from the hazard (Impact Factor = 0)

The impacts of each hazard category were assigned a weighting factor to reflect the significance of the impact. These weighting factors are consistent with those typically used for measuring the benefits of hazard mitigation actions: impact on people was given a weighting factor of 3; impact on property was given a weighting factor of 2; and impact on the economy was given a weighting factor of 1.

Table 16-2, Table 16-3 and Table 16-4 summarize the impacts for each hazard.

TABLE 16-2.
IMPACT ON PEOPLE FROM HAZARDS

Hazard Event	Impact (high, medium, low)	Impact Factor	Multiplied by Weighting Factor (3)
Dam Failure	High	3	9
Drought	High	3	9
Earthquake	High	3	9
Flood	High	3	9
Human-Caused Hazards	High	3	9
Human Health Hazards	High	3	9
Landslide	High	3	9
Severe Weather	High	3	9
Tsunami	High	3	9
Wildfire	High	3	9

TABLE 16-3.
IMPACT ON PROPERTY FROM HAZARDS

Hazard Event	Impact (high, medium, low)	Impact Factor	Multiplied by Weighting Factor (2)
Dam Failure	High	3	6
Drought	Medium	2	4
Earthquake	High	3	6
Flood	High	3	6
Human-Caused Hazards	High	3	6
Human Health Hazards	Low	1	2
Landslide	High	3	6
Severe Weather	High	2	4
Tsunami	High	3	6
Wildfire	High	3	6

TABLE 16-4.
IMPACT ON ECONOMY FROM HAZARDS

Hazard Event	Impact (high, medium, low)	Impact Factor	Multiplied by Weighting Factor (1)
Dam Failure	High	3	3
Drought	High	3	3
Earthquake	High	3	3
Flood	High	3	3
Human-Caused Hazards	High	3	3
Human Health Hazards	High	3	3
Landslide	High	3	3
Severe Weather	High	3	3
Tsunami	High	3	3
Wildfire	High	3	3

16.3 RISK RATING AND RANKING

The risk rating for each hazard was determined by multiplying the probability factor by the sum of the weighted impact factors for people, property and operations, as summarized in Table 16-5.

Based on these ratings, a priority of high, medium or low was assigned to each hazard. The hazards ranked as being of highest concern are earthquake, flood, human health hazards, landslide, severe weather, tsunami and wildfire. Hazards ranked as being of medium concern are dam failure, drought, human caused hazards. There were no hazards ranked as being of low concern. Table 16-6 shows the hazard risk ranking.

TABLE 16-5.
HAZARD RISK RATING

Hazard Event	Probability Factor	Sum of Weighted Impact Factors	Total (Probability x Impact)
Dam Failure	2	9+6+3=18	36
Drought	2	9+4+3=16	32
Earthquake	3	9+6+3=18	54
Flood	3	9+6+3=18	54
Human-Caused Hazards	3	9+6+3=18	54
Human Health Hazards	3	9+2+3=14	42
Landslide	3	9+6+3=18	54
Severe Weather	3	9+4+3=16	48
Tsunami	3	9+6+3=18	54
Wildfire	3	9+6+3=18	54

TABLE 16-6.
HAZARD RISK RANKING

Hazard Ranking	Hazard Event	Category
1	Earthquake	High
2	Flood	High
3	Landslide	High
4	Severe Weather	High
5	Tsunami	High
6	Wildfire	High
7	Human Health Hazard	High
8	Human Caused Hazard	High
9	Dam Failure	Medium
10	Drought	Medium

PART 4 —
MITIGATION STRATEGY

CHAPTER 17.
MITIGATION INITIATIVES

17.1 MITIGATION ALTERNATIVES

Catalogs of hazard mitigation alternatives were developed that present a broad range of alternatives to be considered for use in the planning area, in compliance with 44 CFR (Section 201.7(c)(3)(ii)). One catalog was developed for each hazard of concern evaluated in this plan and for each of three types of infrastructure project (roads, culverts and bridges). The catalogs for each hazard and infrastructure project type are listed in Appendix C. The catalogs present alternatives that are categorized in two ways:

- By what the alternative would do:
  - Manipulate a hazard
  - Reduce exposure to a hazard
  - Reduce vulnerability to a hazard
  - Increase the ability to respond to or be prepared for a hazard
- By who would have responsibility for implementation:
  - Individuals
  - Businesses
  - Government.

The Tribe's 2006 Hazard Mitigation Plan referenced a number of mitigation initiatives which were common to all hazards, but were listed within each hazard as separate strategies. In addition, the 2006 plan also developed strategies for hazards which are not addressed, and for which the Tribe has no, or very limited vulnerability on the Reservation. As this current plan update is of a totally new format and organizational structure, the Steering Committee elected to use this opportunity to modify the structure of the projects to eliminate those for which it has no risk, or even associated hazard profile; combine the strategies as appropriate, and to reword existing strategies to make them more viable and hazard specific, eliminating repetitive strategies for each hazard (e.g., continue public education listed for each individual hazard). It was determined that streamlining the strategies will assist in maintenance activities in the future, and allow for ease in annual reporting of its mitigation strategies. Therefore, those projects which remain valid have been included within Table 17-1, and referenced as having been previously identified, with their current status indicated. Unless listed herein, all other strategies were deemed no longer viable projects based on the current risk assessment and hazards of concern. Appendix E contains the 2014 status of the 2006 strategies.

In addition, many of the hazard mitigation initiatives recommended in this plan were selected from among the examples presented in the referenced catalogs, as well as existing planning and strategic documents. The catalogs provide a baseline of mitigation alternatives that are backed by a planning process, are consistent with the goals and objectives, and are within the capabilities of the Yurok Tribe to implement. However, not all the alternatives meet all the selection criteria.

17.2 SELECTED MITIGATION INITIATIVES

The Steering Committee identified initiatives that could be implemented to provide hazard mitigation benefits. With guidance from the steering committee, the planning team developed an action plan to

mitigate the hazards assessed in this plan. Mitigation alternatives were evaluated against the following criteria:

- **Social criteria**—Community acceptance of the mitigation activities (the public must support the overall implementation strategy and specific mitigation activities)
- **Technical criteria**—The technical feasibility of the proposed mitigation activity to reduce losses in the long term with minimal secondary impact
- **Administrative criteria**—Anticipated staffing, funding, and maintenance required for each mitigation activity
- **Political criteria**—Decision-maker acceptance of the mitigation activities (the local political leadership must support the overall implementation strategy and specific mitigation activities)
- **Legal criteria**—The City's legal authority to implement the proposed mitigation activities
- **Economic criteria**—Budget constraints
- **Environmental criteria**—Environmental impacts caused by implementing specific mitigation activities.

Table 17-1 lists the recommended initiatives, the lead agency for each, and the proposed timeline. The parameters for the timeline are as follows:

- Short Term = to be completed in 1 to 5 years
- Long Term = to be completed in greater than 5 years
- Ongoing = currently being funded and implemented under existing programs.

TABLE 17-1.
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-1—Develop a post-disaster action plan for all hazards of concern that addresses debris management, cultural/historical data gathering, substantial damage assessment, and grant management. This plan would be an appendix to the Tribe's Emergency Management Plan.							
N	New and existing	All Hazards	3, 6, 7	Emergency Management, Public Works Dept., GIS, Planning and Land Use Office, THPO	Low	Discretionary Fund, FEMA Hazard Mitigation Grant, HMGP, Emergency Management Performance Grant, BIA	Short-term, depends on funding
S-2—Adopt the Yurok Tribe Hazard Mitigation Plan as an element of any comprehensive plan that the Tribe will create, in order to ensure linkage between the two documents.							
N	New and existing	All Hazards	2, 3, 5,	Emergency Management, Public Works Department, Planning and Land Use Office	Low	Discretionary Fund	Short-term ongoing
S-3—Work with NOAA to develop a Tsunami model which combines the Klamath River reversing direction.							
N	New	Tsunami and Flood	1, 3, 5	Emergency Management, Public Works Department, Land Use Office, Housing, Realty	Medium	FEMA Hazard Mitigation Grant programs	Short-term, Ongoing
S-4—Pursue feasible, cost-effective home elevation or acquisition projects, targeting identified repetitive loss or frequently flooded properties on the Reservation.							
N	Existing	Flood	1, 10, 11	Emergency Management, Public Works, Land Use Office, Natural Resources, Housing, Realty	High	HMGP, BIA/HUD funding w/ tribal Discretionary Fund contribution for local match	Long-term, depends on funding
S-5—Work with dam owners and operators to develop regulations regarding water usage during drought periods by upstream residents and increasing water releases to raise temperatures to protect fish. Also work on regulations regarding the spilling of the dam during periods of heavy rains so as to avoid flooding on the Reservation.							
N	New and existing	Dam Failure, Drought, Flood, Severe Weather	2, 3, 4, 5, 10	USACE, Dam Owners Emergency Management, Public Works Department, Planning Department, GIS, FEMA	Low	Discretionary Fund, Dam owner funds	Long-term, depends on funding

TABLE 17-1.
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-6—Consider codes and ordinances which positively influence the resiliency of the tribe from the hazards of concern, such as land use development; landscaping ordinance for fuel reduction; building codes for minimum seismic stability; flood damage prevention ordinance to cumulatively track substantial improvements and damage, etc.							
Y- 2006 HMP enhanced	New and Existing	All	1, 9, 10, 11	Emergency Management, Housing, Water, Environmental, Forestry, GIS, Land Use Dept., Public Works, Planning, Tribal Council	Low	Discretionary Fund	Short-term
S-7—Considered adopting a regulatory freeboard standard for new construction to elevate homes above flooding, including from Dam Failure Inundation.							
N	New and existing	Flood	1, 9, 10, 11	Emergency Management, Housing, Realty, GIS, Land Use Dept., Planning Dept., Public Works, Tribal Council	Low	Discretionary Fund	Short-term
S-8—Consider stream bank stabilization projects to protect infrastructure.							
Y-2006 HMP enhanced	New and Existing	Flood	2, 3, 4, 5, 10	Emergency Management, Housing, Realty, GIS, Land Use Dept., Environmental, Forestry, Planning Dept., Public Works, Tribal Council	High	Discretionary Fund	Long-term, ongoing
S-9—Secure funding to acquire generators to maintain critical infrastructure on reservation, including for water systems.							
Y-2006 HMP	New and existing	Flood	1, 2, 3, 4, 5, 7, 9	Emergency Management, Housing, Realty, GIS, Land Use Dept., Planning Dept., Public Works, Tribal Council	Medium	Discretionary Fund, BIA, HUD, FEMA Grant Funds, Homeland Security Grants	Short-term
S-10—Develop a stormwater management plan as development continues on the Reservation and in relation to the Casino site.							
N	New and Existing	Flood, Severe Weather	3, 4, 6, 8, 10	Public Works Department, Land Use Office, Planning Dept., Economic Development Dept. Tribal Government	Medium	Stormwater Utility	Short-term

TABLE 17-1.
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-11—Consider a building setback/spacing requirement for new construction in areas susceptible to wildfire exposure.							
N	New	Wildfire	1, 2, 4	Public Works Department, Land Use Office, Fire Dept., Planning Dept., Tribal Council	Low	Discretionary Fund	Short-term
S-12—Join the Firewise program by adopting the program's policies for managing wildland-urban interface areas on the Reservation.							
N	New and existing	Wildfire	2, 3, 4, 5, 10	Emergency Management, Public Works Dept., Land Use Office, Planning Dept., Tribal Council, Housing, Fire Department, THPO	Low	Discretionary Fund	Short-term
S-13—Consider planting standards in wildland buffer areas to require fire-resistant plants with loose branching habits, non-resinous woody material, high moisture content leaves and limited seasonal accumulation of dead vegetation.							
N	New and existing	Wildfire	4, 10	Land Use Department, Housing, Public Works, Planning Dept. Tribal Government, Fire Dept.	Low	Discretionary Fund	Short Term
S-14— Work with the National Tsunami Hazard Mitigation Program to develop vertical evacuation routes for tsunami hazard.							
N	New	Tsunami	1, 2, 3, 5, 10	Emergency Management, Public Works Department, Natural Resources Department, GIS, Housing, Realty	Low	Discretionary Fund	Short-term
S-15—Consider building codes that would harden new and existing structures from the potential impacts of earthquakes.							
N	New and existing	Earthquake	1, 3, 4	Emergency Management, Public Works Dept., Planning Dept., THPO, Natural Resources Department, GIS, Housing, Realty	Low	Discretionary Fund	Short-term
S-16—Conduct seismic vulnerability studies of all infrastructure, including critical facilities..							
Y 2006 enhanced	Existing	Earthquake	3, 6, 7	All	High	FEMA HMGP & PDM, Homeland Security, BIA & HUD	Long-Term

TABLE 17-1.
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-17—Promote the structural and non-structural seismic retrofit of structures built before 1974 by a targeted outreach to the owners of these structures, including a Reservation-wide tie-down program.							
Y 2006 HMP enhanced	Existing	Earthquake, Landslide, Severe Weather	1, 5, 10	Planning, Public Works, Emergency Mgmt., Housing,	Low	Discretionary Fund	Long-term
S-18—Continue and enhance where feasible the Tribe's drainage system maintenance program to reduce or minimize the impacts of stormwater flooding on the Reservation.							
N	New and existing	Flood, Severe Weather	3, 6, 8	Public Works, Housing, Realty, Emergency Mgmt.	Medium	Land Use Permitting Fees, Grant Funds, Discretionary Funds, CIP	Long-term, ongoing
S-19—Work with the Federal and State Departments of Transportation and Counties to identify landslide-risk areas along major roadways. Promote increased inspections on roadways along and on the Reservation to reduce risk from landslides and washouts. Seek ways to improve slope stability and drainage, and seek funding to plan for and repair future slope failures to reduce the potential for isolation and to provide for additional access to the Reservation.							
N	New and Existing	Landslide, Flood, Severe Storm	6, 8, 10	Public Works, Transportation Dept., Federal and CA State Depts., of Transportation, Humboldt and Del Norte Counties, Forestry, THPO, Emergency Mgmt.	High	CIP, Discretionary Fund, Discretionary Funds, Federal programs, Scenic By-Ways Program, HMGP, PDM, BIA, HUD	Long-term
S-20—Develop a public outreach strategy of ongoing programs providing multiple messages that support all phases of emergency management, including the maintenance of a 7-day supply of food and water. This should include CERT training. Training program should also include an outreach program for elders and sensitive populations to provide assistance as needed.							
Y 2006 HMP enhanced	New and Existing	All Hazards	1, 2, 3, 5, 10	All	Low	Discretionary Fund, FEMA HMGP, BIA, HUD, TEMPG	Short-Term, Ongoing
S-21—Prior to new development, conduct a vulnerability assessment of water and wastewater utilities for exposure to all identified hazards of concern.							
N	Existing	All Hazards	3, 6, 7	Public Works, Planning Dept., GIS Realty, Housing, Tribal Government	High	FEMA Hazard Mitigation Grant, HUD, BIA	Long-term, depends on funding

TABLE 17-1.
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-22—Review utility designs and standards for safety and competence under natural and human-caused disasters, utilizing information from this hazard mitigation plan. Once vulnerability determined, work with tribal and local providers to site harden utility service.							
N	New and Existing	All hazards	1, 2, 4	Public Works, Planning Dept. GIS, Land Use Department, Housing	Low	Discretionary Fund, Grants	Long-Term, ongoing
S-23—Develop a Reservation-wide comprehensive education program to educate tribal members about: hazards of concern on the Reservation, hazard mitigation opportunities, and evacuation routes.							
N	New and existing	Flood, Severe Weather	1, 2, 3, 5, 10	Emergency Management Department, Public Works Department, Housing, Health, Tribal Government, FEMA	Low	Discretionary Fund, Grant funds when available	Short-term, ongoing
S-24— Assess the Tribe's evacuation and primary response routes, and work with Tribal, County and Federal Departments of Transportation to develop alternate routes; develop right of way agreements as necessary, and negotiate removal or unlocking of gates with locks.							
Y-2006 HMP	New	All hazards	1, 2, 4	Emergency Management, Public Works Dept., Planning Dept., Legal Dept., Natural Resources Dept., THPO, Land Use Office	Low	Discretionary Fund, Land Use Permit Fees, PDM & HMGP	Long-term, depends on funding
S-25 Assess potential debris accumulations in water channels and the mouth of the Klamath River, to include debris from the 2011 Japanese tsunami, in an effort to develop recovery and response plans.							
N	Existing	Flood, Earthquake, Tsunami, Severe Weather	1, 6, 11	Emergency Management, Tribal and County Health Depts. Public Works, CA State Dept. of Ecology, Humboldt & Del Norte Counties, Tribal Environmental Dept., Planning Dept. GIS.	High	FEMA Hazard Mitigation Grant; State	Long-term, depends on funding

TABLE 17-1.
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-26— Support and participate in County efforts for public education programs, as well as self-sustainability (such as the Ready, Set Go! campaign) and emergency preparedness.							
N	New and existing	Flood, Severe Weather	1, 2, 3, 5, 10	Emergency Management, Health, Housing, Land Use, Public Works Department, Humboldt and Del Norte Counties, BIA, Indian Health Service, FEMA	Low	Discretionary Fund, Humboldt and Del Norte County program funding	Short-term, ongoing
S-27— Update emergency response plans based on the information contained in this plan. Those plans should then be practiced and exercised so community members know the areas of concern and can evacuate appropriately when a disaster occurs.							
N	New and existing	All	All	Emergency Management, GIS, Land Use Office, Housing, Public Works Department, FEMA	Medium	Discretionary Fund, FEMA funding and FEMA grants	Long-term, ongoing
S-28—Develop a protocol and system for capturing damage data on the Reservation for disaster reporting. Consider including flood depth data, dollar losses for all hazards impacting the Reservation, and duration of impact from the event. The data should be used to update the hazard mitigation plan.							
N	New and existing	All	1, 2, 3, 5, 10	Emergency Management Department, Land Use Office, Planning Dept., THOP Public Works Dept. GIS/IT, FEMA	Low	Discretionary Fund, FEMA grant programs, BIA, HUD	Short-term, development, long term maintenance
S-29—Conduct LIDAR studies on any newly acquired properties to provide enhanced data for determining vulnerability to hazards of concern. Data acquired should be used to update this hazard mitigation plan as needed.							
N	New and existing	All hazards	1, 2, 3, 5, 10	Emergency Management, GIS, Forestry, Fisheries, Natural Resources, Public Works and Planning Depts., Land Use Office	High	Discretionary Fund, Land Use Permit Fees, PDM & HMGP	Long-Term, depends on funding

TABLE 17-1.
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-30— If owners are willing, relocate private and public residences or other facilities that have been repeatedly flooded to areas outside the floodplain through acquisition projects funded by the Hazard Mitigation Grant Program or Flood Mitigation Assistance.							
N	New	Flood	1, 2, 4	Emergency Management, Public Works Department, Natural Resources Department, Land Use Office	High	Discretionary Fund, Land Use Permit Fees, PDM & HMGP	Long-Term, depending on funding
S-31—Work toward becoming a StormReady Community.							
N	New	Severe Weather, Tsunami	1, 2, 4	Emergency Management, Public Works Department, Natural Resources Department, Environmental, Forestry, Planning Dept. Land Use Office	Low	Discretionary Fund, Land Use Permit Fees, PDM & HMGP	Long-Term
S-32— Seismically retrofit water towers and water storage structures to reduce the potential for collapse during an earthquake or significant flood event, and enhance water lines for firefighting. Once completed, the tower can be used to store water for firefighting on the Reservation.							
N	Existing	Earthquake, Tsunami, Flood, Severe Weather,	1, 2, 3, 4, 6 8, 9, 11	Emergency Management, Public Works Department, Natural Resources Department, Environmental, Forestry, Planning Dept. Land Use Office	High	Discretionary Fund, PDM HMGP, BIA, HUD	Long-Term
S-33 – Develop Fire Safe Council(s) to assist neighborhoods and communities in become more resilient to the impacts of fire.							
N	New and Existing	Severe Weather, Wildfire	1, 2, 4	Emergency Management, Public Works Department, Natural Resources Department, Environmental, Forestry, Planning Dept., Yurok Fire and Volunteer Fire Depts., GIS Land Use Office	Low	Discretionary Fund, Permit or Utility Fees, PDM, HMGP, Fire Grants, BIA, HUD	Long-Term

