

HAZARD
VULNERABILITY
ASSESSMENT

UPDATE



City of Kirkland

January 2005

Hazard Vulnerability Assessment

for the

City of Kirkland, Washington

January 2005

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Developed by



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A. INTRODUCTION

This document updates critical data used in 1996 during the original systematic analysis of existing and potential natural and man-caused hazards that impact the city of Kirkland. This need is apparent, because of continued growth of high intensity uses in the city and recent experiences dealing with hazards. The use of the most current jurisdictional data and inventory of current incidents enhances the value of the original Hazard Vulnerability Analysis (HVA) completed in 1996. In addition, GIS maps showing definitive locations of existing and potential hazard areas are incorporated in the document to give city emergency planners and executives a firm framework for developing policies that will go far in protecting life and property. The original document contains many mitigation strategies still of value to the jurisdiction. These have been retained and, in some instances additional strategies or actions have been incorporated if they were considered "value added."

The scope and purpose of the original HVA and this update is not to specifically quantify the levels of risk (e.g. there is a 10% or a 90% chance of this event occurring within the next year or 10 years) within the identified risk areas, nor to suggest solutions of how the city of Kirkland should deal (policies) with the existence of some level of risk. However, the community, utilizing key elected and appointed officials, will decide how it intends to deal with the existence of potential threats. As part of the planning process, it is expected that local efforts will find potential solutions in the form of mitigation strategies, along with preparedness and response training.

The updated Kirkland HVA document is organized very similar to the original document, with one significant change; the Executive Summary becomes a tool that Emergency Program Managers can use to quickly visualize total impacts from each potential hazard. A hazard summary sheet will be developed, accompanied by one or more matrices that identify direct and secondary potential impacts and specific strategies for mitigation. The main background text will still be contained in the appropriate chapters, but significant material will reside in the Executive Summary.

The first part of this document describes and updates Kirkland's physical setting, economic productivity, and infrastructure support systems (a description of the resources that Kirkland has to work with everyday). Research and case studies reflect that disaster and major emergency situations take things away. Each hazard is defined and the potential effects of that threat are listed for the community (the potential or actual impacts to people, property, the economy and the environment as they apply). Suggested mitigation strategies and guidelines are then listed that represent the most common approaches being used across the country to lessen or eliminate the threat.

Sixteen potentially major hazards or situations are identified for the city of Kirkland in this study. The dilemma for policy makers and agency executives is whether to undergo comprehensive preparation for all threats or concentrate on those hazards considered highly probable and a priority because of their potential. This issue alone constitutes a major policy decision for the emergency management program. It should be recognized by planners and executives alike that the primary hazards identified may have the possibility of creating additional threats and adverse effects within the city; sometimes more devastating than the hazard itself. This certainly must include developing a program to inform the public of their roles and responsibilities. Efforts of this nature tend to minimize the impact and encourage self-sufficiency during any periods of disaster or major emergency. The city's own mission statement of purpose states "We are committed to the enhancement of Kirkland as a community for living, working and leisure, with an excellent quality of life which preserves the city's existing charm and natural amenities." In order to accomplish these very basic goals, the essential elements of this document should be reviewed annually, and used consistently for planning and policy development.

The principal threats or hazards that may occur in, or around, the city of Kirkland have been identified and appropriate data updated in this document. While it certainly points out the major events that might occur, it is by no means all inclusive for this snapshot in time. Changes in climatic conditions, anomalies in weather, and catastrophic events along with man-made or technological hazards creates changing conditions. That is why this document must be reviewed and updated on a regular basis as a minimum requirement.

B. GENERAL SUMMARY OF FINDINGS

This assessment of the original Kirkland HVA is based on the most current jurisdictional and hazards data and discusses existing natural and man-caused problems that may occur in the city. The following is a general summary of findings:

- There has been a significant increase in population growth in the city, and changes in the demographics with increases in special populations (elderly, handicapped, and others).
- Substantial increases in property values and growth in development activity, including future annexations.
- An increase in training within the emergency responder cadre and development of multiple mutual aid agreements with surrounding jurisdictions.
- Some special programs in place to educate the public on emergency preparation and awareness. This includes a seismic retrofit building program.
- An increase in the introduction of hazard mitigation principles in comprehensive planning and ordinance development activity.
- Implementation of projects to improve storm water, sewer, and transportation systems.

The city has made some major strides in improving the condition of critical lifelines, but community emergency managers know, the task is not finished. As infill occurs, the potential impacts from natural and man-caused disasters will increase dramatically, since more people and property will be at risk. The threats are real, as evidenced by the recent Nisqually Quake that struck in the Puget Sound Area. A few miles closer, and the city would have experienced many impacts to critical lifelines and substantial economic losses. Again, it must be noted that some jurisdictions in Thurston and King counties are still undergoing recovery operations, and the quake occurred over three years ago. Although the city's Comprehensive Emergency Management Plan, updated in January, 2004, is a highly detailed document that provides a blueprint for amassing resources and responding to jurisdictional emergencies, it is apparent there exists a need for further training, preparedness, and planning by all personnel and will require a firm commitment from all agencies and organizations in the city. Disaster planning requires effective procedures endorsed by city management to ensure all parts of the emergency management cycle are addressed; Mitigation, Preparedness, Response, and Recovery.

C. SUMMARY OF HAZARDS: DESCRIPTION, WARNING TIME, EFFECTS AND IMPACTS

1. CIVIL UNREST/DISOBEDIENCE

Civil unrest is any incident which has the intent to disrupt a community to the degree that police intervention is required to maintain public safety.

Civil unrest comprises a diverse selection of actions or events that could include labor disputes or dissatisfaction, civil disobedience, demonstrations, riots, and verbal or physical attacks on individuals or groups. Precipitating factors could include racial tension, unemployment, a decrease in normally accepted levels of services or goods such as water, food, gasoline and certainly unpopular political actions or decisions such as the Vietnam War. Current social issues such as abortion, HIV and drug testing also have the potential to trigger civil unrest, as it has in other parts of the country. The militia movement, and more recently, the riots in Seattle during the World Trade

Organization in November and early December, 1999, emphasize the increasing potential for this activity throughout society and in this area.

1. CIVIL UNREST/DISOBEDIENCE					
Warning Time	Primary Effects of Hazard	Impacts on People	Impacts on Property/Facilities/Infrastructure	Impacts on Economy	Impacts on Environment
<ul style="list-style-type: none"> Minimal- No 	<ul style="list-style-type: none"> Explosion Fire Toxic Release/Hazardous Substance Spill 	<ul style="list-style-type: none"> Debris in Streets Disrupted Commercial Services Disrupted Government Services Displaced Populations Human Safety Mass Casualties Multiple Deaths Psychological Hardship Stranded 	<ul style="list-style-type: none"> Air Transportation Disruption Bridges/Roads Building/Structure Collapse Damaged Buildings-Commercial Damaged Buildings-Public (Critical Facilities) Damaged Buildings-Public (Essential Services) Damaged Buildings-Public (General Use) Damaged Buildings-Residential Damage to Identified Historical/Cultural Resources Surface (Road/Rail) Transportation Loss or Disruption 	Business Interruptions: <ul style="list-style-type: none"> Temporary Loss of Capital Stock, Loss of Tax Base Unemployment: <ul style="list-style-type: none"> Short Term 	<ul style="list-style-type: none"> Air Pollution Fire

2. COLD WAVE

A Cold Wave is any period of time exceeding 3 to 5 days in which temperatures drop drastically (in teens and below) for extended periods. Statistics gathered by the Federal Emergency Management Agency indicate that deaths and injuries from severe cold and associated problems have been steadily increasing in the past few years nationwide. Every year, needless lives and property are lost and countless people suffer severe hardships due to extreme cold conditions that bring a combination of freezing rain, ice, and even excessive buildups of snow. Severe cold weather can be a killer unless you plan ahead.

2. COLD WAVE					
Warning Time	Primary Effects of Hazard	Impacts on People	Impacts on Property/Facilities/Infrastructure	Impacts on Economy	Impacts on Environment
<ul style="list-style-type: none"> • 12+ Hours 	<ul style="list-style-type: none"> • Extreme Cold/Freeze • Ice • Snow 	<ul style="list-style-type: none"> • Disrupted Commercial Services • Disrupted Government Services • Downed Power Lines • Entrapment • Health • Human Safety • Isolated Areas • Mass Casualties • Multiple Deaths • Psychological Hardship • Stranded 	<ul style="list-style-type: none"> • Air Transportation Disruption • Bridges/Roads • Electric Power Outage • Media (Radio/TV/Print) Loss or Disruption • Pipeline Systems Loss or Disruption • Sewer System Loss or Disruption • Surface (Road/Rail) Transportation Loss or Disruption • Telecommunications System Loss or Disruption • Water System Loss or Disruption 	Business Interruptions: <ul style="list-style-type: none"> • Temporary Unemployment: <ul style="list-style-type: none"> • Short Term 	<ul style="list-style-type: none"> • Damage to Critical Environmental Resources

3. DROUGHT

Drought is a deficiency of precipitation, creating an imbalance between available water supply and demand. The national Weather Service defines drought as less than 60 percent of normal precipitation over a prolonged period of time. Long periods of dryness decreases soil moisture, lowers water tables, affects the availability of water, and disrupts the environmental processes of an area. Droughts are usually considered temporary, but often re-occur. Thus, depending on drought frequency, a solution might be to reduce demand and/or augment the existing water supply from other sources. Some communities experience water shortages; i.e. a lesser amount of water utilized by the community than normal. These conditions are partially dependent upon existing drought conditions, lack of water storage capacity, and an unwillingness to conserve water during the drought period.