TABLE 17-1.
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-34 Enhance water systems on Reservation to increase capacity of water storage facilities; obtain alternate sources (wells) and increase capacity to enable ability to utilize fire hydrants without damaging existing infrastructure and reducing capacity for residents.							
Y (Enhanced from 2006 HMP)	New and Existing	Drought, EQ, Flood, Severe Weather, Wildfire	1, 2, 4	Emergency Management, Public Works Department, Natural Resources Department, Environmental, Forestry, Planning Dept., Yurok Fire and Volunteer Fire Dept., GIS Land Use Office	High	Discretionary Fund, EPA, PDM, HMGP, Fire Grants, BIA, HUD	Long-Term
S-35 Establish policy which sets forth requirements for identifying and using suction supply water sources in areas without fire hydrants on the Reservation to assist in firefighting abilities. This may include working with outside agencies and federal departments to make certain all environmental requirements are considered. This initiative will include enhancing fire response apparatus capacity to support hauled water operations. Specific sites should include: Martin's Ferry Bridge, Pine Creek, Burrill Creek.							
N	New and Existing	Wildfire	1, 2, 4	Emergency Management, Public Works Department, Natural Resources Department, Environmental, Forestry, Planning Dept., Yurok Fire and Volunteer Fire Dept., GIS Land Use Office , THPO, CalTrans	Medium	Discretionary Fund, Land Use Permit Fees, PDM, HMGP, Fire Grants, BIA, HUD	Long-Term
S-36 Purchase portable water storage tanks equipped with fire suppression supply connections which will be strategically located in areas with high fire danger for use in firefighting.							
N	New	Wildfire	1, 2, 4	Emergency Management, Public Works Department, Natural Resources Department, Environmental, Forestry, Planning Dept., Yurok Fire and Volunteer Fire Dept., GIS Land Use Office	High	Discretionary Fund, Land Use Permit Fees, PDM, HMGP, Fire Grants, BIA, HUD	Long-Term

TABLE 17-1.
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-37 Train residents on use of portable water tanks to assist in firefighting efforts until first responders arrive.							
N	New	Wildfire	1, 2, 4	Emergency Management, Public Works Department, Natural Resources Department, Environmental, Forestry, Planning Dept., Yurok Fire and Volunteer Fire Dept., GIS Land Use Office	Low	Discretionary Fund, Land Use Permit Fees, PDM, HMGP, Fire Grants, BIA, HUD	Long-Term
S-38 Obtain hand tools which can be placed in community centers throughout Reservation which residents can check out to help maintain defensible space around residences, and to maintain areas along roadways.							
N	New	Wildfire	1, 2, 4	Emergency Management, Public Works Department, Natural Resources Department, Environmental, Forestry, Planning Dept., Yurok Fire and Volunteer Fire Dept., GIS Land Use Office	Low	Discretionary Fund, Land Use Permit Fees, PDM, HMGP, Fire Grants, BIA, HUD	Short-Term
S-39 Review potential to purchase a chipper for the Reservation which can be used to reduce fire fuel.							
N	New and Existing	Wildfire	1, 2, 4	Emergency Management, Public Works Department, Natural Resources Department, Environmental, Forestry, Planning Dept., Yurok Fire and Volunteer Fire Dept., GIS Land Use Office	Low	Discretionary Fund, Land Use Permit Fees, PDM, HMGP, Fire Grants, BIA, HUD	Short-Term

TABLE 17-1.
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-40 Develop policy and plan for litter removal Reservation wide. This will be a multi-year plan which ultimately encompasses the entire Reservation, and includes private residents' participation.							
N	New and Existing	Severe Weather, Wildfire	1, 2, 4	Emergency Management, Public Works Department, Natural Resources Department, Environmental, Forestry, Planning Dept., Yurok Fire and Volunteer Fire Dept., GIS, Land Use Office Citizens	Low	Discretionary Fund, Land Use Permit Fees, PDM, HMGP, Fire Grants, BIA, HUD	Short-Term
S-41 Seek funding opportunities to assist homeowners in landslide areas to structurally retrofit homes, or for acquisition or relocation of homes currently in high landslide areas to other areas of the Reservation.							
N	New and Existing	Severe Weather, Flooding, Landslide, Wildfire	1, 2, 4	Emergency Management, Public Works Department, Natural Resources Department, Environmental, Forestry, Planning Dept., Yurok Fire and Volunteer Fire Dept., GIS, Land Use Office Citizens	High	Discretionary Fund, PDM, HMGP, Fire Grants, BIA, HUD	Long-Term
S-42 Work with community members within fire units to determine areas where Shaded Fuel projects would be most beneficial in reducing fire severity . Prioritize projects and establish community events/work projects to focus on specific areas.							
N	New and Existing	Wildfire	1, 2, 4	Emergency Management, Public Works Department, Natural Resources Department, Environmental, Forestry, Planning Dept., Yurok Fire and Volunteer Fire Dept., GIS Land Use Office Citizens	Low	Discretionary Fund, PDM, HMGP, Fire Grants, BIA, HUD	Long-Term

TABLE 17-1.
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-43 Work with Cal Trans, Humboldt and Del Norte Counties to widen (Firewise recommendation ~ 24 feet) and clear bridges and roadways for fuel breaks and evacuation routes. Projects should be prioritized based on local emergency response and fire plans, and the Tribe's Safety Plan which establish prioritized evacuation routes.							
N	New and Existing	All	1, 2, 4	Emergency Management, Transportation Dept., Public Works Dept., Natural Resources Dept., Environmental, Forestry, Planning Dept., Yurok Fire and Volunteer Fire Dept., GIS Land Use Office	Low	Discretionary Fund, PDM, HMGP, Fire Grants, BIA, HUD	Long-Term
S-44 Seek funding opportunities to assist with signage needs for streets for emergency response and evacuation.							
2006	New and Existing	All	1, 2, 4	Emergency Management, Transportation Dept. Public Works Dept., Natural Resources Dept., Environmental, Forestry, Planning Dept., Yurok Fire and Volunteer Fire Dept., GIS, Land Use Office Citizens	Low	Discretionary Fund, PDM, HMGP, Fire Grants, BIA, HUD, E9-1-1 Grants	Long-Term
S-45 Work with local Fire Safe Councils to pursue SNAP or NAP grants for low-income residents for defensible space .							
N	New and Existing	Wildfire	1, 2, 4	Emergency Management, Public Works Dept., Natural Resources Dept., Environmental, Forestry, Planning Dept., Yurok Fire and Volunteer Fire Dept., GIS, Land Use Office Humboldt and Del Norte County Fire Safe Councils	Low	Discretionary Fund, PDM, HMGP, Fire Grants, BIA, HUD, Fire Safe Councils	Long-Term

TABLE 17-1.
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-46 Seek funding opportunities to assist homeowners in home retrofitting projects for new roofs, window and siding replacement, netting of eves, aluminum wrapping of structures or other fuel reduction projects, seismic retrofits, flood reduction, and home tie-down projects.							
N	New and Existing	All	1, 2, 4	Emergency Management, Public Works Department, Natural Resources Department, Environmental, Forestry, Planning Dept., Yurok Fire and Volunteer Fire Dept., GIS Land Use Office Citizens	Low	Discretionary Fund, PDM, HMGP, Fire Grants, BIA, HUD	Long-Term
S-47 Complete inventory of known cultural resources located in or near identified hazard areas.							
Y -2006 HMP	New and Existing	All	1, 2, 4	Emergency Management, THPO, Natural Resources Dept., Environmental, Forestry, Planning Dept., Yurok Fire and Volunteer Fire Dept., GIS	Low	Discretionary Fund, BIA, HUD	Short-Term
S-48 Create Dam Failure Working Group to increase community education concerning potential impacts from dam failure. Once inundation maps have been provided from the dam owners, review existing escape routes and safe zones for accuracy.							
Y- 2006 HMP	New and Existing	All	1, 2, 4	Emergency Management, THPO, Natural Resources Dept., Environmental, Forestry, Planning Dept., Yurok Fire and Volunteer Fire Dept., GIS, Citizens	Low	Discretionary Fund, BIA, HUD	Short-Term
S-49 Install early warning systems reservation wide, focusing first in areas without adequate radio and telephone coverage.							
Y (2006 HMP)	New and Existing	All	1, 2, 4	Emergency Management, THPO, Natural Resources Dept., Environmental, Forestry, Planning Dept., Yurok Fire and Volunteer Fire Dept., GIS	High	Tsunami Program, Homeland Security Funds, Discretionary Fund, BIA, HUD	Long-Term

TABLE 17-1.
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-50 Establish shelter capabilities which include generators due to lack of electrical infrastructure on much of the Reservation. These shelter locations which include, at a minimum, kitchen, shower facilities, and air conditioning due to high heat index in area, and should meet the access and functional needs of all individuals.							
Y 2006 HMP	New and Existing	All	1, 2, 4	Emergency Management, THPO, Natural Resources Dept., Environmental, Forestry, Planning Dept., Yurok Fire and Volunteer Fire Dept., GIS	High	Discretionary Fund, BIA, HUD, FEMA Grant Funds, Homeland Security Grant Funds	Long-Term
S-51 Work with Army Core of Engineers to obtain historical information and annual inspections from Levees and Dams on Reservation, or which have the potential to impact the Reservation.							
Y 2006 HMP	New and Existing	Flood, Severe Storm	1, 2, 4	Emergency Management, THPO, Natural Resources Dept., Environmental, Forestry, Planning Dept., GIS Dept.	Medium	Discretionary Fund	Short-Term
S-52 Seek grant funding to obtain NOAA weather radios for each facility and resident on the Reservation. This will provide advanced notice of approaching storms, tsunami evacuation and wildfire danger.							
Y 2006 HMP	New and Existing	All	1, 2, 4	Emergency Management, Forestry, Planning Dept., Yurok Fire and Volunteer Fire Dept.	Medium	Discretionary Fund, BIA, HUD, FEMA Grant Funds, Homeland Security Grant Funds, Tsunami Program	Short-Term
S-53 Seek grant funding to construct a fire station on the Upper Reservation in the Tulley Creek Community that can accommodate the expansion of wildland fire services on the Reservation. Consider including an Emergency Operations Center within this facility.							
Y 2006 HMP	New and Existing	All	1, 2, 4	Emergency Management, Forestry, Planning Dept., Yurok Fire and Volunteer Fire Depts., Tribal Council	High	Discretionary Fund, BIA, HUD, FEMA Grant Funds, Homeland Security Grant Funds, Fire Grants	Long-Term
S-54 Fund a wildland engine crew, supervisors and equipment to assist in firefighting capabilities.							
Y 2006 HMP	New and Existing	Wildfire	1, 2, 4	Emergency Management, Natural Resources Dept., Environmental, Forestry, Planning Dept., Yurok Fire and Volunteer Fire Depts., Tribal Council	High	Discretionary Fund, BIA, HUD, FEMA Grant Funds, Homeland Security Grant Funds, Fire Grants	Long-Term

TABLE 17-1.
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Any Other Plan (Y or N) #	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Responsible Departments	Estimated Cost	Sources of Funding	Timeline
S-55 Seek grant funding to purchase two new fire trucks and a water tender to help with firefighting capabilities on the Reservation, as well as surrounding communities.							
Y 2006 HMP	New and Existing	Wildfire	1, 2, 4	Emergency Management, Natural Resources Dept., Environmental, Forestry, Planning Dept., Yurok Fire and Volunteer Fire Depts., Tribal Council	High	Discretionary Fund, BIA, HUD, FEMA Grant Funds, Homeland Security Grant Funds, Fire Grants	Long-Term
S-56 Work with local utility service providers to install underground utility lines (power, phone, internet) to minimize disruption of service throughout Reservation.							
Y 2006 HMP	New and Existing	All	1, 2, 4	Emergency Management, THPO, Natural Resources Dept., Environmental, Forestry, Planning Dept., Yurok Fire and Volunteer Fire Depts., GIS	High	Discretionary Fund, BIA, HUD, FEMA Grant Funds, Homeland Security Grant Funds, Community Development Block Grants	Long-Term
S-57 Pursue grant and other funding opportunities to assist communities in becoming more resilient to the impacts of fire through educational public outreach on defensible space.							
N	Existing	Earthquake, Tsunami, Flood, Wildfire	1, 2, 3, 4, 6, 8, 9, 11	Emergency Management, Public Works Department, Natural Resources Department, Land Use Office, BIA	Medium	Discretionary Fund, PDM & HMGP, Fire Grants, BIA, HUD	Long-Term, depending on funding

17.3 BENEFIT/COST REVIEW

The action plan must be prioritized according to some form of a benefit/cost analysis of the proposed projects and their associated costs. The benefits of proposed projects were weighed against estimated costs as part of the project prioritization process. The benefit/cost analysis was not of the detailed variety required by FEMA for project grant eligibility under the Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM) grant program. A less formal approach was used because some projects may not be implemented for up to 10 years, and associated costs and benefits could change dramatically in that time. Therefore, a review of the apparent benefits versus the apparent cost of each project was performed. Parameters were established for assigning subjective ratings (high, medium, and low) to the costs and benefits of these projects.

Cost ratings were defined as follows:

- **High**—Existing funding will not cover the cost of the project; implementation would require new revenue through an alternative source (for example, bonds, grants, and fee increases).
- **Medium**—The project could be implemented with existing funding but would require a re-apportionment of the budget or a budget amendment, or the cost of the project would have to be spread over multiple years.
- **Low**—The project could be funded under the existing budget. The project is part of or can be part of an ongoing existing program.

Benefit ratings were defined as follows:

- **High—**Project will provide an immediate reduction of risk exposure for life and property.
- **Medium—**Project will have a long-term impact on the reduction of risk exposure for life and property, or project will provide an immediate reduction in the risk exposure for property.
- **Low—**Long-term benefits of the project are difficult to quantify in the short term.

Using this approach, projects with positive benefit versus cost ratios (such as high over high, high over medium, medium over low, etc.) are considered cost-beneficial and are prioritized accordingly.

For many of the strategies identified in this action plan, the Yurok Tribe may seek financial assistance under the HMGP or PDM programs, both of which require detailed benefit/cost analyses. These analyses will be performed on projects at the time of application using the FEMA benefit-cost model. For projects not seeking financial assistance from grant programs that require detailed analysis, the Yurok Tribe reserves the right to define “benefits” according to parameters that meet the goals and objectives of this plan.

17.4 ACTION PLAN PRIORITIZATION

Table 17-2 lists the priority of each initiative, using the same parameters used in selecting the initiatives. A qualitative benefit-cost review was performed for each of these initiatives. The priorities are defined as follows:

- **High Priority**—A project that meets multiple objectives (i.e., multiple hazards), has benefits that exceed cost, has funding secured or is an ongoing project and meets eligibility requirements for the HMGP or PDM grant program. High priority projects can be completed in the short term (1 to 5 years).

- **Medium Priority**—A project that meets goals and objectives, that has benefits that exceed costs, and for which funding has not been secured but that is grant eligible under HMGP, PDM or other grant programs. Project can be completed in the short term, once funding is secured. Medium priority projects will become high priority projects once funding is secured.
- **Low Priority**—A project that will mitigate the risk of a hazard, that has benefits that do not exceed the costs or are difficult to quantify, for which funding has not been secured, that is not eligible for HMGP or PDM grant funding, and for which the time line for completion is long term (1 to 10 years). Low priority projects may be eligible for other sources of grant funding from other programs.

17.5 ANALYSIS OF MITIGATION INITIATIVES

Each planning partner reviewed its recommended initiatives to classify each initiative based on the hazard it addresses and the type of mitigation it involves. Mitigation types used for this categorization are as follows:

- **Prevention**—Government, administrative or regulatory actions that influence the way land and buildings are developed to reduce hazard losses. Includes planning and zoning, floodplain laws, capital improvement programs, open space preservation, and stormwater management regulations.
- **Property Protection**—Modification of buildings or structures to protect them from a hazard or removal of structures from a hazard area. Includes acquisition, elevation, relocation, structural retrofit, storm shutters, and shatter-resistant glass.
- **Public Education and Awareness**—Actions to inform citizens and elected officials about hazards and ways to mitigate them. Includes outreach projects, real estate disclosure, hazard information centers, and school-age and adult education.
- **Natural Resource Protection**—Actions that minimize hazard loss and preserve or restore the functions of natural systems. Includes sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.
- **Emergency Services**—Actions that protect people and property during and immediately after a hazard event. Includes warning systems, emergency response services, and the protection of essential facilities.
- **Structural Projects**—Actions that involve the construction of structures to reduce the impact of a hazard. Includes dams, setback levees, floodwalls, retaining walls, and safe rooms.

TABLE 17-2.
PRIORITIZATION OF MITIGATION INITIATIVES

Initiative #	# of Objectives Met	Benefits	Costs	Do Benefits Equal or Exceed Costs?	Is Project Grant Eligible?	Can Project be Funded Under Existing Programs/ Budgets?	Priority (High, Med., Low)
1	3	Medium	Low	Yes	Yes	No	Medium
2	3	Medium	Low	Yes	No	Yes	High
3	3	High	Medium	Yes	Yes	No	Medium
4	3	High	High	Yes	Yes	No	Medium
5	5	High	Low	Yes	No	No	Medium
6	4	High	Low	Yes	No	Yes	High
7	4	High	Low	Yes	No	Yes	Medium
8	5	High	High	Yes	Yes	No	Medium
9	7	Medium	Medium	Yes	Yes	No	Medium
10	5	Medium	Medium	Yes	No	Yes	High
11	3	High	Low	Yes	No	Yes	High
12	4	High	Low	Yes	No	Yes	High
13	2	High	Low	Yes	No	Yes	High
14	4	High	Low	Yes	Yes	Yes	High
15	3	High	Low	Yes	No	Yes	High
16	3	High	High	Yes	Yes	No	Medium
17	3	Medium	Low	Yes	No	Yes	High
18	3	Medium	Medium	Yes	No	Yes	High
19	3	High	High	Yes	Yes	No	Medium
20	4	Medium	Low	Yes	No	Yes	High
21	3	High	High	Yes	Yes	No	Medium
22	3	High	Low	Yes	No	Yes	High
23	4	High	Low	Yes	No	Yes	High
24	3	High	Low	Yes	No	Yes	High
25	3	Medium	Medium	Yes	Yes	No	Medium

TABLE 17-2.
PRIORITIZATION OF MITIGATION INITIATIVES

Initiative #	# of Objectives Met	Benefits	Costs	Do Benefits Equal or Exceed Costs?	Is Project Grant Eligible?	Can Project be Funded Under Existing Programs/ Budgets?	Priority (High, Med., Low)
26	4	Medium	Low	Yes	No	Yes	High
27	All	High	Medium	Yes	Yes	Yes	High
28	5	Medium	Low	Yes	No	Yes	High
29	5	High	High	Yes	Yes	No	Medium
30	3	High	High	Yes	Yes	No	Medium
31	3	Low	Low	Yes	No	Yes	Medium
32	8	High	High	Yes	Yes	No	Medium
33	3	High	Low	Yes	No	Yes	High
34	3	High	High	Yes	Yes	No	High
35	3	High	Medium	Yes	Yes	Yes	High
36	3	High	High	Yes	Yes	No	Medium
37	3	Medium	Low	Yes	No	Yes	High
38	3	Medium	Low	Yes	Yes	Yes	high
39	3	Medium	Lo	Yes	No	Yes	High
40	3	Low	Low	Yes	No	Yes	High
41	3	High	High	Yes	Yes	No	Medium
42	3	Medium	Low	Yes	No	Yes	High
43	3	Medium	Low	Yes	Yes	Yes	High
44	3	Medium	Low	Yes	No	Yes	High
45	3	Low	Low	Yes	No	Yes	High
46	3	Low	Low	Yes	No	Yes	High
47	3	Low	Low	Yes	No	Yes	High
48	3	Low	Low	Yes	No	Yes	High
49	3	High	High	Yes	Yes	No	Medium
50	3	High	High	Yes	Yes	No	Medium
51	3	Medium	Medium	Yes	Yes	No	Medium

TABLE 17-2.
PRIORITIZATION OF MITIGATION INITIATIVES

Initiative #	# of Objectives Met	Benefits	Costs	Do Benefits Equal or Exceed Costs?	Is Project Grant Eligible?	Can Project be Funded Under Existing Programs/ Budgets?	Priority (High, Med., Low)
52	3	High	Medium	Yes	Yes	No	Medium
53	3	High	High	Yes	Yes	No	Medium
54	3	High	High	Yes	Yes	No	Medium
55	3	High	High	Yes	Yes	No	Medium
56	3	High	High	Yes	Yes	No	Medium
57	8	Medium	Medium	Yes	Yes	No	Medium

TABLE 17-3.
ANALYSIS OF MITIGATION INITIATIVES

	Initiative Addressing Hazard, by Mitigation Type[a]					
Hazard Type	1. Prevention	2. Property Protection	3. Public Education and Awareness	4. Natural Resource Protection	5. Emergency Services	6. Structural Projects
Dam Failure	1, 2, 6, 8, 9, 21, 22, 29, 43, 45, 48, 51, 56	2, 6, 7, 19, 21, 22, 29, 43, 45, 51, 56	2, 6, 6, 1, 45, 49, 50, 51	2, 6, 8, 19, 43, 51, 56	2, 6, 9, 21, 22, 24, 26, 28, 43, 44, 45, 49, 50, 51, 52, 56	2, 6, 8, 19, 21, 22, 43, 46, 50, 56
Drought	1, 2, 6, 21, 22, 34, 43, 45, 51, 56	2, 6, 21, 22, 43, 45, 56	2, 6, 20, 23, 26, 45, 49, 50	2, 6, 43, 56	2, 6, 9, 21, 22, 23, 26, 28, 43, 44, 45, 49, 50, 52, 56	2, 6, 21, 22, 43, 46, 50, 56
Earthquake	1, 2, 6, 9, 15, 16, 21, 22, 29, 34, 43, 45, 51, 56	2, 6, 9, 15, 16, 17, 21, 22, 29, 43, 45, 56	2, 6, 15, 17, 20, 23, 26, 45, 49, 50	2, 6, 9, 17, 43, 56	2, 6, 9, 16, 17, 21, 22, 24, 26, 28, 43, 44, 45, 49, 50, 52, 56	2, 6, 9, 15, 16, 17, 21, 22, 30, 32, 43, 46, 50, 56
Flood	1, 2, 3, 4, 6, 8, 9, 19, 21, 22, 29, 30, 34, 43, 45, 51, 56	2, 3, 4, 6, 8, 18, 19, 21, 22, 29, 30, 43, 45, 51, 56	2, 3, 4, 6, 20, 23, 26, 31, 45, 49, 50, 51	2, 5, 6, 8, 9, 19, 30, 43, 51, 56	2, 5, 6, 9, 17, 18, 19, 20, 21, 22, 24, 26, 31. 32, 43, 44, 45, 49, 50, 52, 56	2, 3, 4, 6, 8, 9, 10, 18, 19, 21, 22, 30, 32, 43, 46, 50, 56
Landslide	1, 2, 6, 7, 9, 17, 19, 21, 22, 29, 43, 45, 51, 56	1, 2, 7, 8, 18, 19, 21, 22, 29, 43, 45, 56	1, 2, 20, 23, 26, 45, 49, 50	1, 2, 8, 9 19, 43, 56	1, 2, 9, 17, 19, 21, 22, 24, 26, 28, 43, 44, 45, 49, 50, 52, 56	1, 2, 7, 89 9, 10, 17, 18, 19, 21, 22, 32, 43, 46, 50, 56
Severe Weather	1, 2, 8, 9, 6, 18, 19, 21, 22, 29, 34, 41, 42, 43, 45, 51, 52, 56	2, 8, 9, 19 29, 43, 45, 51, 56	2, 20, 23, 26, 31, 45, 49, 50, 51	2, 6, 8, 9 19, 43, 41, 56	2, 6, 9, 19, 24, 26, 28, 31, 43, 44, 45, 49, 50, 51, 52, 56	2, 8, 9, 10, 18 19 21, 22, 32, 43, 46, 50, 56
Tsunami	1, 2, 3, 4, 6, 8, 9, 19, 21, 22, 29, 30, 34, 43, 45, 51, 53, 54 56	2, 3, 4, 6, 8, 14, 18, 19, 21, 22, 25, 29, 30, 43, 45, 51, 56	2, 3, 4, 6, 14, 20, 23, 25, 26, 31, 45, 49, 50, 51	2, 5, 6, 8, 9, 13, 19, 25, 30, 43, 51, 56	2, 5, 6, 9, 14, 17, 18, 19, 20, 21, 22, 24, 25, 26, 28, 31. 32, 43, 44, 45, 49, 50, 52, 56	2, 3, 4, 6, 8, 9, 10, 14, 18, 19, 21, 22, 30, 32, 43, 46, 50, 56
Wildfire	1, 2, 8, 9, 11, 12, 13, 16, 21, 22, 33, 34, 35, 36, 37, 38, 39, 40 41, 42, 43, 45, 51, 56	2, 6, 8, 9, 11, 12, 13, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 42, 45, 53, 54, 56, 57	2, 11, 12, 13, 20, 23, 26, 31, 35, 36, 37, 38, 39, 40, 41, 42, 45, 49, 50	2, 8, 9 11, 13, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 47, 53, 56	2,6, 9, 11, 12, 24, 26, 28, 31, 32, 34, 35, 36, 37, 38, 39, 43, 44, 45, 49, 50, 52, 53, 54, 55, 56, 57	2, 6, 8, 9, 11, 12, 21, 22, 34, 41, 43, 46, 50, 53, 56

a. See Section 17.5 for description of mitigation types

CHAPTER 18.
IMPLEMENTATION

18.1 PLAN ADOPTION

A hazard mitigation plan must document that it has been formally adopted by the governing body of the jurisdiction requesting federal approval of the plan (44 CFR Section 201.7(c)(5)). DMA compliance and its benefits cannot be achieved until the plan is adopted. This plan was adopted by the Tribal Council in February 2013, with language allowing for plan modification if requested by FEMA without the necessity of re-adoption by the Tribe. A copy of the resolution is provided in Figure 18-1.

Insert Plan Adoption Resolution

Figure 18-1. Resolution Adopting Hazard Mitigation Plan

18.2 PLAN MAINTENANCE STRATEGY

A hazard mitigation plan must present a plan maintenance process that includes the following (44 CFR Section 201.7(c)(4)):

- A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan over a 5-year cycle
- A process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate
- A discussion on how the community will continue public participation in the plan maintenance process.

This chapter details the formal process that will ensure that the Hazard Mitigation Plan remains an active and relevant document and that the Yurok Tribe maintains its eligibility for applicable funding sources. The plan maintenance process includes a schedule for monitoring and evaluating the plan annually and producing an updated plan every five years. This chapter also describes how public participation will be integrated throughout the plan maintenance and implementation process. It also explains how the mitigation strategies outlined in this Plan will be incorporated into existing planning mechanisms and programs, such as comprehensive land-use planning processes, capital improvement planning, and building code enforcement and implementation. The Plan's format allows sections to be reviewed and updated when new data become available, resulting in a plan that will remain current and relevant.

18.2.1 Plan Implementation

The effectiveness of the hazard mitigation plan depends on its implementation and incorporation of its action items into existing local plans, policies and programs. Together, the action items in the Plan provide a framework for activities that the Yurok Tribe can implement over the next 5 years. The planning team and the Steering Committee have established goals and objectives and have prioritized mitigation actions that will be implemented through existing plans, policies, and programs.

The Public Safety and Planning Departments will have lead responsibility for overseeing the Plan implementation and maintenance strategy. Plan implementation and evaluation will be a shared responsibility among all agencies identified as lead agencies in the mitigation action plan.

18.2.2 Steering Committee

The Steering Committee is a total volunteer body that oversaw the development of the Plan and made recommendations on key elements of the plan, including the maintenance strategy. It was the Steering Committee's position that an oversight committee with representation similar to the initial Steering Committee should have an active role in the Plan maintenance strategy. Therefore, it is recommended that a steering committee remain a viable body involved in key elements of the Plan maintenance strategy. The new steering committee should include representation from stakeholders in the planning area.

The principal role of the new steering committee in this plan maintenance strategy will be to review the annual progress report and provide input to the Public Safety and Planning Departments on possible enhancements to be considered at the next update. Future plan updates will be overseen by a steering committee similar to the one that participated in this plan development process, so keeping an interim steering committee intact will provide a head start on future updates. It will be the steering committee's role to review the progress report in an effort to identify issues needing to be addressed by future plan updates.

18.2.3 Fire Safe Council

During the life cycle of this plan, the Tribe will attempt to develop Fire Safe Councils in the various Villages throughout the Reservation in an effort to enhance community awareness of the fire danager, as well as to work with the communities to prioritize mitigation efforts such as fuel reduction projects within the villages.

18.2.4 Annual Progress Report

The minimum task of the ongoing annual steering committee meeting will be the evaluation of the progress of its individual action plan during a 12-month performance period. This review will include the following:

- Summary of any hazard events that occurred during the performance period and the impact these events had on the planning area
- Review of mitigation success stories
- Review of continuing public involvement
- Brief discussion about why targeted strategies were not completed
- Re-evaluation of the action plan to determine if the timeline for identified projects needs to be amended (such as changing a long-term project to a short-term one because of new funding)
- Recommendations for new projects
- Changes in or potential for new funding options (grant opportunities)
- Impact of any other planning programs or initiatives that involve hazard mitigation.

The planning team has created a template for preparing a progress report (see Appendix C). The plan maintenance steering committee will provide feedback to the planning team on items included in the template. The planning team will then prepare a formal annual report on the progress of the plan. This report should be used as follows:

- Posted on the Tribe's website page dedicated to the hazard mitigation plan
- Provided to the local media through a press release
- Presented to Tribal Council to inform them of the progress of actions implemented during the reporting period

Annual progress reporting is not a requirement specified under 44 CFR. However, it may enhance opportunities for funding. While failure to implement this component of the plan maintenance strategy will not jeopardize compliance under the DMA, it may jeopardize the opportunity to leverage funding opportunities with other agencies.

18.2.5 Plan Update

Local hazard mitigation plans be reviewed, revised if appropriate, and resubmitted for approval in order to remain eligible for benefits under the DMA (44 CFR, Section 201.7(d)(3)). The Yurok Tribe intends to update the hazard mitigation plan on a 5-year cycle from the date of initial plan adoption. This cycle may be accelerated to less than 5 years based on the following triggers:

- A Presidential Disaster Declaration that impacts the planning area
- A hazard event that causes loss of life

- A comprehensive update of the Yurok Tribe comprehensive plan.

It will not be the intent of future updates to develop a complete new hazard mitigation plan for the planning area. The update will, at a minimum, include the following elements:

- The update process will be convened through a steering committee.
- The hazard risk assessment will be reviewed and, if necessary, updated using best available information and technologies.
- The action plan will be reviewed and revised to account for any initiatives completed, dropped, or changed and to account for changes in the risk assessment or new policies identified under other planning mechanisms (such as the comprehensive plan).
- The draft update will be sent to appropriate agencies and organizations for comment.
- The public will be given an opportunity to comment on the update prior to adoption.
- Tribal Council will adopt the updated plan.

18.2.6 Continuing Public Involvement

The public will continue to be apprised of the plan's progress through the Tribe's website and by providing copies of annual progress reports at various public outreach meetings. The website will not only house the final plan, it will become the one-stop shop for information regarding the plan and plan implementation. Copies of the plan will be distributed to the various Yurok Tribe departments and at annual public meetings. Upon initiation of future update processes, a new public involvement strategy will be initiated based on guidance from a new steering committee. This strategy will be based on the needs and capabilities of the Yurok Tribe at the time of the update. At a minimum, this strategy will include the use of local media outlets within the planning area.

18.2.7 Incorporation into Other Planning Mechanisms

The information on hazard, risk, vulnerability, and mitigation contained in this plan is based on the best science and technology available at the time this plan was prepared. The Yurok Tribe Comprehensive Plan is considered to be an integral part of this plan. The Yurok Tribe, through adoption of a comprehensive plan, through its current development of a new zoning ordinance, and through its various transportation planning efforts has planned for the impact of natural hazards. The plan development process provided the opportunity to review and expand on policies in these planning mechanisms. The comprehensive plan and the hazard mitigation plan are complementary documents that work together to achieve the goal of reducing risk exposure. An update to a comprehensive plan may trigger an update to the hazard mitigation plan.

The Yurok Tribe will create a linkage between the hazard mitigation plan and the comprehensive plan by identifying a mitigation initiative as such and giving that initiative a high priority. Other planning processes and programs to be coordinated with the recommendations of the hazard mitigation plan include the following:

- Emergency response plans
- Capital improvement programs
- Tribal codes
- Community design guidelines
- Water-efficient landscape design guidelines

- Stormwater management programs
- Water system vulnerability assessments
- Community Wildfire Protection Plans
- Vegetation Studies
- Transportation Plans
- Master fire protection plans.

Some action items do not need to be implemented through regulation. Instead, these items can be implemented through the creation of new educational programs, continued interagency coordination, or improved public participation. As information becomes available from other planning mechanisms that can enhance this plan, that information will be incorporated via the update process.

REFERENCES

Center for Disease Control. 2009. Deaths Related to 2009 Pandemic Influenza A (H1N1) Among American Indian/Alaska Natives –12 States. CDC Accessed 21 Aug. 2012. Available online at: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5848a1.htm?s_cid=mm5848a1_e

FEMA 2010. http://www.fema.gov. Website accessed 2009,2010, 2011

FEMA. 2001. Understanding Your Risks; Identifying Hazards and Determining your Risks. FEMA (386-2). August 2001

FEMA. 2002. Getting Started; Building support for Mitigation Planning; FEMA (386-1). September 2002

FEMA. 2003. Developing the Mitigation Plan; Identifying Mitigation Actions and Implementing Strategies. FEMA (386-3). April 2003

FEMA. 2004. Using HAZUS-MH for Risk Assessment, How to Guide, FEMA (433). August 2004

FEMA. 2007. FEMA, National Flood Insurance Program, Community Rating System; CRS Coordinator's Manual FIA-15/2007 OMB No. 1660-0022

International Strategy for Disaster Reduction. 11/11/2008. "Disaster Risk Reduction Strategies and Risk Management Practices: Critical Elements for Adaptation to Climate Change"

NASA, 2004. http://earthobservatory.nasa.gov/Newsroom/view.php?id=25145 NASA Earth Observatory News Web Site Item, dated August 2, 2004.

NOAA. 2010. http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms. NOAA, National Climatic Data Center website, accessed 2010

OTA (Congressional Office of Technology Assessment). 1993. Preparing for an Uncertain Climate, Vol. I. OTA–O–567. U.S. Government Printing Office, Washington, D.C.

Spatial Hazard Events and Losses Database for the United States maintained by the University of South Carolina's (USC) Hazard Research Lab

U.S. Census. 2012. 2006 – 2010 American Community Survey 5-Year Estimates for Yurok Reservation, CA. Prepared by U.S. Census Bureau. Accessed March 2012 at http://factfinder2.census.gov

USGS. 1989. The Severity of an Earthquake. U.S. Government Printing Office: 1989-288-913. Accessed online at: http://pubs.usgs.gov/gip/earthq4/severity_text.html

USGS. 2008. An Atlas of ShakeMaps for Selected Global Earthquakes. U.S. Geological Survey Open-File Report 2008-1236. Prepared by Allen, T.I., Wald, D.J., Hotovec, A.J., Lin, K., Earle, P.S. and Marano, K.D.

USGS. 2010. PAGER—Rapid Assessment of an Earthquake's Impact. U.S. Geological Survey Fact Sheet 2010-3036. September 2010.

APPENDIX A.
ACRONYMS AND DEFINITIONS

APPENDIX A.
ACRONYMS AND DEFINITIONS

ACRONYMS

CFR—Code of Federal Regulations

cfs—cubic feet per second

CIP—Capital Improvement Plan

CRS—Community Rating System

DFIRM—Digital Flood Insurance Rate Maps

DHS—Department of Homeland Security

DMA —Disaster Mitigation Act

EAP—Emergency Action Plan

EPA—U.S. Environmental Protection Agency

ESA—Endangered Species Act

FEMA—Federal Emergency Management Agency

FERC—Federal Energy Regulatory Commission

FIRM—Flood Insurance Rate Map

FIS—Flood Insurance Study

GIS—Geographic Information System

HAZUS-MH—Hazards, United States-Multi Hazard

HMGP—Hazard Mitigation Grant Program

IBC—International Building Code

IRC—International Residential Code

MM—Modified Mercalli Scale

NEHRP—National Earthquake Hazards Reduction Program

NFIP—National Flood Insurance Program

NOAA—National Oceanic and Atmospheric Administration

NWS—National Weather Service

PDM—Pre-Disaster Mitigation Grant Program

PDI—Palmer Drought Index

PGA—Peak Ground Acceleration

PHDI—Palmer Hydrological Drought Index

SFHA—Special Flood Hazard Area

SHELDUS—Special Hazard Events and Losses Database for the US

SPI—Standardized Precipitation Index

USGS—U.S. Geological Survey

DEFINITIONS

100-Year Flood: The term "100-year flood" can be misleading. The 100-year flood does not necessarily occur once every 100 years. Rather, it is the flood that has a 1 percent chance of being equaled or exceeded in any given year. Thus, the 100-year flood could occur more than once in a relatively short period of time. The Federal Emergency Management Agency (FEMA) defines it as the 1 percent annual chance flood, which is now the standard definition used by most agencies and by the National Flood Insurance Program (NFIP).

Acre-Foot: An acre-foot is the amount of water it takes to cover 1 acre to a depth of 1 foot. This measure is used to describe the quantity of storage in a water reservoir. An acre-foot is a unit of volume. One acre foot equals 7,758 barrels; 325,829 gallons; or 43,560 cubic feet. An average household of four will use approximately 1 acre-foot of water per year.

Asset: An asset is any man-made or natural feature that has value, including, but not limited to, people; buildings; infrastructure, such as bridges, roads, sewers, and water systems; lifelines, such as electricity and communication resources; and environmental, cultural, or recreational features such as parks, wetlands, and landmarks.

Base Flood: The flood having a 1% chance of being equaled or exceeded in any given year, also known as the "100-year" or "1% chance" flood. The base flood is a statistical concept used to ensure that all properties subject to the National Flood Insurance Program (NFIP) are protected to the same degree against flooding.

Basin: A basin is the area within which all surface water—whether from rainfall, snowmelt, springs, or other sources—flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains, and ridges. Basins are also referred to as "watersheds" and "drainage basins."

Benefit: A benefit is a net project outcome and is usually defined in monetary terms. Benefits may include direct and indirect effects. For the purposes of benefit-cost analysis of proposed mitigation measures, benefits are limited to specific, measurable, risk reduction factors, including reduction in expected property losses (buildings, contents, and functions) and protection of human life.

Benefit/Cost Analysis: A benefit/cost analysis is a systematic, quantitative method of comparing projected benefits to projected costs of a project or policy. It is used as a measure of cost effectiveness.

Building: A building is defined as a structure that is walled and roofed, principally aboveground, and permanently fixed to a site. The term includes manufactured homes on permanent foundations on which the wheels and axles carry no weight.

Capability Assessment: A capability assessment provides a description and analysis of a community's current capacity to address threats associated with hazards. The assessment includes two components: an inventory of an agency's mission, programs, and policies, and an analysis of its capacity to carry them out. A capability assessment is an integral part of the planning process in which a community's actions to

reduce losses are identified, reviewed, and analyzed, and the framework for implementation is identified. The following capabilities were reviewed under this assessment:

- Legal and regulatory capability
- Administrative and technical capability
- Fiscal capability

Community Rating System (CRS): The CRS is a voluntary program under the NFIP that rewards participating communities (provides incentives) for exceeding the minimum requirements of the NFIP and completing activities that reduce flood hazard risk by providing flood insurance premium discounts.

Critical Area: An area defined by state or local regulations as deserving special protection because of unique natural features or its value as habitat for a wide range of species of flora and fauna. A sensitive/critical area is usually subject to more restrictive development regulations.

Critical Facility: Facilities and infrastructure that are critical to the health and welfare of the population. These become especially important after any hazard event occurs. For the purposes of this plan, critical facilities include:

- Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic and/or water reactive materials;
- Hospitals, nursing homes, and housing likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a hazard event.
- Police stations, fire stations, vehicle and equipment storage facilities, and emergency operations centers that are needed for disaster response before, during, and after hazard events, and
- Public and private utilities, facilities and infrastructure that are vital to maintaining or restoring normal services to areas damaged by hazard events.
- Government facilities.

For the purposes of this planning effort, the steering committee elected to define all structures on the reservation, including culturally significant areas, as critical facilities due to the impact the loss of one structure would have on the Tribe.

Cubic Feet per Second (cfs): Discharge or river flow is commonly measured in cfs. One cubic foot is about 7.5 gallons of liquid.

Dam: Any artificial barrier or controlling mechanism that can or does impound 10 acre-feet or more of water.

Dam Failure: Dam failure refers to a partial or complete breach in a dam (or levee) that impacts its integrity. Dam failures occur for a number of reasons, such as flash flooding, inadequate spillway size, mechanical failure of valves or other equipment, freezing and thawing cycles, earthquakes, and intentional destruction.