3. DROUGHT					
Warning Time	Primary Effects of Hazard	Impacts on People	Impacts on Property/Facilities/Infrastructure	Impacts on Economy	Impacts on Environment
<ul style="list-style-type: none"> • 12+ Hours 	<ul style="list-style-type: none"> • Drought • Extreme Heat • Fire 	<ul style="list-style-type: none"> • Air Quality • Disrupted Commercial Services • Disrupted Government Services • Human Safety • Mass Casualties • Multiple Deaths • Psychological Hardship 	<ul style="list-style-type: none"> • Electric Power Outage • Sewer System Loss or Disruption • Water System Loss or Disruption 	Business Interruptions: <ul style="list-style-type: none"> • Temporary Unemployment: <ul style="list-style-type: none"> • Short Term 	<ul style="list-style-type: none"> • Air Pollution • Damage to Critical Environmental Resources • Fire

4. EARTHQUAKE

Earthquakes in Washington State, as in other areas of the world, do not follow political boundaries. They tend to cause damage over multiple counties or in the case of "great quakes," they may cause damage over a multi-state or regional area. Current seismic research points to a potentially greater earthquake hazard in western Washington than had previously thought to exist. The belief is that the Puget Sound Region in western Washington has the potential of being effected by earthquakes from the following three sources:

- Downward thrusting Juan de Fuca plate, along the Wadati-Benioff Zone. Many of these, including both the 1949 and 1965 tremors, were located at great depth beneath Puget Sound, in this zone. Seismologists speculate that an earthquake within this plate could be as large as magnitude 7.5.
- Intra-plate movement within the North American plate under the Puget Sound basin. Based on the historical evidence, speculation is that shallow earthquakes from this zone could also range as high as magnitude 7.5.
- Along the 600 mile Cascadia Fault. The least likely, but less probable in any given year, is a large subduction earthquake at the overlap of the North American and Juan de Fuca Plates. An earthquake of this type could range up to a magnitude of 9 or above. Such an earthquake, probably located off the coast, could cause considerable damage and destruction hundreds of miles away from the epicenter.

When an earthquake is recorded, an epicenter is identified where possible. The epicenter of an earthquake is the point on the earth's surface directly above the earthquake's focus.

4. EARTHQUAKE					
Warning Time	Primary Effects of Hazard	Impacts on People	Impacts on Property/Facilities/Infrastructure	Impacts on Economy	Impacts on Environment
<ul style="list-style-type: none"> Minimal-No 	<ul style="list-style-type: none"> Explosion Fire Ground Displacement/Shaking Landslides Mud/Debris Flow Subsidence (sink holes) Tidal Waves/Tidal surge Tsunami/Seiche Toxic Release/Hazardous Substance Spill 	<ul style="list-style-type: none"> Debris in Streets Disrupted Commercial Services Disrupted Government Services Displaced Populations Downed Power Lines Entrapment Health/ Epidemic Human Safety Isolated Areas Mass Casualties Multiple Deaths Psychological Hardship Stranded 	<ul style="list-style-type: none"> Air Transportation Disruption Bridges/Roads Building/Structure Collapse Damaged Buildings-Commercial Damaged Buildings-Public (Critical Facilities) Damaged Buildings-Public (Essential Services) Damaged Buildings-Public (General Use) Damaged Buildings-Residential Damage to Identified Historical/Cultural Resources Electric Power Outage Media (Radio/TV/Print) Loss or Disruption Navigable Waterway Impairment Petroleum Products (Gas/Oil) Loss or Disruption Pipeline Systems Loss or Disruption Sewer System Loss or Disruption Stormwater Drainage Impairment Surface (Road/Rail) Transportation Loss or Disruption Telecommunications System Loss or Disruption Water System Loss or Disruption 	<p>Business Interruptions:</p> <ul style="list-style-type: none"> Permanent Temporary <p>Loss of Capital Stock, Loss of Tax Base</p> <p>Unemployment:</p> <ul style="list-style-type: none"> Long Term Short Term 	<ul style="list-style-type: none"> Damage to Critical Environmental Resources Fire Landslide

5. ENERGY AND FUEL SHORTAGES

An energy or fuel shortage is an interruption of a source of fuel, which supplies the infrastructure, or loss of service for an extended period of time (long enough to require an emergency response for food, water, and heating). It can also be characterized as an unstable or failing of critical lifeline energy systems, such as fossil fuel or hydroelectric generation. These shortages are sometimes tied to world events, such as the curtailment of oil production in the Middle East that led to the long vehicle lines at gas stations in the early '70's. A shortage of energy in one form can affect and cause shortages in other fuels such as propane, heating oil, and residual oil, which are substitutes for natural gas. These emergencies can threaten both our health and livelihoods. Natural disasters that cause mass evacuations can also trigger shortages, both in fuel for vehicles and electricity for primary functions. Many in the community suffer, particularly the elderly and other resident-bound segments of the population.

An energy crisis will vary with the type of energy resource involved. For example, a lightning bolt could cause an electric power blackout with no warning, or a truckers' strike could be announced with a week or more to plan for the impending fuel shortage.

5. ENERGY AND FUEL SHORTAGES					
Warning Time	Primary Effects of Hazard	Impacts on People	Impacts on Property/Facilities/Infrastructure	Impacts on Economy	Impacts on Environment
<ul style="list-style-type: none"> • 12+ Hours 	<ul style="list-style-type: none"> • Extreme Cold/Freeze • Extreme Heat 	<ul style="list-style-type: none"> • Disrupted Commercial Services • Disrupted Government Services • Displaced Populations • Health • Human Safety • Isolated Areas • Mass Casualties • Multiple Deaths • Psychological Hardship • Stranded 	<ul style="list-style-type: none"> • Air Transportation Disruption • Electric Power Outage • Media (Radio/TV/Print) Loss or Disruption • Petroleum Products (Gas/Oil) Loss or Disruption • Pipeline Systems Loss or Disruption • Sewer System Loss or Disruption • Stormwater Drainage Impairment • Surface (Road/Rail) Transportation Loss or Disruption • Telecommunications System Loss or Disruption • Water System Loss or Disruption 	Business Interruptions: <ul style="list-style-type: none"> • Permanent • Temporary Unemployment: <ul style="list-style-type: none"> • Long Term • Short Term 	<ul style="list-style-type: none"> • None anticipated

6. EPIDEMIC

An epidemic is a disease transmitted either by animals or humans, which becomes widespread in a particular place at a particular time. The possibility of catastrophic disease affecting humans or animals within the confines of the city of Kirkland (or the county) is a very real, although seldom considered, threat. Epidemics, both animal and human, are usually introduced through some vector or carrier from outside the immediate area.

An epidemic disease may be something exotic that was brought in with animals, either legally or illegally, from other parts of the country or world. For the most part, a clean water supply, effective sewage and waste disposal, and aggressive monitoring and treatment of potential disease outbreaks by public health officials, have kept the

entire region free of serious epidemics. While the effects of disease on large segments of the population have been relatively minor, the potential for large epidemics still continue to exist in this country.

A disease of epidemic proportions in Kirkland would likely be introduced by persons, animals, materials outside the jurisdiction, or by conditions that were created in the city environment for short periods of time. In addition, the potential for an epidemic would increase dramatically in the event of a major disaster, such as an earthquake. In such case, disease could reach a much larger population due to the absence or breakdown of normal sanitation and other intervening factors.

All animals entering Washington State are required to have a certificate of health. For some species, tests or vaccinations are required. However, there is limited control over companion animals entering the city from other states. Thousands of pets move from state to state on a daily basis without any controls because their owners never realize that health certificates are required.

6. EPIDEMIC					
Warning Time	Primary Effects of Hazard	Impacts on People	Impacts on Property/Facilities/Infrastructure	Impacts on Economy	Impacts on Environment
<ul style="list-style-type: none"> Minimal-No 	<ul style="list-style-type: none"> Not Applicable 	<ul style="list-style-type: none"> Disrupted Commercial Services Disrupted Government Services Displaced Populations Health/Epidemic Human Safety Isolated Areas Mass Casualties Multiple Deaths Psychological Hardship 	<ul style="list-style-type: none"> Air Transportation Disruption Surface (Road/Rail) Transportation Loss or Disruption Water System Loss or Disruption 	Business Interruptions: <ul style="list-style-type: none"> Permanent Temporary Unemployment: <ul style="list-style-type: none"> Long Term Short Term 	<ul style="list-style-type: none"> None anticipated

7. FIRE (CONFLAGRATION)

This Analysis does not focus on the everyday fire response hazard in Kirkland. The problems and response-related planning issues for fire in Kirkland have already been studied and discussed in the city's 1991 Fire Protection Master Plan. That document is being used extensively to guide the city's direction and focus for fire protection into the year 2000 and beyond.