Debris Avalanche: Volcanoes are prone to debris and mountain rock avalanches that can approach speeds of 100 mph.

Debris Flow: Dense mixtures of water-saturated debris that move down-valley; looking and behaving much like flowing concrete. They form when loose masses of unconsolidated material are saturated,

become unstable, and move down slope. The source of water varies but includes rainfall, melting snow or ice, and glacial outburst floods.

Debris Slide: Debris slides consist of unconsolidated rock or soil that has moved rapidly down slope. They occur on slopes greater than 65 percent.

Disaster Mitigation Act of 2000 (DMA); The DMA is Public Law 106-390 and is the latest federal legislation enacted to encourage and promote proactive, pre-disaster planning as a condition of receiving financial assistance under the Robert T. Stafford Act. The DMA emphasizes planning for disasters before they occur. Under the DMA, a pre-disaster hazard mitigation program and new requirements for the national post-disaster hazard mitigation grant program (HMGP) were established.

Drainage Basin: A basin is the area within which all surface water- whether from rainfall, snowmelt, springs or other sources- flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains and ridges. Drainage basins are also referred to as **watersheds** or **basins**.

Drought: Drought is a period of time without substantial rainfall or snowfall from one year to the next. Drought can also be defined as the cumulative impacts of several dry years or a deficiency of precipitation over an extended period of time, which in turn results in water shortages for some activity, group, or environmental function. A hydrological drought is caused by deficiencies in surface and subsurface water supplies. A socioeconomic drought impacts the health, well being, and quality of life or starts to have an adverse impact on a region. Drought is a normal, recurrent feature of climate and occurs almost everywhere.

Earthquake: An earthquake is defined as a sudden slip on a fault, volcanic or magmatic activity, and sudden stress changes in the earth that result in ground shaking and radiated seismic energy. Earthquakes can last from a few seconds to over 5 minutes, and have been known to occur as a series of tremors over a period of several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties may result from falling objects and debris as shocks shake, damage, or demolish buildings and other structures.

Exposure: Exposure is defined as the number and dollar value of assets considered to be at risk during the occurrence of a specific hazard.

Extent: The extent is the size of an area affected by a hazard.

Fire Behavior: Fire behavior refers to the physical characteristics of a fire and is a function of the interaction between the fuel characteristics (such as type of vegetation and structures that could burn), topography, and weather. Variables that affect fire behavior include the rate of spread, intensity, fuel consumption, and fire type (such as underbrush versus crown fire).

Fire Frequency: Fire frequency is the broad measure of the rate of fire occurrence in a particular area. An estimate of the areas most likely to burn is based on past fire history or fire rotation in the area, fuel conditions, weather, ignition sources (such as human or lightning), fire suppression response, and other factors.

Flash Flood: A flash flood occurs with little or no warning when water levels rise at an extremely fast rate

Flood Insurance Rate Map (FIRM): FIRMs are the official maps on which the Federal Emergency Management Agency (FEMA) has delineated the Special Flood Hazard Area (SFHA).

Flood Insurance Study: A report published by the Federal Insurance and Mitigation Administration for a community in conjunction with the community's Flood Insurance rate Map. The study contains such background data as the base flood discharges and water surface elevations that were used to prepare the FIRM. In most cases, a community FIRM with detailed mapping will have a corresponding flood insurance study.

Floodplain: Any land area susceptible to being inundated by flood waters from any source. A flood insurance rate map identifies most, but not necessarily all, of a community's floodplain as the Special Flood Hazard Area (SFHA).

Floodway: Floodways are areas within a floodplain that are reserved for the purpose of conveying flood discharge without increasing the base flood elevation more than 1 foot. Generally speaking, no development is allowed in floodways, as any structures located there would block the flow of floodwaters.

Floodway Fringe: Floodway fringe areas are located in the floodplain but outside of the floodway. Some development is generally allowed in these areas, with a variety of restrictions. On maps that have identified and delineated a floodway, this would be the area beyond the floodway boundary that can be subject to different regulations.

Fog: Fog refers to a cloud (or condensed water droplets) near the ground. Fog forms when air close to the ground can no longer hold all the moisture it contains. Fog occurs either when air is cooled to its dew point or the amount of moisture in the air increases. Heavy fog is particularly hazardous because it can restrict surface visibility. Severe fog incidents can close roads, cause vehicle accidents, cause airport delays, and impair the effectiveness of emergency response. Financial losses associated with transportation delays caused by fog have not been calculated in the United States but are known to be substantial.

Freeboard: Freeboard is the margin of safety added to the base flood elevation.

Frequency: For the purposes of this plan, frequency refers to how often a hazard of specific magnitude, duration, and/or extent is expected to occur on average. Statistically, a hazard with a 100-year frequency is expected to occur about once every 100 years on average and has a 1 percent chance of occurring any given year. Frequency reliability varies depending on the type of hazard considered.

Fujita Scale of Tornado Intensity: Tornado wind speeds are sometimes estimated on the basis of wind speed and damage sustained using the Fujita Scale. The scale rates the intensity or severity of tornado events using numeric values from F0 to F5 based on tornado wind speed and damage. An F0 tornado (wind speed less than 73 miles per hour (mph)) indicates minimal damage (such as broken tree limbs), and an F5 tornado (wind speeds of 261 to 318 mph) indicates severe damage.

Goal: A goal is a general guideline that explains what is to be achieved. Goals are usually broad-based, long-term, policy-type statements and represent global visions. Goals help define the benefits that a plan is trying to achieve. The success of a hazard mitigation plan is measured by the degree to which its goals have been met (that is, by the actual benefits in terms of actual hazard mitigation).

Geographic Information System (GIS): GIS is a computer software application that relates data regarding physical and other features on the earth to a database for mapping and analysis.

Hazard: A hazard is a source of potential danger or adverse condition that could harm people and/or cause property damage.

Hazard Mitigation Grant Program (HMGP): Authorized under Section 202 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, the HMGP is administered by FEMA and provides grants to states, tribes, and local governments to implement hazard mitigation actions after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to disasters and to enable mitigation activities to be implemented as a community recovers from a disaster

Hazards U.S. Multi-Hazard (HAZUS-MH) Loss Estimation Program: HAZUS-MH is a GIS-based program used to support the development of risk assessments as required under the DMA. The HAZUS-MH software program assesses risk in a quantitative manner to estimate damages and losses associated with natural hazards. HAZUS-MH is FEMA's nationally applicable, standardized methodology and software program and contains modules for estimating potential losses from earthquakes, floods, and wind hazards. HAZUS-MH has also been used to assess vulnerability (exposure) for other hazards.

Hydraulics: Hydraulics is the branch of science or engineering that addresses fluids (especially water) in motion in rivers or canals, works and machinery for conducting or raising water, the use of water as a prime mover, and other fluid-related areas.

Hydrology: Hydrology is the analysis of waters of the earth. For example, a flood discharge estimate is developed by conducting a hydrologic study.

Intensity: For the purposes of this plan, intensity refers to the measure of the effects of a hazard.

Inventory: The assets identified in a study region comprise an inventory. Inventories include assets that could be lost when a disaster occurs and community resources are at risk. Assets include people, buildings, transportation, and other valued community resources.

Landslide: Landslides can be described as the sliding movement of masses of loosened rock and soil down a hillside or slope. Fundamentally, slope failures occur when the strength of the soils forming the slope exceeds the pressure, such as weight or saturation, acting upon them.

Lightning: Lightning is an electrical discharge resulting from the buildup of positive and negative charges within a thunderstorm. When the buildup becomes strong enough, lightning appears as a "bolt," usually within or between clouds and the ground. A bolt of lightning instantaneously reaches temperatures approaching 50,000ºF. The rapid heating and cooling of air near lightning causes thunder. Lightning is a major threat during thunderstorms. In the United States, 75 to 100 Americans are struck and killed by lightning each year (see http://www.fema.gov/hazard/thunderstorms/thunder.shtm).

Liquefaction: Liquefaction is the complete failure of soils, occurring when soils lose shear strength and flow horizontally. It is most likely to occur in fine grain sands and silts, which behave like viscous fluids when liquefaction occurs. This situation is extremely hazardous to development on the soils that liquefy, and generally results in extreme property damage and threats to life and safety.

Local Government: Any county, municipality, city, town, township, public authority, school district, special district, intrastate district, council of governments (regardless of whether the council of governments is incorporated as a nonprofit corporation under State law), regional or interstate government entity, or agency or instrumentality of a local government; any Indian tribe or authorized tribal organization, or Alaska Native village or organization; and any rural community, unincorporated town or village, or other public entity.

Magnitude: Magnitude is the measure of the strength of an earthquake, and is typically measured by the Richter scale. As an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value.

Mass movement: A collective term for landslides, mudflows, debris flows, sinkholes and lahars.

Mitigation: A preventive action that can be taken in advance of an event that will reduce or eliminate the risk to life or property.

Mitigation Actions: Mitigation actions are specific actions to achieve goals and objectives that minimize the effects from a disaster and reduce the loss of life and property.

Objective: For the purposes of this plan, an objective is defined as a short-term aim that, when combined with other objectives, forms a strategy or course of action to meet a goal. Unlike goals, objectives are specific and measurable.

Peak Ground Acceleration: Peak Ground Acceleration (PGA) is a measure of the highest amplitude of ground shaking that accompanies an earthquake, based on a percentage of the force of gravity.

Preparedness: Preparedness refers to actions that strengthen the capability of government, citizens, and communities to respond to disasters.

Presidential Disaster Declaration: These declarations are typically made for events that cause more damage than state and local governments and resources can handle without federal government assistance. Generally, no specific dollar loss threshold has been established for such declarations. A Presidential Disaster Declaration puts into motion long-term federal recovery programs, some of which are matched by state programs, designed to help disaster victims, businesses, and public entities.

Probability of Occurrence: The probability of occurrence is a statistical measure or estimate of the likelihood that a hazard will occur. This probability is generally based on past hazard events in the area and a forecast of events that could occur in the future. A probability factor based on yearly values of occurrence is used to estimate probability of occurrence.

Repetitive Loss Property: Any NFIP-insured property that, since 1978 and regardless of any changes of ownership during that period, has experienced:

- Four or more paid flood losses in excess of $1000.00; or
- Two paid flood losses in excess of $1000.00 within any 10-year period since 1978 or
- Three or more paid losses that equal or exceed the current value of the insured property.

Return Period (or Mean Return Period): This term refers to the average period of time in years between occurrences of a particular hazard (equal to the inverse of the annual frequency of occurrence).

Riverine: Of or produced by a river. Riverine floodplains have readily identifiable channels. Floodway maps can only be prepared for riverine floodplains.

Risk: Risk is the estimated impact that a hazard would have on people, services, facilities, and structures in a community. Risk measures the likelihood of a hazard occurring and resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate, or low likelihood of sustaining damage above a particular threshold due to occurrence of a specific type of

hazard. Risk also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.

Risk Assessment: Risk assessment is the process of measuring potential loss of life, personal injury, economic injury, and property damage resulting from hazards. This process assesses the vulnerability of people, buildings, and infrastructure to hazards and focuses on (1) hazard identification; (2) impacts of hazards on physical, social, and economic assets; (3) vulnerability identification; and (4) estimates of the cost of damage or costs that could be avoided through mitigation.

Risk Ranking: This ranking serves two purposes, first to describe the probability that a hazard will occur, and second to describe the impact a hazard will have on people, property, and the economy. Risk estimates are based on the methodology used to prepare the risk assessment for this plan. The following equation shows the risk ranking calculation:

Risk Ranking = Probability + Impact (people + property + economy)

Robert T. Stafford Act: The Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 100-107, was signed into law on November 23, 1988. This law amended the Disaster Relief Act of 1974, Public Law 93-288. The Stafford Act is the statutory authority for most federal disaster response activities, especially as they pertain to FEMA and its programs.

Sinkhole: A collapse depression in the ground with no visible outlet. Its drainage is subterranean. It is commonly vertical-sided or funnel-shaped.

Special Flood Hazard Area: The base floodplain delineated on a Flood Insurance Rate Map. The SFHA is mapped as a Zone A in riverine situations and zone V in coastal situations. The SFHA may or may not encompass all of a community's flood problems

Stakeholder: Business leaders, civic groups, academia, non-profit organizations, major employers, managers of critical facilities, farmers, developers, special purpose districts, and others whose actions could impact hazard mitigation.

Stream Bank Erosion: Stream bank erosion is common along rivers, streams and drains where banks have been eroded, sloughed or undercut. However, it is important to remember that a stream is a dynamic and constantly changing system. It is natural for a stream to want to meander, so not all eroding banks are "bad" and in need of repair. Generally, stream bank erosion becomes a problem where development has limited the meandering nature of streams, where streams have been channelized, or where stream bank structures (like bridges, culverts, etc.) are located in places where they can actually cause damage to downstream areas. Stabilizing these areas can help protect watercourses from continued sedimentation, damage to adjacent land uses, control unwanted meander, and improvement of habitat for fish and wildlife.

Steep Slope: Different communities and agencies define it differently, depending on what it is being applied to, but generally a steep slope is a slope in which the percent slope equals or exceeds 25%. For this study, steep slope is defined as slopes greater than 33%.

Sustainable Hazard Mitigation: This concept includes the sound management of natural resources, local economic and social resiliency, and the recognition that hazards and mitigation must be understood in the largest possible social and economic context.

Thunderstorm: A thunderstorm is a storm with lightning and thunder produced by cumulonimbus clouds. Thunderstorms usually produce gusty winds, heavy rains, and sometimes hail. Thunderstorms are usually short in duration (seldom more than 2 hours). Heavy rains associated with thunderstorms can lead to flash flooding during the wet or dry seasons.

Tornado: A tornado is a violently rotating column of air extending between and in contact with a cloud and the surface of the earth. Tornadoes are often (but not always) visible as funnel clouds. On a local scale, tornadoes are the most intense of all atmospheric circulations, and winds can reach destructive speeds of more than 300 mph. A tornado's vortex is typically a few hundred meters in diameter, and damage paths can be up to 1 mile wide and 50 miles long.

Vulnerability: Vulnerability describes how exposed or susceptible an asset is to damage. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. Like indirect damages, the vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power. Flooding of an electric substation would affect not only the substation itself but businesses as well. Often, indirect effects can be much more widespread and damaging than direct effects.

Watershed: A watershed is an area that drains downgradient from areas of higher land to areas of lower land to the lowest point, a common drainage basin.

Wildfire: These terms refer to any uncontrolled fire occurring on undeveloped land that requires fire suppression. The potential for wildfire is influenced by three factors: the presence of fuel, topography, and air mass. Fuel can include living and dead vegetation on the ground, along the surface as brush and small trees, and in the air such as tree canopies. Topography includes both slope and elevation. Air mass includes temperature, relative humidity, wind speed and direction, cloud cover, precipitation amount, duration, and the stability of the atmosphere at the time of the fire. Wildfires can be ignited by lightning and, most frequently, by human activity including smoking, campfires, equipment use, and arson.

Windstorm: Windstorms are generally short-duration events involving straight-line winds or gusts exceeding 50 mph. These gusts can produce winds of sufficient strength to cause property damage. Windstorms are especially dangerous in areas with significant tree stands, exposed property, poorly constructed buildings, mobile homes (manufactured housing units), major infrastructure, and aboveground utility lines. A windstorm can topple trees and power lines; cause damage to residential, commercial, critical facilities; and leave tons of debris in its wake.

Zoning Ordinance: The zoning ordinance designates allowable land use and intensities for a local jurisdiction. Zoning ordinances consist of two components: a zoning text and a zoning map.

APPENDIX B.
PUBLIC OUTREACH

APPENDIX B.
PUBLIC OUTREACH

Yurok Tribe Survey

SurveyMonkey

1. Are you a Federally recognized member of the Yurok Tribe?

	Response Percent	Response Count
Yes	60.0%	3
No	40.0%	2
answered question		5
skipped question		0

2. Do you live on the Reservation?

	Response Percent	Response Count
Yes	60.0%	3
No	40.0%	2
answered question		5
skipped question		0

3. Do you work on the Reservation?

	Response Percent	Response Count
Yes	60.0%	3
No	40.0%	2
answered question		5
skipped question		0

4. Do you make use of the services provided by the Tribe?

	Response Percent	Response Count
Yes	100.0%	5
No	0.0%	0
	answered question	5
	skipped question	0

5. Which of the following natural hazard events have you or has anyone in your household experienced in the past 20 years? (Check all that apply)

	Response Percent	Response Count
Avalanche	0.0%	0
Dam/Levee Failure	0.0%	0
Drought	20.0%	1
Earthquake	60.0%	3
Flood	40.0%	2
Hazardous Materials	0.0%	0
Household Fire	20.0%	1
Landslide	40.0%	2
Severe Weather (wind, lightning, winter storm, etc.)	**80.0%**	**4**
Tsunami/Seiche (waves generated by wind or seismic activity)	40.0%	2
Volcanic Eruption (lahar, ash fall)	0.0%	0
Wildland Fire	60.0%	3
None	0.0%	0
Other (please specify)	0.0%	0
	answered question	5
	skipped question	0

6. How many times have you been impacted by disaster events?

	Response Percent	Response Count
0	0.0%	0
1-3	40.0%	2
4-5	40.0%	2
5 or more	20.0%	1
	answered question	5
	skipped question	0

7. Have these occurred while you have lived (or worked) on the Yurok Reservation?

	Response Percent	Response Count
Yes	80.0%	4
No	20.0%	1
	answered question	5
	skipped question	0

8. If the answer to the preceding question is in the affirmative, has the hazard event impacted your ability to use your residence because of damages?