Kirkland has changed dramatically in recent years with respect to the threat of fire. In the past, the community was primarily made up of mostly single story or two story structures located in easily accessible locations. Now, Kirkland is an urban community comprised of large shopping centers and complex residential and commercial centers that blend natural environment with man-made structures. With an expanding population and the search for privacy and semi-isolation, some limited areas of wildland (natural/urban) interface, brush pockets and wooded ravines exist in very close proximity to multi-tenant buildings and private residents. The threat from fire and related secondary effects has created a very real potential in some areas.

The majority of fires which are dealt with on an annual basis by the fire department, are relatively small, but due to staffing, the total number of calls, and federal and state mandates, mutual aid companies are usually called. Real problems could arise however, if a fire occurred at the end of a particularly long, dry season and covered a broad area, perhaps some wooded steep terrain and/or combined with multiple tenet dwellings. Although unusual in its characteristic, underlying conditions, conflagration or firestorms are certainly a real possibility in some areas of Kirkland. This would be especially true in the aftermath of a major earthquake, windstorm or extended dry period with accompanying winds.

7. FIRE (CONFLAGRATION)					
Warning Time	Primary Effects of Hazard	Impacts on People	Impacts on Property/Facilities/Infrastructure	Impacts on Economy	Impacts on Environment
<ul style="list-style-type: none"> Minimal-No 	<ul style="list-style-type: none"> Explosion Fire Toxic Release/Hazardous Substance Spill 	<ul style="list-style-type: none"> Air Quality Debris in Streets Disrupted Commercial Services Disrupted Government Services Displaced Populations Downed Power Lines Entrapment Human Safety Isolated Areas Mass Casualties Multiple Deaths Psychological Hardship 	<ul style="list-style-type: none"> Air Transportation Disruption Bridges/Roads Building/Structure Collapse Damaged Buildings-Commercial Damaged Buildings-Public (Critical Facilities) Damaged Buildings-Public (Essential Services) Damaged Buildings-Public (General Use) Damaged Buildings-Residential Damage to Identified Historical/Cultural Resources Electric Power Outage Media (Radio/TV/Print) Loss or Disruption Petroleum Products (Gas/Oil) Loss or Disruption Pipeline Systems Loss or Disruption Sewer System Loss or Disruption Surface (Road/Rail) Transportation Loss or Disruption Telecommunications System Loss or Disruption Water System Loss or Disruption 	Business Interruptions: <ul style="list-style-type: none"> Permanent Temporary Loss of Capital Stock, Loss of Tax Base Unemployment: <ul style="list-style-type: none"> Long Term Short Term 	<ul style="list-style-type: none"> Air Pollution Damage to Critical Environmental Resources Erosion, Water/Wind Fire Soil Contamination Water Pollution

8. FLOOD

Although the city of Kirkland has no major streams or rivers that create seasonal or flash flooding conditions for its residents, there are numerous locations within the city which can and do experience high water problems of some kind. The threat of inundation to residents and/or businesses in Kirkland is potentially very real. Excessive precipitation, melting snow, culvert obstruction, and/or excessive runoff from impervious surfaces increase peak flow and quantity of runoff and could cause potential damage from flooding in low-lying areas, roads and housing developments.

8. FLOOD					
Warning Time	Primary Effects of Hazard	Impacts on People	Impacts on Property/Facilities/Infrastructure	Impacts on Economy	Impacts on Environment
<ul style="list-style-type: none"> • 12+ Hours 	<ul style="list-style-type: none"> • Fast Moving Water • Excessive Water (flooding) • Landslides • Mud/Debris Flow • Soil/Beach Erosion (wind, water) • Subsidence (sink holes) • Toxic Release/Hazardous Substance Spill 	<ul style="list-style-type: none"> • Debris in Streets • Disrupted Commercial Services • Disrupted Government Services • Displaced Populations • Downed Power Lines • Entrapment • Health/ Epidemic • Human Safety • Isolated Areas • Mass Casualties • Multiple Deaths • Psychological Hardship • Stranded 	<ul style="list-style-type: none"> • Bridges/Roads • Building/Structure Collapse • Damaged Buildings-Commercial • Damaged Buildings-Public (Critical Facilities) • Damaged Buildings-Public (Essential Services) • Damaged Buildings-Public (General Use) • Damaged Buildings-Residential • Damage to Identified Historical/Cultural Resources • Electric Power Outage • Media (Radio/TV/Print) Loss or Disruption • Petroleum Products (Gas/Oil) Loss or Disruption • Pipeline Systems Loss or Disruption • Sewer System Loss or Disruption • Stormwater Drainage Impairment • Surface (Road/Rail) Transportation Loss or Disruption • Telecommunications System Loss or Disruption • Water System Loss or Disruption 	<p>Business Interruptions:</p> <ul style="list-style-type: none"> • Permanent • Temporary <p>Loss of Capital Stock, Loss of Tax Base</p> <p>Unemployment:</p> <ul style="list-style-type: none"> • Long Term • Short Term 	<ul style="list-style-type: none"> • Damage to Critical Environmental Resources • Erosion, Water/Wind • Landslide • Soil Contamination • Water Pollution

9. HAZARDOUS MATERIALS

A hazardous material is any substance, which has been determined to be capable of posing a threat to the life, health, and safety of the general public if exposed to the substance through spillage or dispersal in the atmosphere. These "hazardous materials" are chemical compounds in gas, solid or liquid form that are used to create the everyday products in our homes that benefit the American standard of living. Dispersal or spillage of these chemicals can result from something as simple as overturning a container at a business establishment or the result of an accident on the freeway or roads leading into Kirkland. Hazardous materials have brought the issues of emergency management and preparedness to the doorstep of every individual in our society. The problem is pervasive throughout the country and is not likely to go away anytime in the future. As more and more chemicals are produced, stored, transported and used in our cities, the potential threat can only go up.

There are additional categories of substances, within the family of hazardous chemicals and materials that further describe their characteristics and threat to people. One of those categories is known as "Extremely Hazardous" or EHS chemicals. These substances have the potential for causing death or irreversible toxicity after very short exposure to small amounts. These are the most dangerous because they are acutely toxic. Other categories of chemicals include explosives, gases, flammable liquids, flammable solids, spontaneous combustible materials, wet reactive, oxidizers, radioactive materials, corrosives and biological hazards, such as etiological or infectious materials. It must be noted that any of these substances are dangerous and could cause death or severe injury under the right circumstances.

9. HAZARDOUS MATERIALS					
Warning Time	Primary Effects of Hazard	Impacts on People	Impacts on Property/Facilities/Infrastructure	Impacts on Economy	Impacts on Environment
<ul style="list-style-type: none"> Minimal-No 	<ul style="list-style-type: none"> Explosion Fire Toxic Release/Hazardous Substance Spill 	<ul style="list-style-type: none"> Air Quality Disrupted Commercial Services Disrupted Government Services Displaced Populations Health Human Safety Isolated Areas Mass Casualties Multiple Deaths Psychological Hardship Stranded 	<ul style="list-style-type: none"> Air Transportation Disruption Building/Structure Collapse Damaged Buildings-Commercial Damaged Buildings-Public (Critical Facilities) Damaged Buildings-Public (Essential Services) Damaged Buildings-Public (General Use) Damaged Buildings-Residential Damage to Identified Historical/Cultural Resources Electric Power Outage Media (Radio/TV/Print) Loss or Disruption Navigable Waterway Impairment Petroleum Products (Gas/Oil) Loss or Disruption Pipeline Systems Loss or Disruption Sewer System Loss or Disruption Stormwater Drainage Impairment Surface (Road/Rail) Transportation Loss or Disruption Telecommunications System Loss or Disruption Water System Loss or Disruption 	<ul style="list-style-type: none"> Business Interruptions: <ul style="list-style-type: none"> Permanent Temporary Loss of Capital Stock, Loss of Tax Base Unemployment: <ul style="list-style-type: none"> Long Term Short Term 	<ul style="list-style-type: none"> Air Pollution Damage to Critical Environmental Resources Fire Soil Contamination Water Pollution

10. HEAT WAVE

While the average citizen in Kirkland normally does not think of the area as one subject to intense heat, anomalies in the average weather patterns do create conditions that can be described as "extreme" in terms of heat. A heat wave can be defined as a period of time, lasting several weeks or more, where temperatures average ten degrees or more above the average high temperatures.

10. HEAT WAVE					
Warning Time	Primary Effects of Hazard	Impacts on People	Impacts on Property/Facilities/Infrastructure	Impacts on Economy	Impacts on Environment
<ul style="list-style-type: none"> • 12+ Hours 	<ul style="list-style-type: none"> • Drought • Extreme Heat • Fire 	<ul style="list-style-type: none"> • Air Quality • Disrupted Commercial Services • Disrupted Government Services • Health • Human Safety • Isolated Areas • Mass Casualties • Multiple Deaths • Psychological Hardship 	<ul style="list-style-type: none"> • Electric Power Outage • Sewer System Loss or Disruption • Water System Loss or Disruption 	Business Interruptions: <ul style="list-style-type: none"> • Temporary Unemployment: <ul style="list-style-type: none"> • Short Term 	<ul style="list-style-type: none"> • Air Pollution • Damage to Critical Environmental Resources • Fire

11. LANDSLIDE (ROCK-MUD-SOIL-VEGETATION)

Landslides are masses of dirt, rock, mud, or vegetation, which slip down hillsides or cliffs. It is one form of earth movement. Other types can be generally classed as:

- Landshifts - A sudden motion of the ground, which may cause surface faulting, ground shake, and ground failure
- Mudslides - A sticky mixture of water and earth or dust down steep slopes
- Ground subsidence - Any vertical displacement or downward movement of a level ground surface

It must be noted that excessive precipitation, heavy snowstorms with freeze-thaw cycles, and alteration of existing groundwater patterns can cause any of the above events to occur. However, the emphasis here is on landslides, since they are commonly triggered by heavy seasonal rains or local earthquake activity and are the most common form of land movement with the potential to inflict great damage to land and people.

High landslide hazards generally exist where:

- Slopes are between 15 & 40 percent
- The area has experienced previous landslide activity
- Areas with slopes greater than 15 percent
- Areas where stream or wave action has undercut banks or shoreline
- Imbedded groundwater lenses or impermeable clay

11. LANDSLIDE (ROCK-MUD-SOIL-VEGETATION).					
Warning Time	Primary Effects of Hazard	Impacts on People	Impacts on Property/Facilities/Infrastructure	Impacts on Economy	Impacts on Environment
<ul style="list-style-type: none"> Minimal-No 	<ul style="list-style-type: none"> Landslides Mud/Debris Flow Soil/Beach Erosion (wind, water) Subsidence (sink holes) 	<ul style="list-style-type: none"> Debris in Streets Displaced Populations Entrapment Human Safety Isolated Areas Mass Casualties Multiple Deaths Psychological Hardship Stranded 	<ul style="list-style-type: none"> Bridges/Roads Building/Structure Collapse Damaged Buildings-Commercial Damaged Buildings-Public (Critical Facilities) Damaged Buildings-Public (Essential Services) Damaged Buildings-Public (General Use) Damaged Buildings-Residential Damage to Identified Historical/Cultural Resources Electric Power Outage Media (Radio/TV/Print) Loss or Disruption Pipeline Systems Loss or Disruption Sewer System Loss or Disruption Stormwater Drainage Impairment Surface (Road/Rail) Transportation Loss or Disruption Telecommunications System Loss or Disruption Water System Loss or Disruption 	Business Interruptions: <ul style="list-style-type: none"> Temporary Loss of Capital Stock, Loss of Tax Base Unemployment: <ul style="list-style-type: none"> Short Term 	<ul style="list-style-type: none"> Damage to Critical Environmental Resources Erosion, Water/Wind Landslide Water Pollution

12. LOST, MISSING, TRAPPED OR OVERDUE PERSON

Each year, literally thousands of incidents relating to lost, missing or overdue people of all ages and descriptions are reported to local authorities. Many are considered abductions or kidnappings and are specifically handled as missing persons with criminal implications through law enforcement and other investigative channels at local, state and federal levels. However, the most significant numbers of incidents involve situations like walkways from Senior Centers or home environments (Alzheimer's patients etc.), or children who wander away from a park, their back yard or a playground through some set of innocent circumstances. People of all ages have become the focus of a search because an accident trapped or incapacitated them in some way. Sometimes it is very difficult to determine whether the incident has criminal implications or not. For this reason, it is essential that any local jurisdiction have clearly defined procedures and protocols for investigating and carrying out a search effort of any kind.

12. LOST, MISSING, TRAPPED OR OVERDUE PERSON					
Warning Time	Primary Effects of Hazard	Impacts on People	Impacts on Property/Facilities/Infrastructure	Impacts on Economy	Impacts on Environment
<ul style="list-style-type: none"> Minimal-No 	<ul style="list-style-type: none"> Not Applicable 	<ul style="list-style-type: none"> Entrapment Human Safety Psychological Hardship 	<ul style="list-style-type: none"> Not Applicable 	<ul style="list-style-type: none"> Not Applicable 	<ul style="list-style-type: none"> Not Applicable

13. SNOW AND ICE STORM

Although Kirkland's climate is characterized by mild temperatures, a defined rainy season and considerable cloudiness, snow and/or ice storms of major consequence do occur. Usually winter storms do not produce snow or freezing rain unless the storm track moves in such a way as to bring cold air directly out of Canada or pressure system differential spills an extreme cold influence from inland in the state. Ice storms (freezing rain) are by far the more rare of the two occurrences, but they do occur. These events are caused by rain falling on objects in a below freezing temperature environment.

13. SNOW AND ICE STORM					
Warning Time	Primary Effects of Hazard	Impacts on People	Impacts on Property/Facilities/Infrastructure	Impacts on Economy	Impacts on Environment
<ul style="list-style-type: none"> • 12+ Hours 	<ul style="list-style-type: none"> • Extreme Cold/Freeze • High Wind/Excessive Wind • Ice • Snow 	<ul style="list-style-type: none"> • Debris (snow) in Streets • Disrupted Commercial Services • Disrupted Government Services • Displaced Populations • Downed Power Lines • Entrapment • Human Safety • Isolated Areas • Mass Casualties • Multiple Deaths • Psychological Hardship • Stranded 	<ul style="list-style-type: none"> • Air Transportation Disruption • Bridges/Roads • Building/Structure Collapse • Damaged Buildings-Commercial • Damaged Buildings-Public (Critical Facilities) • Damaged Buildings-Public (Essential Services) • Damaged Buildings-Public (General Use) • Damaged Buildings-Residential • Damage to Identified Historical/Cultural Resources • Electric Power Outage • Media (Radio/TV/Print) Loss or Disruption • Petroleum Products (Gas/Oil) Loss or Disruption • Pipeline Systems Loss or Disruption • Sewer System Loss or Disruption • Stormwater Drainage Impairment • Surface (Road/Rail) Transportation Loss or Disruption • Telecommunications System Loss or Disruption • Water System Loss or Disruption 	Business Interruptions: <ul style="list-style-type: none"> • Temporary Unemployment: <ul style="list-style-type: none"> • Short Term 	<ul style="list-style-type: none"> • Damage to Critical Environmental Resources

14. TERRORISM AND/OR BOMB THREAT

Terrorism distinguishes itself from other forms of violence and hazards by the fact that the intended target is not actually the victim or facility that is seized or attacked. The real target is beyond the terrorist's reach and the victim is simply a perceived symbolic attack on that target.

Terrorists consider the military, police forces and the establishment as their adversaries. These groups are perceived as the protectors of society, and terrorists believe successful terrorist acts against them demonstrate the vulnerability of that society. They believe successful acts also help demonstrate the effectiveness of terror as a agent of change.

Terrorism involves a criminal act, often symbolic in nature, intended to influence an audience beyond the immediate victims. It is the calculated use of violence to attain political, religious, or ideological goals by instilling fear or using intimidation or coercion. Terrorism may be used by individuals or well-organized groups to obtain their goals when other means such as political process, demonstrations or media attention have failed.

14. TERRORISM AND/OR BOMB THREAT					
Warning Time	Primary Effects of Hazard	Impacts on People	Impacts on Property/Facilities/Infrastructure	Impacts on Economy	Impacts on Environment
<ul style="list-style-type: none"> Minimal-No 	<ul style="list-style-type: none"> Explosion Fire Toxic Release/Hazardous Substance Spill 	<ul style="list-style-type: none"> Air Quality Debris in Streets Disrupted Commercial Services Disrupted Government Services Displaced Populations Downed Power Lines Entrapment Health/ Epidemic Human Safety Isolated Areas Mass Casualties Multiple Deaths Psychological Hardship Stranded 	<ul style="list-style-type: none"> Air Transportation Disruption Bridges/Roads Building/Structure Collapse Damaged Buildings-Commercial Damaged Buildings-Public (Critical Facilities) Damaged Buildings-Public (Essential Services) Damaged Buildings-Public (General Use) Damaged Buildings-Residential Damage to Identified Historical/Cultural Resources Electric Power Outage Media (Radio/TV/Print) Loss or Disruption Petroleum Products (Gas/Oil) Loss or Disruption Pipeline Systems Loss or Disruption Sewer System Loss or Disruption Stormwater Drainage Impairment Surface (Road/Rail) Transportation Loss or Disruption Telecommunications System Loss or Disruption Water System Loss or Disruption 	<p>Business Interruptions:</p> <ul style="list-style-type: none"> Permanent Temporary <p>Loss of Capital Stock, Loss of Tax Base</p> <p>Unemployment:</p> <ul style="list-style-type: none"> Long Term Short Term 	<ul style="list-style-type: none"> Air Pollution Damage to Critical Environmental Resources Fire Soil Contamination Water Pollution

15. VOLCANIC ACTIVITY AND ASHFALL

Volcanic activity occurs when a vent in the earth’s crust allows the ejection of molten lava and gases or ash is ejected. Characteristically a conical hill is formed, but the appearance of a volcano may vary, due to the type of material ejected.

Most people in Washington State would have probably laughed in the late seventies if asked if they thought there was a threat to citizens from volcanoes here in the Pacific Northwest. That all changed on May 18th, 1980, when Mt. St. Helens erupted.