	Response Percent	Response Count
Yes	40.0%	2
No	60.0%	3
	answered question	5
	skipped question	0

9. How prepared is your household to deal with a natural hazard event?

	Not at all prepared	Somewhat prepared	Adequately prepared	Well prepared	Very well prepared	Rating Average	Rating Count
Check one:	**60.0% (3)**	20.0% (1)	20.0% (1)	0.0% (0)	0.0% (0)	1.60	5
						answered question	**5**
						skipped question	**0**

10. Which of the following have provided you with useful information to help you be prepared for a natural hazard event? (Check all that apply)

	Response Percent	Response Count
Emergency preparedness information from a government source (e.g., federal, state, or local emergency management)	25.0%	1
Personal experience with one or more natural hazards/disasters	25.0%	1
Locally provided news or other media information	**50.0%**	**2**
Schools and other academic institutions	25.0%	1
Attended meetings that have dealt with disaster preparedness	**50.0%**	**2**
Community Emergency Response Training (CERT)	0.0%	0
None	0.0%	0
Other (please specify)	0.0%	0
	answered question	**4**
	skipped question	**1**

5 of 22

11. Which of the following steps has your household taken to prepare for a hazard event? (Check all that apply)

	Response Percent	Response Count
Received first aid/CPR training	40.0%	2
Made a fire escape plan	20.0%	1
Removed/reduced vegetation 100 feet from immediate area of house	20.0%	1
Designated a meeting place	0.0%	0
Identified utility shutoffs	20.0%	1
Sand bags	0.0%	0
Cleared Roof/Gutters	0.0%	0
Prepared a disaster supply kit	20.0%	1
Installed smoke detectors on each level of the house	40.0%	2
Stored food and water	0.0%	0
Stored flashlights and batteries	0.0%	0
Stored a battery-powered radio	0.0%	0
Stored a fire extinguisher	**60.0%**	**3**
Stored medical supplies (first aid kit, medications)	0.0%	0
Planted fire resistent landscaping	0.0%	0
Natural hazard insurance (Flood, Earthquake, Wildfire)	0.0%	0
None	20.0%	1
Other (please specify)	0.0%	0
	answered question	**5**
	skipped question	**0**

12. How concerned are you about the following natural hazards on the Reservation? (Check or response for each hazard)

	Not Concerned	Somewhat Concerned	Concerned	Very Concerned	Extremely Concerned	Rating Average	R C
Avalanche	**100.0% (3)**	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	1.00	
Climate Change	0.0% (0)	**66.7% (2)**	0.0% (0)	33.3% (1)	0.0% (0)	2.67	
Dam/Levee Failure	0.0% (0)	25.0% (1)	**75.0% (3)**	0.0% (0)	0.0% (0)	2.75	
Drought	0.0% (0)	**33.3% (1)**	**33.3% (1)**	**33.3% (1)**	0.0% (0)	3.00	
Earthquake	0.0% (0)	0.0% (0)	**40.0% (2)**	**40.0% (2)**	20.0% (1)	3.80	
Flood	0.0% (0)	0.0% (0)	**40.0% (2)**	**40.0% (2)**	20.0% (1)	3.80	
Hazardous Materials	0.0% (0)	0.0% (0)	**50.0% (2)**	**50.0% (2)**	0.0% (0)	3.50	
Household Fire	0.0% (0)	0.0% (0)	**33.3% (1)**	**33.3% (1)**	**33.3% (1)**	4.00	
Landslide	0.0% (0)	0.0% (0)	**33.3% (1)**	**33.3% (1)**	**33.3% (1)**	4.00	
Severe Weather	0.0% (0)	0.0% (0)	0.0% (0)	**50.0% (1)**	**50.0% (1)**	4.50	
Tsunami/Seiche	**33.3% (1)**	**33.3% (1)**	0.0% (0)	0.0% (0)	**33.3% (1)**	2.67	
Volcanic Eruption	**66.7% (2)**	33.3% (1)	0.0% (0)	0.0% (0)	0.0% (0)	1.33	
Wildland Fire	0.0% (0)	0.0% (0)	25.0% (1)	**50.0% (2)**	25.0% (1)	4.00	
Other	**100.0% (1)**	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	1.00	

(Please specify other natural hazard)

answered question

skipped question

13. Which of the following methods do you think are most effective for providing hazard and disaster information? (Check all that apply)

	Response Percent	Response Count
Newspaper	40.0%	2
Informational Brochures	0.0%	0
Tribal Newsletters	40.0%	2
Public Meetings	20.0%	1
Workshops	20.0%	1
Schools	40.0%	2
TV News	40.0%	2
TV Ads	20.0%	1
Radio News	**80.0%**	**4**
Radio Ads	40.0%	2
Internet	40.0%	2
Outdoor Advertisements	60.0%	3
Fire Department/Rescue	60.0%	3
Church (faith-based institutions)	20.0%	1
CERT Classes	0.0%	0
Public Awareness Campaign (e.g., Flood Awareness Week, Winter Storm Preparedness Month)	0.0%	0
Books	0.0%	0
Tribal Meetings	40.0%	2
Academic Institutions	20.0%	1
Public Library	0.0%	0
Red Cross Information	0.0%	0

8 of 22

Community Safety Events	40.0%	2
Booths at Gatherings	40.0%	2
Word of Mouth	40.0%	2
Other (please specify)	0.0%	0
	answered question	5
	skipped question	0

14. Is your property located in or near a floodplain?

	Response Percent	Response Count
Yes	40.0%	2
No	40.0%	2
Not Sure	20.0%	1
	answered question	5
	skipped question	0

15. Is your residence in or near a high fire danager area?

	Response Percent	Response Count
Yes	80.0%	4
No	20.0%	1
	answered question	5
	skipped question	0

16. Do you have homeowner's or renter's insurance?

	Response Percent	Response Count
Homeowners	**100.0%**	**3**
Renters	0.0%	0
	answered question	**3**
	skipped question	**2**

17. Do you have trees within 75 feet of your residence?

	Response Percent	Response Count
Yes	**80.0%**	**4**
No	20.0%	1
	answered question	**5**
	skipped question	**0**

18. What type of roof does your home have?

	Response Percent	Response Count
Composite	**80.0%**	**4**
Wood shake/shingles	20.0%	1
Ceramic tiles	0.0%	0
Aluminum, tin or other metal	0.0%	0
Other	0.0%	0
	answered question	**5**
	skipped question	**0**

19. Do you have a lawn (grass) surrounding your home?

	Response Percent	Response Count
Yes	100.0%	5
No	0.0%	0
answered question		5
skipped question		0

20. Do livestock (cattle, horses, sheep) graze the grasses and shrubs around your home?

	Response Percent	Response Count
Yes	20.0%	1
No	80.0%	4
answered question		5
skipped question		0

21. How close is your house to a main road? (How many feet or miles?)

	Response Count
	5
answered question	5
skipped question	0

22. If the roadway to your residence is over 400 feet long, does it have turnouts that would allow two large trucks to pass each other?

	Response Percent	Response Count
Yes	50.0%	2
No	50.0%	2
	answered question	4
	skipped question	1

23. What type of surfacing does the roadway in front of your residence have?

	Response Percent	Response Count
Dirt	20.0%	1
Gravel/rock	0.0%	0
Paved	80.0%	4
	answered question	5
	skipped question	0

24. Please indicate which of the following items are available at or near your home that could be used in fighting a wildfire that threatens your home (mark all that apply).

	Response Percent	Response Count
Hand tools (shovels, axe, etc.)	75.0%	3
Portable water tank	0.0%	0
Fixed/Stationary water tank	0.0%	0
Nearby pond, swimming pool or stream water supply	0.0%	0
Well or cistern	0.0%	0
Fire department	75.0%	3
Fire hydrant	25.0%	1
Equipment suitable for creating fire breaks (bulldozer, cat, farm tractor, etc.)	0.0%	0
	answered question	4
	skipped question	1

25. Do you conduct periodic fuels reduction activities near your home site such as:

	Response Percent	Response Count
Clearing and removing brush	**100.0%**	**2**
Clearing and removing downed tree limbs on your property	0.0%	0
Trimming tree branches away from your home	0.0%	0
Removing trees that are dead or infested that pose a risk to your home	0.0%	0
	answered question	**2**
	skipped question	**3**

26. If the primary access to your home were cut off because of wildfire or other hazard, would you have an alternate escape route?

	Response Percent	Response Count
Yes	40.0%	2
No	**60.0%**	**3**
	answered question	**5**
	skipped question	**0**

27. When you moved into your home, did you consider the impact a natural disaster could have on your home?

	Response Percent	Response Count
Yes	20.0%	1
No	**60.0%**	**3**
Not Sure	20.0%	1
	answered question	**5**
	skipped question	**0**

28. How much money would you be willing to spend to make modifications around your home which will reduce risks associated with natural disasters? (For example, by elevating a home above the flood level, performing seismic upgrades, or replacing a combustible roof with non-combustible roofing.)

	Response Percent	Response Count
$10,000 or above	0.0%	0
$5,000 to $9,999	0.0%	0
$1,000 to $4,999	0.0%	0
Less than $1,000	**40.0%**	**2**
Nothing - not willing to make changes	20.0%	1
Not Sure	**40.0%**	**2**
	answered question	**5**
	skipped question	**0**

29. Which of the following incentives would encourage you to spend money to retrofit your home to protect against natural disasters? (Check all that apply)

	Response Percent	Response Count
Insurance premium discount	20.0%	1
Mortgage discount	20.0%	1
Low interest rate loan	20.0%	1
Grant funding	**60.0%**	**3**
Reducing the impact from hazards	20.0%	1
None	0.0%	0
Other (please specify)	0.0%	0
	answered question	**5**
	skipped question	**0**

30. If your property were located in a designated "high hazard" area or had received repetitive damages from a natural hazard event, would you consider a "buyout" offered by a public agency?

	Response Percent	Response Count
Yes	20.0%	1
No	20.0%	1
Not Sure	**60.0%**	**3**
	answered question	**5**
	skipped question	**0**

31. If your property is in a high-hazard area, and you would be interested in a buy-out option or other type of mitigation project, would you like more information from your Tribal Emergency Manager on this opportunity? If so, please provide your name and contact information below.

	Response Count
	0
answered question	0
skipped question	5

32. Please indicate how you feel about the following statement: It is the responsibility of government (tribal, local, state and federal) to provide education and programs that promote citizen actions that will reduce exposure to the risks associated with natural hazards.

	Strongly Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Strongly Agree	Rating Average	Rating Count
Choose one:	0.0% (0)	0.0% (0)	0.0% (0)	60.0% (3)	40.0% (2)	4.40	5
					answered question		5
					skipped question		0

33. Please indicate how you feel about the following statement: It is my responsibility to educate myself and take actions that will reduce my exposure to the risks associated with natural hazards.

	Strongly Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Strongly Agree	Rating Average	Rating Count
Choose one:	0.0% (0)	0.0% (0)	0.0% (0)	40.0% (2)	60.0% (3)	4.60	5
						answered question	5
						skipped question	0

34. Please indicate how you feel about the following statement: Information about the risks associated with natural hazards is readily available and easy to locate.

	Strongly Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Strongly Agree	Rating Average	Rating Count
Choose one:	0.0% (0)	60.0% (3)	20.0% (1)	20.0% (1)	0.0% (0)	2.60	5
						answered question	5
						skipped question	0

35. Please indicate your age range:

	Response Percent	Response Count
Under 18	0.0%	0
18 to 30	20.0%	1
31 to 40	20.0%	1
41 to 50	20.0%	1
51 to 60	**40.0%**	**2**
61 or older	0.0%	0
	answered question	**5**
	skipped question	**0**

36. Please indicate the primary language spoken in your household.

	Response Percent	Response Count
Native American (please specify Tribal affiliation below in 'other')	20.0%	1
English	**80.0%**	**4**
Spanish	0.0%	0
Other (please specify)	0.0%	0
	answered question	**5**
	skipped question	**0**

37. How many people live with you in your home?

	Response Count
	5
answered question	5
skipped question	0

38. Please indicate your gender:

	Response Percent	Response Count
Male	20.0%	1
Female	80.0%	4
answered question		5
skipped question		0

39. Please indicate your highest level of education.

	Response Percent	Response Count
Grade school/No schooling	0.0%	0
Some high school	0.0%	0
High school graduate/GED	40.0%	2
Some college/Trade school	40.0%	2
College degree	20.0%	1
Graduate degree	0.0%	0
Other (please specify)	0.0%	0
answered question		5
skipped question		0

40. How long have you lived on the Reservation?

	Response Percent	Response Count
Do not live on Reservation	40.0%	2
Less than 1 year	0.0%	0
1 to 5 years	0.0%	0
6 to 10 years	0.0%	0
11 to 20 years	20.0%	1
More than 20 years	40.0%	2
	answered question	5
	skipped question	0

41. Do you own or rent your place of residence?

	Response Percent	Response Count
Own	80.0%	4
Rent	20.0%	1
	answered question	5
	skipped question	0

42. How much is your gross household income?

	Response Percent	Response Count
$20,000 or less	0.0%	0
$20,001 to $49,999	**100.0%**	**4**
$50,000 to $74,999	0.0%	0
$75,000 to $99,999	0.0%	0
$100,000 or more	0.0%	0
	answered question	**4**
	skipped question	**1**

43. Comments

	Response Count
	1
answered question	**1**
skipped question	**4**

APPENDIX C.
MITIGATION ALTERNATIVE CATALOGS

APPENDIX C.
MITIGATION ALTERNATIVE CATALOGS

TABLE C-1.
CATALOG OF MITIGATION ALTERNATIVES—DAM FAILURE

Personal Scale	Corporate Scale	Government Scale
Manipulate Hazard		
• None	1. Remove dams 2. Remove levees 3. Harden dams	1. Remove dams 2. Remove levees 3. Harden dams
Reduce Exposure		
• Relocate out of dam failure inundation areas.	• Replace earthen dams with hardened structures	1. Replace earthen dams with hardened structures 2. Relocate critical facilities out of dam failure inundation areas. 3. Consider open space land use in designated dam failure inundation areas.
Reduce Vulnerability		
• Elevate home to appropriate levels.	• Flood-proof facilities within dam failure inundation areas	1. Adopt higher regulatory floodplain standards in mapped dam failure inundation areas. 2. Retrofit critical facilities within dam failure inundation areas.
Increase Preparation or Response Capability		
1. Learn about risk reduction for the dam failure hazard. 2. Learn the evacuation routes for a dam failure event. 3. Educate yourself on early warning systems and the dissemination of warnings.	1. Educate employees on the probable impacts of a dam failure. 2. Develop a continuity of operations plan.	1. Map dam failure inundation areas. 2. Enhance emergency operations plan to include a dam failure component. 3. Institute monthly communications checks with dam operators. 4. Inform the public on risk reduction techniques 5. Adopt real-estate disclosure requirements for the re-sale of property located within dam failure inundation areas. 6. Consider the probable impacts of climate in assessing the risk associated with the dam failure hazard. 7. Establish early warning capability downstream of listed high hazard dams. 8. Consider the residual risk associated with protection provided by dams in future land use decisions.

TABLE C-2.
CATALOG OF MITIGATION ALTERNATIVES—DROUGHT

Personal Scale	Corporate Scale	Government Scale
Manipulate Hazard		
None	None	Groundwater recharge through stormwater management
Reduce Exposure		
None	None	Identify and create groundwater backup sources
Reduce Vulnerability		
1. Drought-resistant landscapes 2. Reduce water system losses 3. Modify plumbing systems (through water saving kits)	1. Drought-resistant landscapes 2. Reduce private water system losses	1. Water use conflict regulations 2. Reduce water system losses 3. Distribute water saving kits
Increase Preparation or Response Capability		
• Practice active water conservation	• Practice active water conservation	1. Public education on drought resistance 2. Identify alternative water supplies for times of drought; mutual aid agreements with alternative suppliers 3. Develop drought contingency plan 4. Develop criteria “triggers” for drought-related actions 5. Improve accuracy of water supply forecasts 6. Modify rate structure to influence active water conservation techniques

TABLE C-3.
CATALOG OF MITIGATION ALTERNATIVES—EARTHQUAKE

Personal Scale	Corporate Scale	Government Scale
Manipulate Hazard		
None	None	None
Reduce Exposure		
• Locate outside of hazard area (off soft soils)	• Locate or relocate mission-critical functions outside hazard area where possible	• Locate critical facilities or functions outside hazard area where possible
Reduce Vulnerability		
1. Retrofit structure (anchor house structure to foundation) 2. Secure household items that can cause injury or damage (such as water heaters, bookcases, and other appliances) 3. Build to higher design	1. Build redundancy for critical functions and facilities 2. Retrofit critical buildings and areas housing mission-critical functions	1. Harden infrastructure 2. Provide redundancy for critical functions 3. Adopt higher regulatory standards
Increase Preparation or Response Capability		
1. Practice "drop, cover, and hold" 2. Develop household mitigation plan, such as creating a retrofit savings account, communication capability with outside, 72-hour self-sufficiency during an event 3. Keep cash reserves for reconstruction 4. Become informed on the hazard and risk reduction alternatives available. 5. Develop a post-disaster action plan for your household	1. Adopt higher standard for new construction; consider "performance-based design" when building new structures 2. Keep cash reserves for reconstruction 3. Inform your employees on the possible impacts of earthquake and how to deal with them at your work facility. 4. Develop a continuity of operations plan	1. Provide better hazard maps 2. Provide technical information and guidance 3. Enact tools to help manage development in hazard areas (e.g., tax incentives, information) 4. Include retrofitting and replacement of critical system elements in capital improvement plan 5. Develop strategy to take advantage of post-disaster opportunities 6. Warehouse critical infrastructure components such as pipe, power line, and road repair materials 7. Develop and adopt a continuity of operations plan 8. Initiate triggers guiding improvements (such as <50% substantial damage or improvements) 9. Further enhance seismic risk assessment to target high hazard buildings for mitigation opportunities. 10. Develop a post-disaster action plan that includes grant funding and debris removal components.

TABLE C-4.
CATALOG OF MITIGATION ALTERNATIVES—FLOOD

Personal Scale	Corporate Scale	Government Scale
Manipulate Hazard		
1. Clear stormwater drains and culverts 2. Institute low-impact development techniques on property	1. Clear stormwater drains and culverts 2. Institute low-impact development techniques on property	1. Maintain drainage system 2. Institute low-impact development techniques on property 3. Dredging, levee construction, and providing regional retention areas 4. Structural flood control, levees, channelization, or revetments. 5. Stormwater management regulations and master planning 6. Acquire vacant land or promote open space uses in developing watersheds to control increases in runoff
Reduce Exposure		
1. Locate outside of hazard area 2. Elevate utilities above base flood elevation 3. Institute low impact development techniques on property	1. Locate business critical facilities or functions outside hazard area 2. Institute low impact development techniques on property	1. Locate or relocate critical facilities outside of hazard area 2. Acquire or relocate identified repetitive loss properties 3. Promote open space uses in identified high hazard areas via techniques such as: planned unit developments, easements, setbacks, greenways, sensitive area tracks. 4. Adopt land development criteria such as planned unit developments, density transfers, clustering 5. Institute low impact development techniques on property 6. Acquire vacant land or promote open space uses in developing watersheds to control increases in runoff
Reduce Vulnerability		
1. Retrofit structures (elevate structures above base flood elevation) 2. Elevate items within house above base flood elevation 3. Build new homes above base flood elevation 4. Flood-proof existing structures	1. Build redundancy for critical functions or retrofit critical buildings 2. Provide flood-proofing measures when new critical infrastructure must be located in floodplains	1. Harden infrastructure, bridge replacement program 2. Provide redundancy for critical functions and infrastructure 3 Adopt appropriate regulatory standards, such as: increased freeboard standards, cumulative substantial improvement or damage, lower substantial damage threshold; compensatory storage, non-conversion deed restrictions. 4. Stormwater management regulations and master planning. 5. Adopt “no-adverse impact” floodplain management policies that strive to not increase the flood risk on downstream communities.

TABLE C-4.
CATALOG OF MITIGATION ALTERNATIVES—FLOOD

Personal Scale	Corporate Scale	Government Scale
Increase Preparation or Response Capability		
1. Buy flood insurance 2. Develop household mitigation plan, such as retrofit savings, communication capability with outside, 72-hour self-sufficiency during and after an event	1. Keep cash reserves for reconstruction 2. Support and implement hazard disclosure for the sale/re-sale of property in identified risk zones. 3. Solicit cost-sharing through partnerships with other stakeholders on projects with multiple benefits.	1. Produce better hazard maps 2. Provide technical information and guidance 3. Enact tools to help manage development in hazard areas (stronger controls, tax incentives, and information) 4. Incorporate retrofitting or replacement of critical system elements in capital improvement plan 5. Develop strategy to take advantage of post-disaster opportunities 6. Warehouse critical infrastructure components 7. Develop and adopt a continuity of operations plan 8. Consider participation in the Community Rating System 9. Maintain existing data and gather new data needed to define risks and vulnerability 10. Train emergency responders 11. Create a building and elevation inventory of structures in the floodplain 12. Develop and implement a public information strategy 13. Charge a hazard mitigation fee 14. Integrate floodplain management policies into other planning mechanisms within the planning area. 15. Consider the probable impacts of climate change on the risk associated with the flood hazard 16. Consider the residual risk associated with structural flood control in future land use decisions 17. Enforce National Flood Insurance Program 18. Adopt a Stormwater Management Master Plan

TABLE C-5.
CATALOG OF MITIGATION ALTERNATIVES—LANDSLIDE

Personal Scale	Corporate Scale	Government Scale
Manipulate Hazard		
1. Stabilize slope (dewater, armor toe) 2. Reduce weight on top of slope 3. Minimize vegetation removal and the addition of impervious surfaces.	1. Stabilize slope (dewater, armor toe) 2. Reduce weight on top of slope	1. Stabilize slope (dewater, armor toe) 2. Reduce weight on top of slope
Reduce Exposure		
• Locate structures outside of hazard area (off unstable land and away from slide-run out area)	• Locate structures outside of hazard area (off unstable land and away from slide-run out area)	1. Acquire properties in high-risk landslide areas. 2. Adopt land use policies that prohibit the placement of habitable structures in high-risk landslide areas.
Reduce Vulnerability		
• Retrofit home.	• Retrofit at-risk facilities.	1. Adopt higher regulatory standards for new development within unstable slope areas. 2. Armor/retrofit critical infrastructure against the impact of landslides.
Increase Preparation or Response Capability		
1. Institute warning system, and develop evacuation plan 2. Keep cash reserves for reconstruction 3. Educate yourself on risk reduction techniques for landslide hazards.	1. Institute warning system, and develop evacuation plan 2. Keep cash reserves for reconstruction 3. Develop a continuity of operations plan 4. Educate employees on the potential exposure to landslide hazards and emergency response protocol.	1. Produce better hazard maps 2. Provide technical information and guidance 3. Enact tools to help manage development in hazard areas: better land controls, tax incentives, information 4. Develop strategy to take advantage of post-disaster opportunities 5. Warehouse critical infrastructure components 6. Develop and adopt a continuity of operations plan 7. Educate the public on the landslide hazard and appropriate risk reduction alternatives.

TABLE C-6.
CATALOG OF MITIGATION ALTERNATIVES—SEVERE WEATHER

Personal Scale	Corporate Scale	Government Scale
Manipulate Hazard		
None	None	None
Reduce Exposure		
None	None	None
Reduce Vulnerability		
1. Insulate house 2. Provide redundant heat and power 3. Insulate structure 4. Plant appropriate trees near home and power lines (“Right tree, right place” National Arbor Day Foundation Program)	1. Relocate critical infrastructure (such as power lines) underground 2. Reinforce or relocate critical infrastructure such as power lines to meet performance expectations 3. Install tree wire	1. Harden infrastructure such as locating utilities underground 2. Trim trees back from power lines 3. Designate snow routes and strengthen critical road sections and bridges
Increase Preparation or Response Capability		
1. Trim or remove trees that could affect power lines 2. Promote 72-hour self-sufficiency 3. Obtain a NOAA weather radio. 4. Obtain an emergency generator.	1. Trim or remove trees that could affect power lines 2. Create redundancy 3. Equip facilities with a NOAA weather radio 4. Equip vital facilities with emergency power sources.	1. Support programs such as “Tree Watch” that proactively manage problem areas through use of selective removal of hazardous trees, tree replacement, etc. 2. Establish and enforce building codes that require all roofs to withstand snow loads 3. Increase communication alternatives 4. Modify land use and environmental regulations to support vegetation management activities that improve reliability in utility corridors. 5. Modify landscape and other ordinances to encourage appropriate planting near overhead power, cable, and phone lines 6. Provide NOAA weather radios to the public

TABLE C-7.
CATALOG OF MITIGATION ALTERNATIVES—TSUNAMI

Personal Scale	Corporate Scale	Government Scale
Manipulate Hazard		
• None	• None	• Build wave abatement structures (e.g. the "Jacks" looking structure designed by the Japanese)
Reduce Exposure		
• Locate outside of hazard area	• Locate structure or mission critical functions outside of hazard area whenever possible.	1. Locate structure or functions outside of hazard area whenever possible. 2. Harden infrastructure for tsunami impacts. 3. Relocate identified critical facilities located in tsunami high hazard areas.
Reduce Vulnerability		
• Apply personal property mitigation techniques to your home such as anchoring your foundation and foundation openings to allow flow though.	• Mitigate personal property for the impacts of tsunami	1. Adopt higher regulatory standards that will provide higher levels of protection to structures built in a tsunami inundation area. 2. Utilize tsunami mapping once available, to guide development away from high risk areas through land use planning.
Increase Preparation or Response Capability		
1. Develop and practice a household evacuation plan. 2. Support/participate in the Redwood Coast Tsunami Working Group. 3. Educate yourself on the risk exposure from the tsunami hazard and ways to minimize that risk.	1. Develop and practice a corporate evacuation plan. 2. Support/participate in the Redwood Coast Tsunami Working Group. 3. Educate employees on the risk exposure from the tsunami hazard and ways to minimize that risk.	1. Create a probabilistic tsunami map for the planning area. 2. Provide incentives to guide development away from hazard areas. 3. Develop a tsunami warning and response system. 4. Provide residents with tsunami inundation maps 5. Join NOAA's Tsunami Ready program 6. Develop and communicate evacuation routes 7. Enhance the public information program to include risk reduction options for the tsunami hazard

TABLE C-8.
CATALOG OF MITIGATION ALTERNATIVES—WILDFIRE

Personal Scale	Corporate Scale	Government Scale
Manipulate Hazard		
• Clear potential fuels on property such as dry overgrown underbrush and diseased trees	• Clear potential fuels on property such as dry underbrush and diseased trees	1. Clear potential fuels on property such as dry underbrush and diseased trees 2. Implement best management practices on public lands.
Reduce Exposure		
1. Create and maintain defensible space around structures 2. Locate outside of hazard area 3. Mow regularly	1. Create and maintain defensible space around structures and infrastructure 2. Locate outside of hazard area	1. Create and maintain defensible space around structures and infrastructure 2. Locate outside of hazard area 3. Enhance building code to include use of fire resistant materials in high hazard area.
Reduce Vulnerability		
1. Create and maintain defensible space around structures and provide water on site 2. Use fire-retardant building materials 3. Create defensible spaces around home	1. Create and maintain defensible space around structures and infrastructure and provide water on site 2. Use fire-retardant building materials 3. Use fire-resistant plantings in buffer areas of high wildfire threat.	1. Create and maintain defensible space around structures and infrastructure 2. Use fire-retardant building materials 3. Use fire-resistant plantings in buffer areas of high wildfire threat. 4. Consider higher regulatory standards (such as Class A roofing) 5. Establish biomass reclamation initiatives
Increase Preparation or Response Capability		
1. Employ techniques from the National Fire Protection Association's Firewise Communities program to safeguard home 2. Identify alternative water supplies for fire fighting 3. Install/replace roofing material with non-combustible roofing materials.	1. Support Firewise community initiatives. 2. Create /establish stored water supplies to be utilized for firefighting.	1. More public outreach and education efforts, including an active Firewise program 2. Possible weapons of mass destruction funds available to enhance fire capability in high-risk areas 3. Identify fire response and alternative evacuation routes 4. Seek alternative water supplies 5. Become a Firewise community 6. Use academia to study impacts/solutions to wildfire risk 7. Establish/maintain mutual aid agreements between fire service agencies. 8. Create/implement fire plans 9. Consider the probable impacts of climate change on the risk associated with the wildfire hazard in future land use decisions

APPENDIX D.
EXAMPLE PROGRESS REPORT

APPENDIX D.
EXAMPLE PROGRESS REPORT

Yurok Tribe
Hazard Mitigation Plan
Annual Progress Report

Reporting Period: *(Insert reporting period)*

Background: The Yurok Tribe developed a hazard mitigation plan to reduce risk from all hazards by identifying resources, information, and strategies for risk reduction. The federal Disaster Mitigation Act of 2000 requires state and local governments to develop hazard mitigation plans as a condition for federal disaster grant assistance. To prepare the plan, the Yurok Tribe organized resources, assessed risks from natural hazards, developed planning goals and objectives, reviewed mitigation alternatives, and developed an action plan to address probable impacts from natural hazards. By completing this process, the Yurok Tribe maintained compliance with the Disaster Mitigation Act, achieving eligibility for mitigation grant funding opportunities afforded under the Robert T. Stafford Act. The plan can be viewed on-line at:

INSERT LINK

Summary Overview of the Plan's Progress: The performance period for the Hazard Mitigation Plan became effective on ____, 2012, with the final approval of the plan by FEMA. The initial performance period for this plan will be 5 years, with an anticipated update to the plan to occur before _____, 2016. As of this reporting period, the performance period for this plan is considered to be __% complete. The Hazard Mitigation Plan has targeted __ hazard mitigation initiatives to be pursued during the 5-year performance period. As of the reporting period, the following overall progress can be reported:

- __ out of __ initiatives (__%) reported ongoing action toward completion.
- __ out of __ initiatives (__%) were reported as being complete.
- __ out of __ initiatives (___%) reported no action taken.

Purpose: The purpose of this report is to provide an annual update on the implementation of the action plan identified in the Yurok Tribe Hazard Mitigation Plan. The objective is to ensure that there is a continuing and responsive planning process that will keep the Hazard Mitigation Plan dynamic and responsive to the needs and capabilities of __[Client name]__. This report discusses the following:

- Natural hazard events that have occurred within the last year
- Changes in risk exposure within the planning area (all of the Yurok Tribe Reservation)
- Mitigation success stories
- Review of the action plan
- Changes in capabilities that could impact plan implementation
- Recommendations for changes/enhancement.

The Hazard Mitigation Plan Steering Committee: The Hazard Mitigation Plan Steering Committee, made up of stakeholders within the planning area, reviewed and approved this progress report

at its annual meeting held on _____, 201_. It was determined through the plan's development process that a steering committee would remain in service to oversee maintenance of the plan. At a minimum, the Steering Committee will provide technical review and oversight on the development of the annual progress report. It is anticipated that there will be turnover in the membership annually, which will be documented in the progress reports. For this reporting period, the Steering Committee membership is as indicated in Table 1.

TABLE 1.
STEERING COMMITTEE MEMBERS

Name	Title	Jurisdiction/Agency

Natural Hazard Events within the Planning Area: During the reporting period, there were __ natural hazard events in the planning area that had a measurable impact on people or property. A summary of these events is as follows:

- _____
- _____

Changes in Risk Exposure in the Planning Area: *(Insert brief overview of any natural hazard event in the planning area that changed the probability of occurrence or ranking of risk for the hazards addressed in the hazard mitigation plan)*

Mitigation Success Stories: *(Insert brief overview of mitigation accomplishments during the reporting period)*

Review of the Action Plan: Table 2 reviews the action plan, reporting the status of each initiative. Reviewers of this report should refer to the Hazard Mitigation Plan for more detailed descriptions of each initiative and the prioritization process.

Address the following in the "status" column of the following table:

- *Was any element of the initiative carried out during the reporting period?*
- *If no action was completed, why?*
- *Is the timeline for implementation for the initiative still appropriate?*
- *If the initiative was completed, does it need to be changed or removed from the action plan?*

TABLE 2.
ACTION PLAN MATRIX

Action Taken? (Yes or No)	Time Line	Priority	Status	Status (X, O,✓)
Initiative #__ — _____ [description]				
Initiative #__ — _____ [description]				
Initiative #__ — _____ [description]				
Initiative #__ — _____ [description]				
Initiative #__ — _____ [description]				
Initiative #__ — _____ [description]				
Initiative #__ — _____ [description]				
Initiative #__ — _____ [description]				
Initiative #__ — _____ [description]				
Initiative #__ — _____ [description]				
Initiative #__ — _____ [description]				
Initiative #__ — _____ [description]				
Initiative #__ — _____ [description]				

TABLE 2.
ACTION PLAN MATRIX

Action Taken? (Yes or No)	Time Line	Priority	Status	Status (X, O,✓)
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				

Completion status legend:
- ✓= Project Completed
- O = Action ongoing toward completion
- X = No progress at this time

Changes That May Impact Implementation of the Plan: *(Insert brief overview of any significant changes in the planning area that would have a profound impact on the implementation of the plan. Specify any changes in technical, regulatory and financial capabilities identified during the plan's development)*

Recommendations for Changes or Enhancements: Based on the review of this report by the Hazard Mitigation Plan Steering Committee, the following recommendations will be noted for future updates or revisions to the plan:

- _____
- _____
- _____
- _____
- _____
- _____

Public review notice: *The contents of this report are considered to be public knowledge and have been prepared for total public disclosure. Copies of the report have been provided to the Yurok Tribe governing board and to local media outlets and the report is posted on the Yurok Tribe Hazard Mitigation Plan website. Any questions or comments regarding the contents of this report should be directed to:*

Insert Contact Info Here

Yurok Tribe
Hazard Mitigation Plan

APPENDIX E.
2006 STRATEGY UPDATE

Appendix E

2006 Strategy Update for 2013 Hazard Mitigation Plan

As indicated within the 2013 Hazard Mitigation Plan, the Yurok Tribe developed its initial 2006 Hazard Mitigation Plan in an expedited fashion (within 30 days) as a result of the 2006 flood event to ensure the Tribe would be eligible for HMGP funds. As a result of the limited assistance and guidance from the approving regulatory authority, the Tribe, in its efforts to make certain the plan was passed, developed objectives (instead of strategies) for all hazards - even those hazards which do not impact the Reservation.

In an effort to meet the requirements of 44 CFR 201, the Tribe, during development of the 2013 plan update, focuses only on those hazards of concern as required. As such, during the time period of 2006-2013, none of the objectives (strategies) which were developed to which the tribe is not vulnerable were addressed during the 2006-2013 period, and all are removed from the 2013 update (e.g., Coastal Storm).

As required by FEMA for passage of the 2013 plan, the following represents the current status of the 2006 strategies contained within Section 4.1 of the 2006 HMP. The Tribe has specifically elected not to include these strategies as written herein within the main body of the document to avoid confusion. There were 21 strategies from the 2006 plan which are identified within Table 17-1 as existing within the 2006 plan which were carried over. Many of the remaining 2006 strategies were re-worded to be more encompassing where appropriate to all hazards, rather than repeat the same strategy for each hazard of concern, and as such are now listed just one time in more general terms in the current table (17-1). This will allow for greater opportunity to seek grant funding from different sources, and to limit repetitiveness of similar strategies. Additional information on the current strategies for the 2013 update, as well as the carry-over of the strategies from the 2006 plan, can be located within Chapter 17 of the 2013 Yurok Tribe Hazard Mitigation Plan.

Funding Opportunities:
As stated previously, the Tribe has received a limited number grants during the 2006-2013 period as follows:

- ✓ State of California Disaster Recovery Initiative Grant (DRI) to fund development of this Hazard Mitigation Plan and the evacuation maps.
- ✓ NOAA for two alert and warning sirens
- ✓ Two homeland security grants – one for CERT training, and one to develop an IED plan, which information was used within the development of this document.
- ✓ 2010 Community Development Block Grant to fund, in part, a shelter on the Reservation. Unfortunately, those funds were not sufficient to construct the entire shelter, and the Tribe was just able to complete the shelter at the end of 2013 using additional general funds.
- ✓ California Endowment funds to install a kitchen facility in newly constructed shelter.
- ✓ PDM grant (2010-2011) which funded a GPS locating project of all wastewater systems and facilities on the Reservation. That information was utilized within this plan's development.

2006 YUROK TRIBE MITIGATION OBJECTIVES (STRATEGIES):

AVALANCHE
The threat of avalanche is not considered to be a severe or high-priority threat for communities or infrastructure within the Yurok Indian Reservation.

2013 Update: Hazard not addressed within current HMP.

COASTAL EROSION
No analysis was conducted for this hazard in the 2006 plan.

CE.1: Mitigation Goal – Minimize damage to infrastructure and property from coastal erosion.
2013 Update: Hazard not addressed within the 2006 plan other than within Section 4.1; also not addressed within 2013 update as stand-alone hazard.

Objectives:

- *CE.1.1 - By 2008, perform an assessment of infrastructure and properties subject to coastal erosion and develop and plan to install protective measures at 100% of sites.*
- *2013 Update: Hazard addressed in conjunction with other hazards – not as a stand-alone hazard; however, infrastructure and property at risk is identified within the Flood and Severe Weather profile portions of the HMP.*
- *Carry-over 2013 Plan: #s-8, 21, 22*

- *CE.1.2 - Work with Del Norte County and Redwood National Park to install protective measures at 100% of identified sites by 2010.*
- *2013 Update: No sites were identified within 2006 plan to identify progress made.*
- *Carry-over to 2013 Plan: #'s19, 21, 22*

- *CE.1.3 - Rebuild currently damaged coastal roads and reinforce coastal routes by 2015.*
- *2013 Update: No roadways have been rebuilt by the Tribe due to lack of funding, but the Tribe has implemented programmatic efforts to assist in this issue such as becoming a member of the Scenic By-Ways Program and the association with development of a Highway/Roadway Safety Improvement Design Report and Transportation Plan.*
- *Carry over to 2013 Plan - #'s S-24, 43, 44.*

- *CE.1.4 - Work with Del Norte County to improve response to washed-out roadways in the future; aim for no more than 2 weeks of site inaccessibility.*
- *2013 Update: This is an on-going effort which will continue in perpetuity due to poor roadways on Reservation. The Tribe continues to work with the Counties to improve response time, and has also taken action independent of the County to facilitate this activity, such as identified in CE 1.3 above.*
- *Carry over to 2013 Plan: #s, 14, 24, 43*

- *CE.1.5 - By 2007, enact building and zoning codes, which will prevent further development in erosion-prone zones.*
- *2013 Update: Building Codes and Land Use Development in progress. Privileged information and at present not publicly released.*
- *Carry over to 2013 Plan - #'s S-2, 6, 2, 11, 22*

- *CE.1.6 - By 200, [sic] develop an acquisition and buyout plan for properties in areas subject to coastal erosion.*
  Alternatives:
  - *Assess infrastructure and processes.*
  - *Install protective measures.*
  - *Rebuild currently damaged roadways.*
  - *Reinforce existing roadways.*
  - *Develop improved County response mechanisms.*
  - *Develop and adopt building and zoning codes.*
- *2013 Update: Four acquisitions occurred of camp grounds due to flooding and inadequate sewer systems during 2006-2013 time period. Also purchased Jet Boat Tours business due to presence in flood plan. All Purchased with tribal funds.*
- *Carry Over to 2013 Plan: #S-2, 3, 4, 6, 41, 30*

CE.2: Mitigation Goal – Minimize damage to cultural resources related to coastal erosion.

Objectives:

- *CE.2.1 - By 2007, complete an inventory of known cultural resources located in or near areas identified in the assessment of infrastructure and properties subject to coastal erosion. Include input*

from the Yurok Tribe Cultural Committee on relative site priority and identification of protective measures.

- *2013 Update: In progress; on-going effort as new sites are discovered. Information privileged.*
- *Carry Over to 2013 Plan: #S-47*

- *CE.2.2 - By 2015, install protective measures at 100% of threatened cultural sites supported by the Cultural Committee.*
- *2013 Update: In progress; on-going effort as new sites are discovered. Information privileged.*
- *Carry Over to 2013 Plan: #S-47*

- *CE.2.3 - Include cultural resource monitoring and protective measures in 100% of erosion prevention and response activities.*

  Alternatives:
  - *Inventory cultural resources within the assessment area.*
  - *Gain input on site characterization and prioritization from Cultural Committee members.*
  - *Install protective measures.*
  - *Monitor all future projects related to coastal erosion prevention and response.*
- *2013 Update: In progress; on-going effort as new sites are discovered. Information privileged.*
- *Carry Over to 2013 Plan: #S-47*

COASTAL STORM

The Yurok Indian Reservation is not located in a NOAA Coastal Storm Probability Zone.

DAM FAILURE

Failure of hydroelectric and water storage projects upriver of the Yurok Indian Reservation could cause immediate and catastrophic flooding within the Reservation. For additional impacts, see Flood information.

DF.1: Mitigation Goal: Minimize losses to residential structures in outlying areas.