We now know and respect these sleeping giant hazards for what they truly are and also what they can do. Of the volcanoes located in Washington State, five are classified as active and one is designated dormant. These mountains are considered active if they have erupted within recent historical time, or are showing present signs of activity. By this definition, Mt. Baker, Mt. St. Helens, Mt. Rainier and Glacier Peak are all active. Dormant volcanoes are those that have not shown signs of erupting within the last 10,000 years. Mt. Adams is considered dormant, but has the capabilities of renewed activity. Both the active and dormant volcanoes of Washington State are classified as composites. Composite volcano eruptions are characterized by explosive emissions of steam, cinder ash, or lava flows.

While the counties and jurisdictions directly adjacent to these mountains certainly bear the brunt of direct life threatening occurrences from an eruption, there are other hazards and secondary complications that constitute a very real threat to other parts of the state, including the city of Kirkland. A good example of this was evidenced in eastern Washington during the Mt. St. Helens eruption. Virtually the entire Puget Sound area was spared all but a dusting of volcanic ash in 1980 simply because of the prevailing winds.

15. VOLCANIC ACTIVITY AND ASHFALL					
Warning Time	Primary Effects of Hazard	Impacts on People	Impacts on Property/Facilities/Infrastructure	Impacts on Economy	Impacts on Environment
<ul style="list-style-type: none"> Minimal-No 	<ul style="list-style-type: none"> Not Applicable 	<ul style="list-style-type: none"> Air Quality Debris (ash) in Streets Disrupted Commercial Services Disrupted Government Services Displaced Populations Health Human Safety Psychological Hardship 	<ul style="list-style-type: none"> Air Transportation Disruption Bridges/Roads Building/Structure Collapse Damaged Buildings-Commercial Damaged Buildings-Public (Critical Facilities) Damaged Buildings-Public (Essential Services) Damaged Buildings-Public (General Use) Damaged Buildings-Residential Damage to Identified Historical/Cultural Resources Electric Power Outage Stormwater Drainage Impairment Surface (Road/Rail) Transportation Loss or Disruption Telecommunications System Loss or Disruption Water System Loss or Disruption 	Business Interruptions: <ul style="list-style-type: none"> Temporary Unemployment: <ul style="list-style-type: none"> Short Term 	<ul style="list-style-type: none"> Air Pollution Damage to Critical Environmental Resources Water Pollution

16. WINDSTORM

Western Washington and the Puget Sound Basin are extremely susceptible to high winds with associated damage and destruction. These windstorms may accompany precipitation of one kind or another, but often they are just hours or day- long periods in which winds may reach in excess of 90 miles per hour somewhere in the Puget Sound area. When accompanied by moisture in the form of rain or snow, these storms can be of even greater danger and cause devastating impact to transportation and communication capabilities. With greater and greater accuracy, the National Weather Service has gained the capability to track these windstorms and also to predict the wind speeds that may be experienced.

16. WINDSTORM					
Warning Time	Primary Effects of Hazard	Impacts on People	Impacts on Property/Facilities/Infrastructure	Impacts on Economy	Impacts on Environment
<ul style="list-style-type: none"> • 12+ Hours 	<ul style="list-style-type: none"> • High Wind/Excessive Wind 	<ul style="list-style-type: none"> • Debris in Streets • Disrupted Commercial Services • Disrupted Government Services • Displaced Populations • Downed Power Lines • Human Safety • Isolated Areas • Mass Casualties • Multiple Deaths • Psychological Hardship • Stranded 	<ul style="list-style-type: none"> • Air Transportation Disruption • Bridges, Roads • Building/Structure Collapse • Damaged Buildings-Commercial • Damaged Buildings-Public (Critical Facilities) • Damaged Buildings-Public (Essential Services) • Damaged Buildings-Public (General Use) • Damaged Buildings-Residential • Damage to Identified Historical/Cultural Resources • Electric Power Outage • Media (Radio/TV/Print) Loss or Disruption • Surface (Road/Rail) Transportation Loss or Disruption • Telecommunications System Loss or Disruption 	Business Interruptions: <ul style="list-style-type: none"> • Temporary Loss of Capital Stock, Loss of Tax Base Unemployment: <ul style="list-style-type: none"> • Short Term 	<ul style="list-style-type: none"> • Damage to Critical Environmental Resources • Erosion, Water/Wind

CURRENT JURISDICTIONAL DATA

Topography and Environment

Kirkland is located in the geological province known as the Puget Sound Basin. Local topography forms a north-south oriented terraced hillside for almost the entire length of the city. Elevations range from about 20 feet along the edge of Lake Washington to a high point in the Bridle Trails neighborhood, about 500 feet above mean sea level. Lakes and wetlands such as Lake Washington, Totem Lake, and Forbes Lake occupy glacial basins and depressions of retarded drainage. The primary geologic unit is till, with local lenses of sands and gravels. Critical soils include those of alluvium, peat, and older clay, which can present development constraints related to drainage, settlement, seismic risk or landsliding. Valleys and lowlands have been carved into the terrain by several large perennial streams, including Juanita Creek, Forbes Creek, and Cochran Springs. All drain westerly towards Lake Washington. (See Map # 1 Topography.)

Environmentally Sensitive Areas

The city has identified areas which require special development standards for protection against flooding, erosion, seismic hazard, and priority habitat. Kirkland's Critical Area Ordinance, the Updated Comprehensive Plan, and the Natural Resource Management Plan provides this direction and control.

Weather

Kirkland weather is influenced by coastal ocean currents on the west, Cascade Mountains to the east, and its location in the Puget Sound lowland province. The Cascades are effective in shielding Kirkland from most continental air masses, creating a mild maritime climate, with few temperature extremes in winter and summer. However, the movement of large continental air masses from Canada during the winter, or from the south during summer months, can create short periods of temperature and precipitation extremes in the area. In general, the prevailing southwesterly circulation from the Pacific Ocean keeps the average winter daytime temperatures in the 40's and the nighttime readings in the 30's. Summer temperatures are in the 70's with nighttime lows in the 50's. The wet season occurs from October to March, with December normally being the wettest month. More than 75 percent of the yearly precipitation falls during the winter months. Annual rainfall for the Kirkland area averages slightly more than 37 inches; however, large storms can cause impacts from flooding, earth movement, and severe erosion.

High winds in the Seattle-Kirkland areas are associated with strong storms crossing the state from the southwest during the winter. Prevailing direction is SSW. However, severe winter storms can create strong northerly winds when high pressure dominates the weather pattern.

Fog or low clouds that form over the Puget Sound area in late summer, fall, and early winter months often dominate the weather conditions during the late night and early morning hours and produce conditions with very low visibility. Extremes in wind speeds and maximum monthly precipitation totals are shown below:

MAXIMUM WIND SPEEDS AND PRECIPITATION MONTH AND YEAR

MONTH	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind												
Speed (mph)	64	46	43	44	39	33	29	38	39	45	66	52
Year	'93	'88	'91	'90	'93	'94	'94	'91	'90	'90	'81	'93
Rain												
Amt.(inches)	12.9	9.1	8.4	6.5	4.7	-	-	-	5.9	8.9	10.7	11.8
Year	'53	'61	'50	'91	'48	-	-	-	'78	'47	'90	'79

Based on 30 years of data, the first and last occurrence of freezing temperatures (32 degrees) is November 11th and March 24th. The following table shows the mean temperature by month and extreme readings for selected years:

MEAN TEMPERATURE AND EXTREME READING FOR SELECTED YEARS

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Year	'50	'50	'55		'92	'92	'94	'93	'88	'91	'55	'68
High Temp. °F					89	92	100	95	98	83		
Low Temp. °F	0	1	11								6	6
Mean Temp. °F	40.1	43.5	45.6	49.2	55.1	60.9	65.2	65.5	60.6	52.8	45.3	40.5

Snowfall in the Kirkland area is extremely variable, because of complex local weather patterns. There are winters on record with only a trace of snow, but at the other extreme, over 21 inches have fallen in a 24 hour period, and in one instance, over 57 inches in a month. Storms of greater magnitude are fueled by large Arctic air masses out of Canada and snow amounts vary, depending on their trajectory. A strong counter clockwise flow of marine air over a cold Arctic air mass can produce large quantities of snow. The following table shows maximum monthly totals for selected years when snowfall amounts were significantly higher than normal.

SNOW- MAXIMUM MONTHLY TOTALS

Month	Jan.	Feb.	Mar.	Nov.	Dec.
Year	'50	'49	'51	'46	'68
Snow (inches)	57.2	13.1	18.2	17.5	22.1

Another major factor impacting weather in this area is the relationship between the cycle of El Nino-La Nina events, which occur in the equatorial Pacific Ocean and its effect on severe weather phenomena. These naturally occurring events result from interactions between the ocean surface and the atmosphere over the tropical Pacific. These changes impact ocean temperatures and currents, which, in turn cause changes in the weather patterns around the globe. The El Nino phenomenon affects the central and east-central equatorial Pacific. The La Nina phenomenon creates opposite weather conditions than El Nino and causes periodic cooling of ocean surface temperatures in the same region. A strong El Nino usually brings an uncommonly mild and dry winter with less than normal snow or rain and a hot, dry summer as well. Moderate to strong La Nina pattern yields colder temperatures, along with larger amounts of precipitation of winter rain and snow, which could equate to more land instability and floods. An El Nino event usually lasts 9-12 months and returns approximately every 4 years. A La Nina event usually occurs every 3 to 5 years. Suffice to say, these weather phenomena can have a direct impact on weather-related hazards.

Land Use

The city of Kirkland is a residential community, located in King County, on the eastern shore of Lake Washington. It is bounded by Bellevue, Clyde Hill, and Yarrow to the south, Redmond to the east and also by pockets of unincorporated King County, to the north, northwest, and northeast. The population for 2003 was 45,630, making it the seventh largest city in King County and the fourteenth largest in the state. Kirkland population represents 2.6 percent of the total King County population.

The current size of the city is 10.42 square miles, reflecting several periods of growth, twelve times larger since its incorporation in 1905. Gross land area approximates 7,000 acres, with 5,200 acres as part of the developable land base. The city continues to grow and potential future annexations include Finn Hill, North Juanita, and Kinsgate.

Residential land use comprises 63 percent of total land usage. Other uses include commercial-office-industrial (9 percent), institutional (9 percent), vacant (6 percent), and utilities (1 percent). The amount of land allocated to each land use/zoning category is as follows:

CURRENT CITYWIDE ZONING LAND ALLOCATION

Land use Category	Percent in Category
Residential	72 %
Parks/Open Space	10%
Commercial	7%
Office	5%
Industrial	4%
Institutional	2%

Future land uses identified on the City Comprehensive Plan Land Use Map reinforces the existing residential development pattern. As the Plan is implemented, existing land use activities will intensify through infill in many of the city neighborhoods. A primary land use concept articulated in the plan is to create a balanced community to accommodate growth. (See Map # 2 Comprehensive Land Use and Zoning.)

Population, Housing, & Facilities

Population growth in Kirkland is a reflection of annexations of Rose Hill and South Juanita between 1980 and 1990, which added 16,119 people to the jurisdiction and accounted for 76 percent of the city population increase during the decade. However, the typical growth rate for the city is closer to that achieved between 1980 and 1990, at 12.5 percent. King County grew 15.2 percent during the same time period. Population forecasts, based on household growth, projects 50,756 inhabitants by the year 2012. Household statistics show a steady decrease in average household size from 2.28 persons per household in 1990 to 2.13 in 2000, due to a decrease in the number of children per household and an increase in single person households, from 30.1 percent in 1990 to 35.6 percent in 2000. This trend is seen throughout King County and is expected to continue in the future.

Housing in Kirkland occurs in well-established neighborhoods and includes a wide variety of housing styles. In the early 1900's, about half of the housing in Kirkland was single-family homes. This has dropped to just 45 percent over the past ten years, a reflection of the growth in multi-family units, which are typically concentrated near activity areas and commercial centers.

CHANGE IN HOUSING TYPES

Period	Single Family	Multi-Family
1990	49%	51%
2000	44%	56%

Housing densities are variable, depending on the neighborhood and range from an average of 2.68 units/acre in Bridle Trail to 17.25 units/acre in Moss Bay.

At the neighborhood level, the Totem Lake Neighborhood has the greatest percentage of commercial and industrial acreage in the city. The largest percentage of office uses is located in the Lakeview Neighborhood.

The following table shows the variation in density in city neighborhoods.

NEIGHBORHOOD RESIDENTIAL DENSITIES & POPULATION ESTIMATES

Neighborhood	Density	Population
Central Houghton	<i>(No data)</i>	<i>(No data)</i>
Bridle Trails	2.68	2,104
Everest	7.13	1,271
Highlands	4.34	2,462
Lakeview	8.96	2,706
Market	4.03	2,234
Moss Bay	17.25	4,468
Norkirk	5.60	3,683
North Juanita	7.73	4,074
North Rose Hill	5.31	6,333
South Juanita	6.66	7,668
South Rose Hill	4.28	2,964
Totem Lake	14.62	3,076

Population, Housing, and Facilities *(Continued)*

Housing costs have increased by 55 percent since 1996, from \$172,196 to \$267, 508 in 2003.

Kirkland's population is characterized by a mixture of racial types, ages, minorities, and those with special needs. Since 1990, the racial diversity of Kirkland's population has more than doubled from 7.2 to 16.9 percent minority population. The percentage of seniors 65 years and older increased from 9.6 to 10.2 percent of the population. In contrast, the number of children under age 18 has decreased from 20.7 to 18.5 percent. The median age is 36.1 years. Minorities with language problems are another special population category. In year 2000, there were 224 residents who did not speak English and 734 who had trouble with the language.

The 2000 census also records 279 city residents in various types of group quarters. This includes 7 convalescent homes, 2 hospitals, and 7 adult family homes, with a total population of around 960 personnel (residents). It is also estimated there are over 800 city residents over 65 years of age with a disability. Other populations of concern are located in local public and private schools. As of 2004, there were 16 elementary, 3 middle, and 2 high schools, with approximate total enrollment just over 13,000. There are also two colleges; one public, Lake Washington Technical College, and one private school, Northwest College of the Assemblies of God, with enrollments of 2,328 and 1,004 respectfully.

MAIN TYPE OF GROUP QUARTERS AND YR 2004 POPULATIONS

Type	NO	% Total
Adult Family Homes	24	2.5
Nursing Homes	146	16.2
Hospitals & Medical Centers	788	82.3
Total	958	100

Census data also records 826 health care practitioners in the city, including the following clinics staffed with 63 personnel.

CLINICS AND STAFFING

Clinic Name	NO.
Lakeshore Clinics	25
Pacmed Clinics	10
Virginia Mason Clinics	28
Total	63

Public areas where people congregate include the Kirkland City Library and City Hall. The library population varies and there are 103 personnel in City Hall.

Economics

In 2003, taxable retail sales in the city totaled over \$362 million from five distinct economic areas; Downtown, Totem Lake, Houghton, Rose Hill, and Juanita. Retail trade and contracting activities comprise approximately 84 percent of all taxable revenue. Revenue categories by industrial classification are as follows.

2003 TAXABLE RETAIL SALES BY INDUSTRIAL CATEGORY*

Industry	Sales*	% Total
Retail Trade	224	62
Contracting	48	14
Services	36	10
Wholesaling	25	7
Transportation, Communication, & Utilities	16	4
Fire, Insurance, & Real Estate	6	2
Other: Government, Agriculture, Fisheries	4	1
Total	359	100

* Amounts rounded to the nearest million dollar

The Downtown and Totem Lake Neighborhoods dominate the retail, wholesale, and service markets. Numbers of establishments located in major commercial centers within general economic sectors are as follows. (See Map # 4 Business Districts and Neighborhoods.)

NUMBERS OF ESTABLISHMENTS

Sector	Number
Services	981
Wholesale/Retail Trade	575
Finance, Insurance, & Real Estate	237
Construction	208
Manufacturing	79
Other (agriculture, fishing, etc)	47
Transportation/Utilities	46
Government & Education	35
Total	2,208

Businesses paid approximately \$10 million in retail sales tax to the city in 2003 and comprise the main part of Kirkland's budget revenue, with retail, contracting, and service sectors comprising the largest percentages.

Taxable assessed valuation also indicates wealth and economic stability of a community. In Kirkland, valuations increased by more than 3.7 billion dollars between 1992 and 2002. The median income for Kirkland households approximates \$66,000 and provides more discretionary income than the average resident in King County, the region, or the state.

Kirkland provided approximately 31,592 jobs to the region in 2002 and approximately 23 percent of these workers live within the jurisdiction. Major employers in Kirkland and approximate work force numbers depict the mix of employment sectors.

MAJOR EMPLOYMENT IN KIRKLAND

Employer	# Employed
Evergreen Hospital	2,400
Kenworth Truck Co	450
Captaris	425
Convergys	400
City of Kirkland	394
Larry's Market	350
Costco Wholesale	304
Fred Meyer	280
Evergreen Pharmaceutical	269
Vopak USA	268
Netmanage, Inc	260
Birthday Express Com, Inc	227
Metrocall, Inc.	225
Digeo, Inc	215
Lake Vue Gardens	200
Lake Wash. Tech College	200
Travis Industries	200
Totals	7,067

PUBLIC SERVICES AND UTILITIES

Transportation

Approximately 76 percent of Kirkland's work force drives in single occupancy vehicles (SOV's), 5.5 percent use mass transit (METRO), and 18.5 percent carpool. The main north-south route I-405 has three interchanges providing connections to Kirkland's arterials and the downtown business community. METRO and Sound Transit currently provide mass transit options for residents, including park and ride stations and 26 different routes. The work force suffers many delays due to congestion on the main arterials, particularly, I-405. Traffic problems along this corridor create a serious bottleneck and could have dire consequences if needed for transport in times of emergency. Almost 30 percent of all city commuters take more than 30 minutes to travel to work, and many take up to an hour. Kirkland also experiences peak hour congestion primarily in its highly commercial areas (Totem Lake, NE 85th St., and Downtown). By the year 2020, the congested portions of the Puget Sound region's freeway and arterial network are forecast to be far more extensive and delays much longer.

The Washington State Dept. of Transportation is currently undertaking some major improvements to relieve the congestion on I-405. The construction of the first phase, which includes new additional lanes, is scheduled to be completed between 2007-2009. The second phase will occur from 2009-2011. It is anticipated these improvements will provide some relief, but congestion problems will persist and likely worsen. (See Map # 5 Kirkland Vicinity Map.)