Objectives:

- *DF.1.1 - By 2006, create a Dam Failure Workgroup to increase community education and to accomplish 2007 and 2008 goals.*
- *2013 Update: Limited workgroup (mostly tribal personnel) established during 2006-2013 time period; Tribe continues to actively work with dam owners in an attempt to gather relevant planning information.*
- *Carry Over to 2013 Plan: #S-48, 51*

- *DF.1.2 - By 2007, prepare detailed mapping and GPS of residences; structures and infrastructure located in dam break run-up zone, escape routes and safe zones.*
- *2013 Update: 50% completed due to lack of information from dam owners; some inundation information has been provided by dam owners (see Figure 6-2 in main plan); 2013 evacuation routes area established for anticipated flooded areas; residences, structures, etc., are available via GIS.*
- *Carry over to 2013 Plan: #S-5, 48, 51.*

- *DF.1.3 - By 2008, install early warning systems, particularly in areas without adequate radio and telephone coverage.*
- *2013 Update: Some warning sirens installed (see map Figure 12-12 in main plan); Funding Source: NOAA and Tribal General Funds;*
- *Carry Over to 2013 Plan: S-49, S-52*

- *DF.1.4 - 100% of permanent residential, commercial and public utility structures located outside of known dam break run up zone in 50 years*
- *2013 Update: Combined with other similar strategies.*

- *DF.1.5 - 100% of known at-risk community infrastructure (roads, utilities, public use areas) located away from dam break run up zone, or sufficiently protected from dam break impacts in 50 years*

- *2013 Update: While some progress has been made, only a small percentage of infrastructure has been protected due, in part, to the lack of information from dam owners; some inundation information has been provided by dam owners (see Figure 6-2 in main plan); infrastructure, residences, structures, etc., are available via GIS.*
- *Carry over to 2013 Plan: #S-5, 21, 22, 24.*

- *DF.1.6 - Remove 100% of dams that have the capability to impact residential and commercial structures in 25 years.*
- *2013 Update: No progress made in removal, but talks with dam owners continue.*
- *Carry over to 2013 Plan: #S5*

- *DF.1.7 - By 2008, develop an acquisition and buyout plan for properties in dam break run up zone.*
  Alternatives:
  - *Remove dams identified in objectives.*
  - *Develop land use management plan and zoning regulations minimizing further permanent development in the dam break run up zone*
  - *Identify lands for purchase and retirement within the dam break run up zone*
  - *Decommission and/or relocate existing structures and infrastructure in the dam break run up zone*
  - *Develop a real-time emergency communication system linked to dam conditions including associated infrastructure to operate (power sources, access, and training).*
- *2013 Update: Four acquisitions occurred of camp grounds due to flooding and inadequate sewer systems during 2006-2013 time period. Also purchased Jet Boat Tours business due to presence in flood plan. All Purchased with tribal funds.*
- *Carry Over to 2013 Plan: #S-2, 3, 4, 6, 41, 30*

DF.2: Mitigation Goal: Protect Health and Safety

Objectives:

- *DF.2.1 - Identify evacuation routes for 100% of Reservation residents located within the dam break run up zone and 75% of those residents located outside the dam break run up zone that may experience indirect flood impacts (access, utilities, medical) in 10 years*
- *2013 Update: Evacuation plans completed in conjunction with 2013 Risk Assessment*

- *DF.2.2 - Provide for automated warning system linked with impending dam failure for 100% of the Reservation in 5 years*
- *2013 Update: Some warning sirens installed (see map Figure 12-12 in main plan); Funding Source: NOAA and Tribal General Funds; Carry Over to 2013: S-49, S-52*

- *DF.2.3 - Provide education and outreach to 100% of Reservation residents and businesses about dam break impact minimization and avoidance*
- *2013 Update: Public outreach conducted in conjunction with HMP plan development; public education perpetual in nature;*
- *Carry over to 2013 Plan: #'s S-14, 20, 23, 24, 26, 43, 44, 48, 57.*

- *DF.2.4 - Remove 100% of dams that have the capability to impact residential and commercial structures in 25 years*
  Alternatives:
  - *Remove dams identified in objectives*
  - *Map current evacuation routes*
  - *Develop additional evacuation routes as identified as necessary*
  - *Acquire evacuation routes and/or develop right of way agreements from landowners for use in case of dam failure*
  - *Maintain evacuation routes*
  - *Publish and provide outreach to community on evacuation routes*

- *Develop a real-time emergency communication system linked to dam conditions including associated infrastructure to operate (power sources, access, training)*
- *Conduct workshops on dam failure awareness and response*
- *Purchase and distribute flood avoidance and minimization equipment and supplies for residents, businesses and government entities*

- *2013 Update: No progress made in removal, but talks with dam owners continue; evacuation routes established, and publicly disseminated; however, as tribe does not own property, there currently is no legislation in place to force private land owners to unlock gates for access. Tribe will continue to work with landowners to ensure access is available.*
- *Carry over 2013 Plan: #'s S-5, 7, 14, 20, 23, 24, 43, 44, 48, 49, 51*

DF.3: Mitigation Goal: Protect Environmental and Cultural Resources

Objectives:

- *DF.3.1 - Assess 100% of and prescribe actions, if necessary, to reduce to 90% of features within the dam break run up zone that have the potential to release toxic or hazardous materials into water, air or soil in 10 years*
- *2013 Update: Although not directly related to dam break or failure, four acquisitions occurred of camp grounds due to flooding and inadequate sewer systems during 2005-2013 time period. The Tribe also purchased Jet Boat Tours business due to presence in flood plan. All Purchased with tribal funds. Hazardous materials continue to be at issue on the Reservation in general. Tribe continues to work on this effort.*
- *Carry Over to 2013 Plan #S-2, 3, 4, 5, 6, 41, 30*

- *DF.3.2 - Inventory and assess 100% of known cultural sites within the dam break run up zone within 10 years*
- *2013 Update: In progress; on-going effort as new sites are discovered. Information privileged.*
- *Carry Over 2013 Plan: #S-47*

- *DF.3.3 - Prescribe and implement protective measures to 100% of cultural resources that are deemed at-risk by a dam break, as culturally appropriate after consultation with affected parties*
- *2013 Update: In progress; on-going effort as new sites are discovered. Information privileged.*
- *Carry Over 2013 Plan: #S-47*

- *DF.3.4 - Remove 100% of dams that have the capability to impact residential and commercial structures in 25 years*

  Alternatives:
  - *Remove dams identified in objectives.*
- *2013 Update: No progress made in removal, but talks with dam owners continue. Tribe continues to work on this effort.*
- *Carry over to 2013 Plan: #'s S-5, 7, 14, 20, 23, 24, 43, 44, 48, 49, 51*

DROUGHT

Periods of drought not only affect domestic water supplies for residents of the Yurok Reservation, but also environmental and cultural resources vital to the health of the Yurok way of life.

DR.1: Mitigation Goal: Protect Health and Safety

Objectives:

- *DR.1.1 - Assess 100% and reduce by 90% the susceptibility of households and communities that would be at-risk during a 10yr. drought occurrence in 10 years*
- *2013 Update: Removed from 2013 plan as drought is not designated by a geographic boundary; therefore, the entire Tribe would be susceptible.*

- *DR.1.2 - Identify potential alternate water resources and/or relocation zones for 90% of households and communities identified as at-risk during a 10yr. drought occurrence in 10 years*
  - *Alternatives:*
    - *Install greater capacity water storage facilities for community and individual water systems identified at risk*
    - *Tie existing water systems, both community and individual, together for emergency use*
    - *Construct wells*
    - *Purchase a mobile potable water tank*
    - *Conduct outreach sessions on water use efficiency*
    - *Procure and distribute water efficiency devices for residential and commercial use*
    - *Adopt codes and ordinances regulating water use during declared drought periods*
- *2013 Update: In progress as the Tribe has limited funding to pursue development of infrastructure. Since 2006, Shelters have been established to serve as cooling stations for tribal members. The Tribe continues to seek funding for mobile potable water tanks, and its Environmental Department continues outreach concerning water efficiency, as well as working with Dam owners to determine appropriate times to spill dams to protect natural resources and maintain appropriate water temperatures.*
- *Carry over 2013 Plan: #'s S-5, 7, 14, 20, 23, 24, 43, 44, 48, 49, 51*

DR.2: Mitigation Goal: Protect Environmental and Cultural Resources

Objectives:

- *DR 2.1 - Assess 100% of Lower Klamath Basin water resource demand and prescribe action for 10% of water resource demand that is identified to impact environmental and cultural resources during a 10yr. drought occurrence*

- *DR.2.2 - Assess 75% of Klamath Basin water resource demand and prescribe action for 25% of water resource demand that is identified to impact environmental and cultural resources during a 10yr. drought occurrence in 25 years*
  - *Alternatives:*
    - *Install water use efficiency measures on community and individual water systems*
    - *Coordinate with basin-wide efforts to reduce water use during drought periods*
- *2013 Update: In progress. The Tribe has limited funding to pursue development of infrastructure, but continues to move forward in this effort. The Tribe continues to seek funding for mobile potable water tanks, and its Environmental Department continues outreach concerning water efficiency. The Tribe continues to work with Dam owners to determine appropriate times to spill dams to protect natural resources and maintain appropriate water temperatures.*
- *Carry over 2013 Plan: #'s S-1, 2, 5, 6, 7, 9, 14, 15, 16, 17, 20, 21, 22, 23, 24, 26, 32, 34, 35, 36, 37, 43, 44, 46, 48, 49, 51, 52, 56.*

EARTHQUAKE

The Yurok Reservation is located in the vicinity of the Cascadia Subduction Zone, a triple-fault located off the Coast of Humboldt and Del Norte County. In addition, there are several major earthquake faults running parallel to this zone in Humboldt County. The Reservation is at high risk and probability of experiencing a major earthquake. Ground shaking from a major earthquake could be expected to produce a tsunami and landslides, as well as exacerbate natural land subsidence. See relevant sections for more information. Earthquakes can be expected to produce power outages, disruption of drinking water supplies (for both spring-fed and well-fed systems), damage to infrastructure (roadways and pipelines), and damage to facilities.

EQ.1: Mitigation Goal: Minimize damage to infrastructure and property from earthquakes.

Objectives:

- *EQ.1.1 - By 2010, perform a structural assessment of all infrastructure, buildings, and homes within the Reservation to determine their compliance with earthquake safe construction guidelines, as well as their relative risk for damage from ground shaking.*

- *2013 Update: Structural assessment have not been completed as anticipated; however, this continues to be a priority for the Tribe and assessments will be completed as funding and opportunity arises.*

- *EQ.1.2 - By 2015, make improvements to at least 50% of high priority structures within the Reservation, and to 100% of critical structures (those identified as shelter areas).*
- *2013 Update: A new shelter has been built for use by tribal members. The Tribe was not able to make improvements to 50% of the high priority structures, nor 100% of the critical structures as indicated in the 2006 plan due to lack of funding; however, this remains a priority for the Tribe and they will continue to move forward on this effort over the life-cycle of this plan.*

- *EQ.1.3 - By 2007, adopt regulations that ensure that all future structures built within the Reservation meet minimum earthquake safety code requirements. Adopting requirements similar to those of the state of California would ensure that the most current body of knowledge concerning earthquake safety has been considered.*
  Alternatives:
  - *Prepare structural assessments.*
  - *Improve structures.*
  - *Adopt regulations related to project design and construction.*
- *2013 Update: In progress. Land use regulations are currently under development, but information contained within the document is not available for public review until adopted by council.*

- *Carry Over to 2013 Plan: #S 6, 15, 16, 17, 19, 22, 32, 41, 46, 47, 51, 56*

- **EQ.2: Mitigation Goal: Minimize health and human safety risks from earthquakes.**

Objectives:

- *EQ.2.1 - By 2007, develop and implement education, assistance, and outreach programs for earthquake preparedness.*
- *2013 Update: The Tribe continues to conduct extensive outreach, such as that which occurred during this plan development. In addition, the Tribe conducts exercises related to drop-cover-and hold.*

- *EQ.2.2 - By 2007, establish shelter capabilities in populated areas for housing and feeding community members if necessary in the event of an earthquake.*
- *2013 Update: Since completion of the 2006 plan, the Tribe has constructed a new shelter facility, partially grant funded. This effort will continue to grow as the Tribe establishes additional shelter locations and as population on the Reservation increases.*

- *EQ.2.3 - By 2007, coordinate Community Emergency Response Team (CERT) Red Cross training on the Reservation.*
  Alternatives:
  - *Develop education programs and outreach programs; implement programs.*
  - *Establish and equip emergency shelter areas.*
- *2013 Update: During the 2006-2013 timeframe, the Tribe received THLS funds, which were utilized to train CERT members. The Tribe anticipates that this type of training will continue.*
- *Carry over to 2013 Plan: #'s 20, 23, 26, 27, 28, 50, 57*

EXPANSIVE SOILS

The Yurok Tribe is not aware of any known expansive soils within the Reservation. This section will be updated as new information is gathered.

EXTREME HEAT

Extended periods of high ambient temperatures can not only impact the elderly and sensitive human populations, but also have deleterious effects on salmonids within the Klamath River system.

EH.1: Mitigation Goal: Minimize health and human safety risks from extreme heat

Objectives:

- *EH.1.1 - By 2007, develop assistance and outreach programs for elders and sensitive populations in times of extreme heat.*
- *2013 Update: During the 2006-013 timeframe, the Tribe constructed a shelter which serves as a cooling station. Public outreach and education materials are distributed in various means Reservation wide in an effort to assist its members. The Tribe continues to work on this effort to ensure the safety of its tribal members.*

- *E.H.1.2 - By 2007, establish shelter capabilities in populated areas for refuge from high heat episodes.*
- *2013 Update: During the 2006-013 timeframe, the Tribe constructed a shelter which serves as a cooling station. Public outreach and education materials are distributed in various means Reservation wide in an effort to assist its members. The Tribe continues to work on this effort to ensure the safety of its tribal members.*

- *E.H.1.3 - By 2008, purchase a mobile potable water truck.*
  Alternatives:
  - *Develop assistance and outreach programs.*
  - *Establish and equip emergency shelter areas.*

- *2013 Update: During the 2006-013 timeframe, the Tribe constructed a shelter which serves as a cooling station. Public outreach and education materials are distributed in various means Reservation wide in an effort to assist its members. The Tribe continues to work on this effort to ensure the safety of its tribal members.*
- *Carry over to 2013 Plan: #'s 2, 9, 20, 23, 26, 27, 34, 36, 37, 44, 46, 50*

EH.2: Mitigation Goal: Improve response by water managers to extreme heat situations

Objectives:

- *EH.2.1 - By 2008, establish agreements or ordered actions governing additional cool water releases into the Klamath River system in the event of prolonged extreme heat raising the temperature of the Klamath River above the tolerance level for salmonids.*
- *2013 Update: Work in this area continues for the Tribe, although progress has been limited. A workgroup has been established for this purpose, and the Environmental Department continues to address this concern working with dam owners and other federal partners.*
- *Carry over to 2013 Plan: #5*

- *E.H.2.2 - By 2010, with other Klamath Basin interest groups, develop an emergency action plan for periods of high Klamath River water temperature.*
  Alternatives:
  - *Establish emergency action protocol for water delivery.*
  - *Develop an emergency action plan for periods of high temperatures.*
- *2013 Update: Work in this area continues for the Tribe, although progress has been limited. A workgroup has been established for this purpose, and the Environmental Department continues to address this concern working with dam owners and other federal partners.*
- *Carry over to 2013 Plan: #5*

FLOOD

As it is situated along a major river, the Yurok Reservation is prone to flood inundation as waters of the Klamath River and its tributaries exceed flood stage. There are numerous documented historical floods along the Klamath River, which have resulted in structural damage, property loss, and threats to human health and safety.

FL.1: Mitigation Goal: Minimize losses to residential structures in outlying areas.

Objectives:

- *FL.1.1 - 100% of permanent residential, commercial and public utility structures located outside of known 100yr. floodplain areas in 25 years*
- *2013 Update: Four acquisitions occurred of camp grounds due to flooding and inadequate sewer systems during 2006-2013 time period. The Tribe also purchased Jet Boat Tours business due to presence in flood plan. All Purchased with tribal funds.*
- *Carry Over to 2013 Plan: #S-4, 6, 7, 10, 11, 21, 22, 30, 32, 41, 43, 48, 51, 56, 57*

- *FL.1.2 - 100% of known at-risk community infrastructure (roads, utilities, public use areas) located away from 100yr. floodplain, or sufficiently protected from 100yr. flood impacts in 25 years*
- *2013 Update: Four acquisitions occurred of camp grounds due to flooding and inadequate sewer systems during 2006-2013 time period. The Tribe also purchased Jet Boat Tours business due to presence in flood plan. All Purchased with tribal funds.*
- *Carry Over to 2013 Plan: #S-4, 6, 7, 10, 11, 21, 22, 30, 32, 41, 43, 48, 51, 56, 57*

- *FL.1.3 - 75% of Lower Klamath sub-watershed road systems decommissioned or hydrologically disconnected from stream network in 50 years*
- *2013 Update: No progress made due, in part, to funding issues and in many cases, the law of ownership of the roadways in question.*
- *Carry over to 2013 Plan: #S-19*

- *FL.1.4 - Assess 100% of and prescribe actions, if necessary, to reduce to 90% of features that alter hydrologic peak flows (channelization structures, drainage, seasonal flow impoundments or alterations) in 25 years.*
- *2013 Update: This remains a primary focus for the Tribe, although it was not an achievable project as written for the identified measureable outcome. This project will be continued during the next planning cycle.*
- *Carry over to 2013 Plan: #S-5, 8, 10, 18, 19.*

- *FL.1.5 - Install Emergency Communication networks (telephones, emergency service radio systems, repeater sites and base stations) to provide early warning to community members to minimize impacts to life and property.*
- *2013 Update: The Tribe has completed installation of some sirens on the Reservation; however, telephone coverage continues to be sparse as much of the Reservation is without telephone capabilities, either land-lines or cellular. NOAA radios have been purchased and distributed to some residents, although many residents are also without electrical power and maintaining the radios with battery power in many cases has become difficult for residents due to the cost of the batteries. The Tribe continues to see this as a priority and seeks new opportunities to ensure a communication network Reservation-wide.*
- *Carry over to 2013 Plan: #'s 49, 52*

- *FL.1.6 - By 2007, develop an acquisition and buyout plan for structures, businesses and infrastructure located in flood zones.*
- *2013 Update: Four acquisitions occurred of camp grounds due to flooding and inadequate sewer systems during 2006-2013 time period. The Tribe also purchased Jet Boat Tours business due to presence in flood plan. This continues to be a priority for the Tribe. All Purchased with tribal funds.*
- *Carry Over to 2013 Plan: #S-4, 6, 7, 10, 11, 21, 22, 30, 32, 41, 43, 48, 51, 56, 57*

- *FL.1.7 - By 2010, purchase 10% of properties located in flood zones.*
- *2013 Update: Four acquisitions occurred of camp grounds due to flooding and inadequate sewer systems during 2006-2013 time period. The Tribe also purchased Jet Boat Tours business due to presence in flood plan. This continues to be a priority for the Tribe. All Purchased with tribal funds.*
- *Carry Over to 2013 Plan: #S-4, 6, 7, 10, 11, 21, 22, 30, 32, 41, 43, 48, 51, 56, 57*

- *FL.1.8 - By 2010, install stream bank stabilization for critical infrastructure.*
- *2013 Update: Stream bank stabilization remains one of the top goals in for the Tribe's Watershed Department and the Fisheries program. Since completion of the 2006 plan, the Tribe has completed approximately 4 bank stabilization projects per year, dependent on the volume of water traveling through the area.*
- *Carry over to 2013 Plan: #S-8*

- *FL.1.9 - By 2007, increase fuel storage tanks for Klamath-Glen Levee pumps.*
  Alternatives:
  - *Develop land use management plan and zoning regulations prohibiting further permanent development in the 100 yr. floodplain*
- *2013 Update: In progress. No fuel storage tanks purchased.*
- *Carry over to 2013 Plan: #S-9*

  - *Identify lands for purchase and retirement within the 100 yr. floodplain*
- *2013 Update: Four acquisitions occurred of camp grounds due to flooding and inadequate sewer systems during 2006-2013 time period. The Tribe also purchased Jet Boat Tours business due to presence in flood plan. This continues to be a priority for the Tribe. All Purchased with tribal funds.*

  - *Decommission and/or relocate existing structures and infrastructure in the 100 yr. floodplain*
  See status update above.

  - *Construct high water barriers and/or erosion control structures around structures and infrastructure that are otherwise unable to be feasibly relocated*
  - *Hydrologically decommission "legacy" logging road systems in Lower Klamath sub-watersheds*
  - *Decommission or redesign features that alter hydrologic peak flows*

- *2013 Update: Since the 2006 plan was completed, decommissioning of roads on the reservation varies per year based on what is involved. Since 2006, approximately 35 miles have been decommissioned. This estimate includes decommissioning of roads in Redwood National Parks, Forest Service, and Phase I acquisition lands, all within Yurok ancestral territory. With respect to the number of in-stream stabilization projects, the Watershed Department has removed approximately 30 stream crossings per year and has since 2006.*
- *Carry Over to 2013 Plan: #S-4, 6, 7, 10, 11, 21, 22, 30, 32, 41, 43, 48, 51, 56, 57*

FL.2: Mitigation Goal: Protect Health and Safety

Objectives:

- *FL.2.1 - Identify evacuation routes for 100% of Reservation residents located within the 100yr. floodplain and 75% of those residents located outside the 100yr. floodplain that may experience indirect flood impacts (access, utilities, medical) in 5 years*
- *2013 Update: Evacuation routes completed in 2013.*
- *Carry over to 2013 Plan: #'s S-14, 17, 20, 23, 24, 26, 43, 44, 48, 57.*

- *FL.2.2 - Provide for communications for 100% of the Reservation in 5 years*
- *2013 Update: The Tribe has completed installation of some sirens on the Reservation; however, telephone coverage continues to be sparse as much of the Reservation is without telephone capabilities, either land-lines or cellular. NOAA radios have been purchased and distributed to some residents, although many residents are also without electrical power and maintaining the radios with battery power in many cases has become difficult for residents due to the cost of the batteries. The Tribe continues to see this as a priority and seeks new opportunities to ensure a communication network Reservation-wide.*
- *Carry over to 2013 Plan: #'s 49, 52*

- *FL.2.3 - Provide education and outreach to 100% of Reservation residents and businesses about flood impact minimization and avoidance.*
- *2013 Update: Public outreach conducted in conjunction with HMP plan development; public education perpetual in nature;*
- *Carry over to 2013 Plan: #'s S-14, 17, 20, 23, 24, 26, 43, 44, 48, 57.*

- *FL.2.4 - Ensure emergency generations systems are available for critical infrastructure, including the McBeth Water System, Requa Water System, and the Weitchpec Tribal Office.*
- *2013 Update: One generator was purchased with general funds for the Weitchpec Tribal Office. This remains a focus for the tribe during the 2013-2018 cycle.*
- *Carry over to 2013 Plan: #S-9, 50*

- *FL.2.5 - By 2006, update the Yurok Emergency Operations Plan and ensure compliance with the National Incident Management System.*
- *2013 Update: Limited progress made due to lack of staffing and funding. This remains a focus for the Tribe.*
- *Carry over to 2013 Plan: #1, 2, 27*

- *FL.2.6 - By 2010, work with Pacific Power to raise or relocate the Yurok Substation out of flood zone.*
- *2013 Update: No progress made due to lack of response by Pacific Power. Remains a focus of Alternatives (2013 Update: Repeat of other objectives already addressed):*
  - *Map current evacuation routes*
  - *2013 Update: Repeat of other objectives already addressed*
  - *Develop additional evacuation routes as identified necessary*
  - *2013 Update: Repeat of other objectives already addressed*
  - *Acquire evacuation routes and/or develop right of way agreements from landowners for use in case of flood.*
  - *2013 Update: Repeat of other objectives already addressed*
  - *Negotiate the removal or unlocking of gates on escape routes.*
  - *2013 Update: Repeat of other objectives already addressed*
  - *Maintain evacuation routes*
  - *2013 Update: Repeat of other objectives already addressed*
  - *Publish and provide outreach to community on evacuation routes*
  - *2013 Update: Repeat of other objectives already addressed*
  - *Develop a Reservation-wide emergency communication system including associated infrastructure to operate (power sources, access, training)*
  - *2013 Update: Repeat of other objectives already addressed*
  - *Conduct workshops on flood awareness and response*
  - *2013 Update: Repeat of other objectives already addressed*
  - *Purchase and distribute flood avoidance and minimization equipment and supplies for residents, businesses and government entities*
  - *2013 Update: During the 2006-2013 timeframe, the Tribe has purchased these items as funding allows. No grant funds were available for this effort. This strategy as written was removed from the 2013 plan.*

FL.3: Mitigation Goal: Protect Environmental and Cultural Resources

Objectives:

- *FL.3.1 - 75% of Lower Klamath sub-watershed road systems decommissioned or hydrologically disconnected from stream network in 50 years*
- *2013 Update: Repeat of other objectives already addressed*

- *FL.3.2 - Assess 100% of and prescribe actions, if necessary, to reduce to 90% of features within the 100 yr. floodplain that have the potential to release toxic or hazardous materials into water, air or soil in 25 years*
- *2013 Update: Repeat of other objectives already addressed*

- *FL.3.3 - Inventory and assess 100% of known cultural sites within the 100yr. floodplain within 10 years*
- *2013 Update: Repeat of other objectives already addressed*

- *FL.3.4 - Prescribe and implement protective measures to 100% of cultural resources that are deemed at-risk by a 100yr. flood, as culturally appropriate after consultation with affected parties.*
- *2013 Update: In progress; on-going effort as new sites are discovered. Information privileged.*

- *Carry over to 2013 Plan: #S-47; Land use codes and zoning regulations in progress and not for public dissemination as of the 2013 update; Carry over 2013 #'s 2, 6, 11*

  Alternatives:
  - *Develop land use management plan and zoning regulations prohibiting further permanent development in the 100 yr. floodplain*
  - *2013 Update: Repeat of other objectives already addressed*

  - *Identify lands for purchase and retirement within the 100 yr. floodplain*
  - *2013 Update: Repeat of other objectives already addressed*

  - *Decommission and/or relocate existing structures and infrastructure in the 100 year floodplain*
  - *2013 Update: Repeat of other objectives already addressed*

  - *Construct high water barriers and/or erosion control structures around structures and infrastructure that are otherwise unable to be feasibly relocated*
  - *2013 Update: Repeat of other objectives already addressed*

  - *Hydrologically decommission "legacy" logging road systems in Lower Klamath sub-watersheds*
  - *2013 Update: Repeat of other objectives already addressed*

  - *Decommission or redesign features that alter hydrologic peak flows*
  - *2013 Update: Repeat of other objectives already addressed*

  - *Relocate, prohibit construction or retrofit features that have the potential to release toxic or hazardous materials into water, air or soil*
  - *2013 Update: Repeat of other objectives already addressed*

HAILSTORM

Hailstorms are a common winter occurrence within the Reservation. Hazards and mitigation strategies concerning hailstorms are included in the Winter Storm section.

HURRICANE

Hurricanes have not been known to exist in the Pacific Ocean. Typhoons (extreme Pacific weather events) are not expected in the Pacific Northwest.

LAND SUBSIDENCE

Land subsidence is common within the Yurok Reservation, as many roads and structures are built on steep slopes comprised of relatively unstable soils. The majority of ongoing subsidence occurs in the coastal areas of the Reservation. Land subsidence is of importance in this document mainly with regard to its ongoing damage to infrastructure and potential damage to structures within the Reservation.

LS.1: Mitigation Goal: Minimize damage to infrastructure and property from land subsidence.

Objectives:

- *LS.1.1 - By 2007, perform an assessment of infrastructure and properties subject to ongoing land subsidence and install protective measures at 100% of identified sites by 2010.*
- *2013 Update: Landslide assessment of properties and structures completed with 2013 HMP update; protective measures at 100% of identified sites not completed due to lack of funding. This remains a focus for the Tribe during the 2013-2018 cycle.*

- *LS.1.2 - Rebuild currently damaged coastal roads and reinforces coastal routes by 2010.*
- *2013 Update: Repeat of similar objectives already addressed*

- *LS.1.3 -By 2007, enact building and zoning codes, which will prevent further development in subsidence-prone zones.*
- *2013 Update: Repeat of other land-use objectives already addressed*

Alternatives:

- *Assess infrastructure and properties.*
- *Rebuild currently damaged roadways.*
- *Reinforce roadways where possible.*
- *Draft and adopt zoning and building ordinances.*

- *Carry over to 2013 Plan: #'s S-1, 2, 6, 7, 8, 17, 18, 19, 21, 22, 23, 29, 30, 43, 45, 50, 51, 52, 56,*

LS.2: Mitigation Goal – Minimize damage to cultural resources related to land subsidence.

Objectives:

- *LS.2.1 - By 2007, complete an inventory of known cultural resources located in or near areas identified in the assessment of infrastructure and properties subject to land subsidence. Include input from the Yurok Tribe Cultural Committee on relative site priority and identification of protective measures.*
- *2013 Update: In progress; on-going effort as new sites are discovered. Information privileged.*
- *Carry Over to 2013 Plan: #S-47*

- *LS.2.2 - By 2010, install protective measures at 100% of threatened cultural sites supported by the Cultural Committee.*
- *2013 Update: In progress; on-going effort as new sites are discovered. Information privileged.*
- *Carry Over to 2013 Plan: #S-47*

- *LS.2.3 - Include cultural resource monitoring and protective measures in 100% of subsidence prevention and response activities.*
- *2013 Update: In progress; on-going effort as new sites are discovered. Information privileged.*
- *Carry Over to 2013 Plan: #S-47*

Alternatives:

- *Inventory cultural sites pertinent to assessment.*
- *2013 Update: Repeat of other objectives already addressed*

- *Install protective measures as dictated by Cultural Committee.*
- *2013 Update: Repeat of identical objectives already addressed above.*

- *Monitor preventive and response activities.*
- *2013 Update: The tribe continues to conduct preventive activities through training, outreach and planning initiatives to address both preventive and response activities. Completion of the 2013 HMP is demonstrative of preventive activities, which support response activities. The*

Tribe will continue to make this a priority in the future through continued plan development and public education.

- *Carry over to 2013 Plan: #'s 20, 23, 24, 26, 27, 41, 43, 44, 47, 48, 49, 52.*

LANDSLIDES AND MUDFLOWS

USGS has identified the Yurok Reservation as an area with a high incidence of landslides and a high likelihood of landslides. Anecdotal evidence supports this claim. Landslides can impact human health and safety, as well as rendering roadways impassible and destroying structures. As much of the Reservation population is situated in areas with steep slopes and unstable soils, and there are frequent winter storms, heavy rainfall, and a high likelihood of saturated soils and flooding, landslides are considered to be a major hazard within the Yurok Indian Reservation.

LM.1: Mitigation Goal: Minimize health and human safety risks from landslides.

Objectives:

- *LM.1.1 - By 2008, develop and implement education, assistance, and outreach programs for landslide preparedness.*
- *2013 Update: Repeat of similar objectives already addressed.*

- *LM.1.2 - By 2007, establish shelter capabilities in populated areas for housing and feeding community members if necessary in the event of landslide.*
  Alternatives:
  - *Develop and implement education and outreach programs.*
  - *2013 Update: Repeat of identical objectives already addressed above.*

  - *Establish and equip emergency shelter areas.*
  - *2013 Update: New emergency shelter built in 2013 with funding from CA CDBG funds, in conjunction with CA Endowment funds to complete kitchen portion of shelter, and the remaining funds from Tribal general funds.*

Carry over to 2013 Plan: See strategies identified above for identical project.

LM.2: Mitigation Goal: Minimize damage to infrastructure and property from landslides.

Objectives:

- *LM.2.1 - By 2010, perform an assessment of infrastructure and properties potentially threatened by landslides and install protective measures at 100% of identified sites by 2015.*
- *2013 Update: Repeat of identical objectives already addressed above.*

- *LM.2.2 - Rebuild currently damaged inland roads and reinforces 25% of routes by 2010.*
- *2013 Update: The Tribe has completed road construction as the major thoroughfares at issue are not under the ownership of the Tribe. The Tribe continues to work with surrounding jurisdictions and the Federal Highway Transportation Administration to attempt to enhance roadways on the Reservation. The Tribe has become involved with various transportation programs, such as the Scenic By-Ways Program since the completion of the 2006 HMP. This remains a current focus of the Tribe.*
- *Carry over to 2013 Plan: See identical projects discussed above for itemized list of 2013 strategies.*

- *LM.2.3 - By 2007, enact building and zoning codes, which will include consideration of landslide potential in identifying building sites.*
  Alternatives:
  - *Assess infrastructure and properties.*
  - *Install protective measures.*
  - *Rebuild damaged roadways.*
  - *Draft and adopt building and zoning codes.*

2013 Update: Previously addressed above with identical strategy – see above information.

Carry over to 2013 Plan: Previously addressed above with identical strategy – see above information.

L.M.3: Mitigation Goal: Minimize damage to cultural resources from landslides.

Objectives:

- *LM.3.1 - By 2007, complete an inventory of known cultural resources located in or near areas identified in the assessment of infrastructure and properties subject to landslides. Include input from the Yurok Tribe Cultural Committee on relative site priority and identification of protective measures.*
- *2013 Update: In progress; on-going effort as new sites are discovered. Information privileged.*
- *Carry Over to 2013 Plan: #S-47*

- *LM.3.2 - By 2010, install protective measures at 100% of threatened cultural sites supported by the Cultural Committee.*
- *2013 Update: In progress; on-going effort as new sites are discovered. Information privileged.*
- *Carry Over to 2013 Plan: #S-47*

- *LM.3.3 - Include cultural resource monitoring and protective measures in 100% of landslide prevention and response activities.*
  - *Alternatives:*
    - *Inventory resources relative to assessment.*
    - *Install protective measures as directed by Cultural Committee.*
    - *Monitor prevention and response activities.*
- *2013 Update: In progress; on-going effort as new sites are discovered. Information privileged.*
- *Carry Over to 2013 Plan: #S-47*

LEVEE FAILURE

LF.1: Mitigation Goal: Minimize health and human safety risks from landslides.

Objectives:

- *LF.1.1 By 2006, obtain all historical information and annual inspections from the Army Core of Engineers.*
- *2013 Update: Limited progress made due to refusal of dam owners and USACE to provide information. Remains a focus of the tribe.*
- *Carry over to 2013 Plan: # 51*

- *LF.1.2 By 2007, develop an evacuation plan and conduct community drills for evacuation of areas at risk in the event of a levee failure.*
- *2013 Update: Evacuation plans completed by the tribe during 2013 based on HMP risk assessment. Community drills for evacuation occur annually on the Reservation for the various hazards of concerns, including tsunami and flooding issues of various types.*

- *LF.1.3 By 2007, develop shelter agreements with the American Red Cross*
- *2013 Update: One new shelter was built in 2013 with grant funds from CA HUD and CA Endowment.*
- *Carry over to 2013 Plan: # 50*

SEVERE WINTER STORM

Severe winter storms in the Pacific Northwest are common. Storm events often include erosion, landslide, flooding, hailstorms, and high winds. Many storms disrupt power service to communities, which can last for hours or days.

SWS.1: Mitigation Goal: Minimize health and human safety risks from severe winter storms.

Objectives:

- *SWS.1.1 - By 2007, establish a public education program to inform the public on preparedness activities in advance of winter storm events.*
  - *Alternatives:*
    - *Establish educational programs.*

2013 Update: See previous objectives above for public education program initiatives and carry over to 2013 plan strategies.

SWS.2: Mitigation Goal: Cross-cutting Goal

Objectives

See goals and objectives relative to coastal erosion, dam failure, flood, hailstorm, landslide, and windstorm.

TORNADO

While the Yurok Reservation is located in a FEMA Wind Zone 1, there have been historical incidences of tornadoes in the Del Norte County area.

TO.1: Mitigation Goal: Minimize health and human safety risks from tornadoes.

Objectives:

- *TO.1.1 - By 2007, improve warning system in populated areas.*
- *2013 Update: Warning sirens have been installed on the Reservation during the 2006-2013 timeframe; NOAA radios have been provided to residents and in community centers. This remains a focus of the Tribe for the 2013-2018 cycle.*

- *TO.1.2 - By 2007, establish programs to educate community on actions to take in the event of a tornado.*
  - *Alternatives:*
    - *Install warning systems in populated areas.*
    - *Establish educational programs.*
- *2013 Update: The tribe continues to conduct preventive activities through training, outreach and planning initiatives to address both preventive and response activities. Completion of the 2013 HMP is demonstrative of preventive activities, which support response activities. The Tribe will continue to make this a priority in the future through continued plan development and public education.*

- *Carry over to 2013 Plan: #'s 20, 23, 24, 26, 27, 43, 44, 47, 48, 49, 52.*

TSUNAMI

The Yurok Reservation is located in the vicinity of the Cascadia Subduction Zone, a triple-fault located off the Coast of Humboldt County. In addition, there are several major earthquake faults running parallel to this zone in Humboldt County, which extend into the Pacific. The Reservation is at high risk and probability of experiencing a tsunami. Tsunamis have been recorded in the area in the past, and caused flooding damages to coastal areas.

TS.1: Mitigation Goal: Minimize health and human safety risks from tsunamis.

Objectives:

- *TS.1.1 - By 2006, initiate Klamath Tsunami Readiness Workgroup*
- *2013 Update: The Tribe participates in a local and state-wide Tsunami Readiness Workgroup, and will continue to do so over the course of the 2013-2018 time period.*
- *Cary over to 2013 Plan: #S-3, 14*

- *TS.1.2 - By 2007, improve warning systems in populated areas.*

- *2013 Update: Since the 2006-2013 timeframe, new warning sirens funded by NOAA have been installed on the Reservation. NOAA radio systems have also been provided to tribal residents and installed in some public facilities.*
- *Cary over to 2013 Plan: #S-31, 49, 52*

- *TS.1.3 - By 2007, develop improved tsunami run-up maps for the Klamath River area.*
- *2013 Update: The Tribe has worked and continues to work with the State of California and its universities to complete this project as new and updated information evolves. This remains a focus for the Tribe.*
- *Carry over to 2013 Plan: #S-3*

- *TS.1.4 - By 2007, develop evacuation routes, maps and signage*
- *2013 Update: Evacuation routes and maps completed during 2013 using Risk Assessment for the 2013 HMP. The Tribe continues to seek funding for signage, and will continue to maintain this as a strategy during the 2013-2018 cycle.*
- *Carry over to 2013 Plan: #S44*

- *TS.1.5 - By 2007, educate the community on actions to take in the event of a tsunami.*
- *2013 Update: The tribe continues to conduct preventive activities through training, outreach and planning initiatives to address both preventive and response activities. Completion of the 2013 HMP is demonstrative of preventive activities, which support response activities. The Tribe will continue to make this a priority in the future through continued plan development and public education.*
- *Carry over to 2013 Plan: #'s 20, 23, 24, 26, 27, 43, 44, 47, 48, 49, 52, 57*

- *TS.1.6 - By 2006, install NOAA emergency radios in all public buildings, schools, police and fire stations.*

  Alternatives:
  - *Install warning systems in populated areas.*
  - *Develop improved mapping database.*
  - *Establish educational programs.*

- *2013 Update and Carry Over: See response to TS 1.2, 1.3 and 1.4 and 1.5 above.*

Mitigation Goal: Cross-cutting Goal
Objectives:
See goals and objectives related to flooding.

VOLCANO
The threat of volcano eruption is not considered to be a severe or high-priority threat for communities or infrastructure within the Yurok Indian Reservation due the distance from the Reservation to the closest known active volcanoes.

WILDFIRE
WF.1: Mitigation Goal: Minimize damage to infrastructure and property from wildfire.

Objective
- *WF.1.1 - By 2007, construct a fire station on the upper Reservation in the Tulley Creek Community that can accommodate the expansion of wildland fire services on the Reservation (funded by HUD-ICDBG).*
- *2013 Update: Since completion of the 2006 plan, a new fire station has been constructed with ICDBG funds within the Wautec area. The Tribe will continue to seek funds to build a station in the Tulley Creek Area.*
- *Carry over to 2013 Plan: #S-53*

- *WF.1.2 - By 2007, apply for FEMA grant funds to increase training opportunities of the Yurok Volunteer Fire Department.*

- *2013 Update: Strategy removed. No FEMA funds were received for this initiative.*

- *WF.1.3 - By 2008, fund a wildland engine crew, supervisors and support programs through National Wildland Fire Fighting Program.*
- *2013 Update: Funding did not allow the establishment of a wildland engine crew, although there is a limited volunteer fire department (pre-existing 2006). However, the Tribe continues to make this a priority and continues to seek funding to provide equipment, personnel and facilities for the Reservation.*
- *Carry over to 2013 Plan: #'s 54*

- *WF.1.4 - By 2010, add fire hydrants to a minimum of fifty homes in the up-river communities of the Reservation.*
- *2013 Update: No progress made during 2006-2013 timeframe.*
- *Carry over to 2013 plan: #S-34, 35, 36, 37,*

- *WF.1.5 – By 2010, purchase two new fire trucks and a water tender.*
- *2013 Update: Funding did not allow for the purchase of new fire trucks or water tenders.*
- *Carry over to 2013 plan: #S-54, 55*

WINDSTORM

WIN.1: Mitigation Goal: Minimize damage to infrastructure and property from windstorms.

Objectives:

- *WIN.1.1 - By 2007, establish a public education program to educate public on maintaining private property free of wind hazards (dead trees, etc.)*
- *2013 Update: Public outreach has occurred which addresses all hazards of concern during eh 2006-2013 timeframe.*

- *WIN.1.2 - To minimize disruption in service due to high winds, encourage the installation of underground power lines whenever economically feasible and to the greatest extent possible.*
  Alternatives:
  - *Establish educational programs.*
  - *Influence future design of power grid.*

2013 Update: No progress has been made on this effort during the 2006-2013 timeframe, due to the fact that the Tribe does not control the power distribution lines, and the power companies have refused to address this issue. In addition, much of the Reservation remains without power. The Tribe continues to see this as a priority and will continue to work with the power distributors in an effort to enhance resiliency on the Reservation in this capacity.
Carry over to 2013 Plan: #S-22, 56

WIN.2: Mitigation Goal: Minimize health and human safety risks from windstorms.

Objectives:

- *WIN.2.1 - By 2010, upgrade community and individual water systems to have the capacity to store at least three days' water supply in the event of a prolonged power outage.*
- *2013 Update: The Tribe continues to seek additional water supplies, including from new wells, storage tanks and potable water tanks. As new construction has occurred on the Reservation, such as with the Fire Station Wautec and the Shelter, the Tribe has used these opportunities to increase capabilities to the best of their abilities; however, as much of the water is provided from outside purveyors, their abilities to address this are limited. The Tribe continues to seek opportunities to increase water storage capacities through potable water tenders and additional wells, as well as through establishing policies and procedures for the use of the Klamath River during drought times, and will continue these efforts during the 2013-2018 timeframe.*

- *WIN.2.2 - By 2007, establish shelter capabilities in populated areas for feeding community members if necessary in the event of a prolonged power outage.*
- *2013 Update: One shelter completed with HUD funds during 2006-2013 timeframe.*

- *WIN.2.3 - By 2007, improve assistance and outreach to elders and sensitive populations in times of prolonged power outage.*
- *2013 Update and Carry Over: See previous outreach strategies discussed above.*

- *WIN.2.4 - By 2008, ensure emergency generation on all critical building and infrastructure.*
  Alternatives:
  - *Upgrade community and individual water system storage.*
  - *Establish and equip emergency shelter areas.*
  - *Improve assistance and outreach to elders and sensitive populations.*

2013 Update and Carry Over: See #FL 2.4 above.