Burlington Northern Railroad also has a rail line that runs north and south through the city and supplies building materials to the industrial area and provides the general public with access to a local dinner train. There are nine at-grade crossings and five underpasses in the city.

Publicly used air facilities near Kirkland include Boeing Field and Kenmore Air Harbor, located on Lake Washington, which provides service to Lake Union, San Juan Islands, and British Columbia.

Fire Department and Medical Aid

The 70 uniformed members of the Kirkland Fire Department (KFD) provide fire and emergency response for all types of incidents, including hazardous materials, structure fires, emergency medical services, trench and confined space rescue, near shore water rescue and wildfires. They also serve King County Fire District #41. Additional responses include aid to Northshore Fire, Bothell Fire and EMS, Redmond Fire, Bellevue Fire, Eastside Fire and Rescue, and Woodinville Fire and Life Safety, through automatic mutual aid. The extent of the “first in” coverage is 19.6 sq miles, serving a population of over 80,000. There are five full time stations, staffed 24 hours a day and one reserve station staffed from 7:00am to 7:00pm. Fire stations are distributed in the following locations with the following rolling stock.

Station #	Resources	Location
21	Aid Engine 21 Battalion 21	9816 Forbes Creek Drive
22	Engine 22 Aid 22	6602 108 Ave. NE.
24	Aid 24 Air Unit 21	8411 NE 141 St.
25	Aid 25 Engine 25	12033 76th Place NE
26	Aid 26 Truck 26	9930 124 Ave NE
27	Aid 27 Engine 2 Engine 20	11210 NE 132 St.

KFD is part of the King County Medic One Program, providing EMS response with Northeast King County Medic 1, a consortium of fire departments operating in the Kirkland, Redmond, Woodinville, & Duvall area. Fire Emergency Services has 70 uniformed personnel, directed by the Deputy Fire Chief, who oversees the Emergency Services Division. Major divisions and staffing are as follows.

- Fire Operations and Emergency Medical Services; three shift Battalion Chiefs, seven Captains, eight Lieutenants, and fifty firefighters.
- Training Division; Battalion Chief and a Captain. The Battalion Chief of Training is the designated Safety Officer.

The Training Division is staffed with a Battalion Chief and a Captain and is currently being combined with two neighboring Fire Departments, the Redmond Fire Department and Woodinville Fire & Life Safety. The consolidation of the three Training Divisions facilitates Regional Group Training, which addresses EMTD Competency Based Training (CBT), and state and federal mandated firefighter training. In addition, the Training Division oversees all the training requirements and certification for specialized training, i.e. haz-mat, high angle rescue, confined space rescue, trench rescue, near shore water rescue, and wildland firefighting. A portion of the duties involve community education and information, including emergency preparedness. In addition, twenty-four volunteers serve as support personnel at emergency scenes, and two chaplains provide services for crisis intervention.

Kirkland Fire handles all BLS treatment and transport and is supported by Evergreen Hospital Medical Center for ALS treatment and transport. Both Kirkland Fire and Northeast King County Medic One are part of the King County Medic One Program. The department also has two SCBA-certified technicians. The service shop is at Station 22 and the air compressor and cascade system are located at Station 26.

Incident reporting from the public is achieved through an enhanced 911 system and communications are provided by a joint operating agreement known as the Eastside Public Communications Agency (EPSCA), created as a result of a county-wide public safety bond to bring 800 MHz radios to our region. EPSCA is a sub region provider of 800 MHz radio communications for Police, Fire, Public Works, and school districts.

Fire dispatching is provided by contract with the city of Bellevue, as part of a regional dispatch system, which has been in place for more than twenty years. This regional dispatch allows for automatic aid to be provided in a seamless fashion. Agencies operating under the dispatch center's agreement for service disregard jurisdictional boundaries and send the closest emergency response resources.

The Fire Department has a Class 4 ISO (insurance service office) rating. Surrounding departments such as the city of Bellevue and Redmond have ISO ratings of 2. The lower the number rated, a lower insurance risk is presumed. The Department has an EMS response time of 5.15 minutes and fire response time of 5.88 minutes and meets the National Fire Protection Association Standard of 1.5 firefighters per 1,000 population.

In 2002, 64 percent was for emergency medical services, 11 percent for automatic fire alarms, 3 percent service calls, 2 percent hazardous conditions, and 20 percent other miscellaneous activities. Property losses grew from \$989,230 in 2001 to \$1,232,000 in 2002. (See Map # 6 Fire Response Map.)

Police Department

The Kirkland Police Department provides public safety and crime prevention services 24 hours a day, seven days a week to the residents within the city limits. The staff complement for the department is 62 personnel.

Public Works- Streets, Potable Water, Sewage, and Storm Water

The city's Public Works Department is staffed with 105 employees with responsibility for streets and roads, water, storm water and sewage, traffic flows, signs, engineering, and development as well as inspections.

Streets

Some of the most heavily traveled road segments, with average daily traffic counts over 25,000 vehicles per day are:

- NE 85th St. along 114th, 120th, 124th, & 132nd Aves. NE
- 100th Ave. NE along NE 124th, and 132nd Sts
- NE 116th St. along 120 Ave. NE

- Central Way along 6th St.
- NE 124th St along 116th & 124th Ave. NE
- NE 124th St. along Slater Ave. NE

The Public Works Department has identified areas within the city requiring improvements to the existing traffic system in neighborhoods and city-wide. These upgrades and improvements are scheduled with other planning projects for each neighborhood in the city. (See Map # 7 Streets.)

Water

In the past, the city bought water directly from Seattle Public Utilities. As of January 1, 2004 however, water is purchased from Seattle Public Utilities, as part of the Cascade Water Alliance (CWA) and is under contract to do so through year 2012. CWA collects revenues from capital facilities to fund planning and development of future water sources.

Kirkland currently provides water to all areas of the city, except those north of NE 116th Street, which is served by the Northshore Utility District. It receives all of its water supply from the city of Seattle's Tolt and Cedar River supply pipelines through three joint-use supply stations and also has two additional joint-use facilities that consist of a reservoir and a pump station. The system is primarily gravity driven with 152 miles of water lines and two reservoirs; North Reservoir at Mark Twain Park, 14.2 m. gallons capacity; and South Reservoir at Bridle Trails, 11.2 m. gallons capacity, totaling 25.4 m. gallons available storage capacity. In 2003, the average water usage for 11,427 City connections was 5.21 m. gallons/day.

Projected water system costs are based on those associated with maintenance and replacement of existing structure, since the system is considered "built out". The City of Kirkland 1998 *Comprehensive Water System Plan* indicates water loss was below the average (8-10 percent) for a city the size of Kirkland and the city continues to implement upgrades to the system. In 2003, the city replaced 105 water service lines in conjunction with the street overlay program. In addition, a program to replace water meters each year is well underway and will eventually replace approximately 7,500 lineal feet of asbestos-cement water main with ductile iron pipe as well as valves, hydrants, and fittings. No capacity costs are anticipated through 2022. The 1998 Water System Plan also notes that the city's Water Conservation Program helped stabilize the growth in water demand during a seven year period; 1989 through 1996.

The city has a number of both non-emergency and emergency interties with adjacent purveyors. Interties are defined as "an interconnection between public water systems permitting the exchange or delivery of water between those systems." It maintains three interties to the regional supply system (Told Eastside Supply Line), which provides 100% of the supply. These connections are jointly-owned facilities within the Rose Hill service area and are shared with the cities of Redmond and Bellevue. (See Map # 9 Kirkland Water System.)

Sewage Disposal

The city provides sanitary sewer service to all of its residents south of NE 116th Street, with Northshore Utility District providing sewer service to most residents north of NE 116th Street. The city standard is to provide for a daily average demand of 100 gallons per capita per day.

The sewage collection system consists of 35 wastewater collection basins, 88 miles of sewer pipe, nine lift stations and force mains, and approximately 2,200 manholes. Approximately five to ten percent of city residents use septic systems. The systems most serious deficiency is the age of some of the pipelines. The 45 year-old concrete pipes allow inflow/infiltration and root intrusions, which reduce system capacity and increase operation and maintenance costs. Recently, the city undertook a pilot project of testing for infiltration and inflow problem areas and replaced defective pipes. The primary costs to maintain existing levels of service include replacement and rehabilitation of older pipelines, improvement of pumping capacity, and system expansions in the Lake Plaza,

Central Way, and Juanita Basins.

Sewer

The King County Department of Metropolitan Services (METRO) provides sanitary sewer treatment services at the West Point and Renton treatment plants at a capacity of 100 gallons per day per capita under terms of an intergovernmental agreement. (See Map # 10 Kirkland Sanitary Sewer System.)

Storm Water

A watershed approach has been used for managing the surface water utility by dividing the city into nine drainage basins. The largest and most important streams are Juanita and Forbes Creeks. The size of their drainage basins are especially important for receipt of runoff and discharge into Lake Washington. Most stormwater runoff in the city flows into Lake Washington, with the exception of an area adjacent to 132nd Ave. NE, which drains into Lake Sammamish.

The city maintains conveyance, detention, and water quality treatment systems in public right-of-ways, which accept stormwater runoff and surface water from private property within the city and neighboring jurisdictions. As of 2004, the system contained 364 public and private detention systems, 9,867 public and private catch basins, and approximately 170 miles of public and private pipes. The current 24 hour runoff release rate for development within the city follows the 1998 King County Surface Water Manual and runoff standards vary, depending on site conditions. A general standard, described in Chapter 15.52 of the City Municipal Code states “post-development stormwater flow onto adjacent properties can not exceed pre-development flow”. (See Map # 11 Surface Water System.)

Solid Waste

The city contracts with a local company, Waste Management Sno-King, to collect residential, multi-family, and commercial recycling, garbage, and yard waste. In 2003, approximately 164,000 tons of garbage was sent to the Houghton Transfer station, which is operated by the King County Solid Waste Division. The waste is then transferred to the Cedar Hills Regional Landfill. A new transfer station roof is proposed for construction next year.

Electricity and Natural Gas

Puget Sound Energy (PSE) is a public service company which distributes electricity and natural gas in the city. Electricity is transmitted by the Bonneville Power Administration (BPA), as part of the Northwest power grid. Kirkland is a part of the Eastside and Northshore Electrical Sub areas.

Electricity is delivered on 230 kV transmission lines to several substations and distribution stations for transforming voltage before delivery to customers. In 2003, approximately 500,000 megawatt hours (mwh) were used. Average energy demand per customer for the city was as follows.

AVERAGE ENERGY DEMAND

Customer	Average Demand/Customer
Residential	269,926
Commercial	14,332
Industrial	215,300
Total	499,558

PSE's long range plans indicate the need for three new distribution substations in the city and a new 115 kV line along the eastern and northern boundaries to connect to the Sammamish substation in Redmond. PSE also provides natural gas to the city purchased from Williams Energy. The main distribution pipeline crosses east of Redmond. Existing 4"-8" gas lines in Kirkland, as well as extensions currently anticipated, will service Kirkland's growth.

Telecommunication Service Providers

System facilities within Kirkland include switching stations, trunk lines, and distribution lines. There are four switching stations in the city. Connecting trunk lines are concrete encased four-inch conduit, and distribution lines are either pole-mounted or underground.

Several companies provide wireless telephone service. Cellular telecommunication permits wireless transmission of messages on a network of strategically placed receivers. Cable TV and internet services are fed from a microwave receiving site in Bellevue. The majority of trunk and distribution lines are overhead, rather than underground. Many telecommunication vendors own optic fiber in city right-of-way for commercial use. (See Map # 12 Fiber Optic Network.)

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HAZARD IDENTIFICATION

This document identifies principal threats or hazards that may occur in, or around, the city of Kirkland. This analysis was originally completed in 1996 and now, updated with new jurisdictional information, will more accurately describe hazards, impacts, and needed mitigation measures. While this update certainly points out the major hazards that might occur, conditions will change and this document will need scheduled updates in the future.

Hazards are classed into two groups, based on whether they are naturally-occurring or man-caused.

Events originating from natural phenomena are:

- Cold Wave
- Drought
- Earthquake
- Epidemic (human or animal)
- Fire (conflagration)
- Flood
- Heat Wave
- Landslide & Heavy Erosion
- Snow and/or Ice Storms
- Volcanic Ash Fallout
- Windstorm

Man-caused events are:

- Civil Unrest
- Energy and Fuel Shortages
- Hazardous Materials Spills or Releases
- Terrorism

The discussion on hazards will be developed in the following manner:

- Define the hazard; what are the characteristics
- Discuss historical events that have occurred within the city or region to depict real life scenarios
- Describe potential effects; what could happen if the event were to occur in the city in the present time frame, based on research and the existing jurisdictional conditions.
- Provide suggestions and guidelines for developing hazard mitigation strategies.

Many hazards identified will also reference risk maps showing areas where the hazard has occurred or is projected to occur.

A. CIVIL UNREST/DISOBEDIENCE

1. Define The Hazard

Civil unrest is any incident which has the intent to disrupt a community to the degree that police intervention is required to maintain public safety.

Civil unrest comprises a diverse selection of actions or events that could include labor disputes or dissatisfaction, civil disobedience, demonstrations, riots, and verbal or physical attacks on individuals or

groups. Precipitating factors could include racial tension, unemployment, a decrease in normally accepted levels of services or goods such as water, food, gasoline and certainly unpopular political actions or decisions such as the Vietnam War. Current social issues such as abortion, HIV and drug testing also have the potential to trigger civil unrest, as it has in other parts of the country. The militia movement and more recently, the riots in Seattle during the World Trade Organization in November and early December, 1999, emphasize the increasing potential for this activity throughout society and even in this area.

2. Kirkland Experience

The history of civil unrest activity in Kirkland is definitely at a minimum. While labor disputes may result in strikes, they have never degenerated into violence, which lead to property damage or death and/or injury. That does not mean that such incidents are outside the realm of possibility. Even large crowds of teens and college age students associated with "cruising" have the potential of developing into some type of civil disturbance.

Racial tensions have been known to be high in other areas of the county and state, but even the heightened state of emotions following the shooting of an African-American by Seattle Police, which precipitated marches in Seattle, did not trigger similar demonstrations in Kirkland. There may have been some economic damage to businesses from lost customers because of closed stores and other retail outlets, but no civil unrest per se. Although the population of minority citizens in Kirkland is small, it is growing, but, as a general rule, tends to be on equal socio-economic footing with the surrounding community.

3. Potential Effects

Civil unrest can, in extreme cases, cause extensive social disruption, loss of jobs, extensive property damage and in some cases even needless death. The riots in Los Angeles in October of 1992, following the verdict in the Rodney King trial, is a classic example of civil unrest taken to its extreme. It is entirely possible for a faction from outside of Kirkland to use the city as a kindling point for issues or perceived notions that otherwise may not even be an issue in the jurisdiction. While it is difficult to speculate on the potential events that might trigger such a situation in Kirkland, experiences from other cities definitely indicate what may happen in extreme cases. Los Angeles suffered arson, looting, sniper attacks, traffic disruption, extensive property damage and violent attacks against individuals.

Other issues such as conflicts between anti-abortion demonstrators and pro-choice advocates are possible, but have never materialized. Military intervention overseas always allows anti-war groups to focus on a cause to rally support around. In addition, white supremacy and neo-nazi movements and their backlash demonstrations all hold the potential for problems or threats in the Kirkland area. However, the experience to date is not indicative of any future events.

4. Suggested Mitigation Strategies

The variable nature of civil unrest, combined with the inherent volatility of any such event, demands a very cautious approach to dealing with the situation. Society at large and jurisdictions in particular, if they are to mitigate civil unrest, must be responsive to the social problems that are inherent to the place and time. As conditions arise which could lead to widespread or even isolated civil unrest or disobedience, the prevailing authorities must monitor the situation and then respond accordingly with whatever actions are needed to lessen the tension or resolve issues and/or disputes. Inaction or ignoring such potential is a clear path to failure and escalation of the problem.

5. Specifics

- Recognize conditions that could lead to civil unrest

- Instill vigilance and provide adequate resources to fight crime and threats to law and order.

Subtle changes over time can serve to erode strong community programs that are complacent.

- Increase Police Department attention to training and planning designed to enhance crisis management experience and skills.
- Enhance the Police Department's and city's capability to exercise effective command and control over emergencies.

This should include state of the art communications and an effective jurisdiction-wide operations and coordination center. Full agency participation in threshold planning should also be a policy so the Crisis Action Team can proactively consider any potential threat to the city.

- Maintain a list of local community contacts or leaders who are available to assist when controversial events in the jurisdiction occur.

Frequently, increased tensions are created by influences from outside the city and can adversely affect certain aspects of the social fabric in the community.

- Develop a Civil Disorder Special Response Team of personnel who are specifically trained to intervene before minor disturbances can escalate into illegal activities.
- Keep a pulse on the community through meetings with concerned community members and influential leaders. Use Crisis Action Team advisors early in discussions of potentially controversial events or conditions.

B. COLD WAVE

1. Define the Hazard (Threat)

A Cold Wave is any period of time exceeding 3 to 5 days in which temperatures drop drastically (in teens and below) for extended periods. Statistics gathered by the Federal Emergency Management Agency indicate that deaths and injuries from severe cold and associated problems have been steadily increasing in the past few years nationwide. Every year, needless lives and property are lost and countless people suffer severe hardships due to extreme cold conditions that bring a combination of freezing rain, ice, and even excessive buildups of snow. Severe cold weather can be a killer unless you plan ahead.

2. Kirkland Experience

While Kirkland certainly does not have to endure regular or even annual bouts with extreme cold conditions, the city had to come to grips with this hazard. Despite the normal mild temperatures of Kirkland and the surrounding Puget Sound area, the influence of cold continental air masses can dominate the local weather pattern for weeks. Historical weather data indicates ambient air temperatures have reached zero and the single digit range on numerous occasions. Add wind chill factors to the ambient air temperatures and there will be danger to life and property. There is no better reminder of the city's susceptibility as the impacts from the cold snap that occurred in January of 1996.

3. Potential Effects

Extreme cold temperatures can cause many compounding problems and overwhelm any jurisdiction. A main problem for Kirkland is transmission outages. Widespread power outages in extreme cold weather could generate exposure problems in two factions of the community; the very young and the very old. Also, when

stranded, individuals will leave their vehicles in their attempt to obtain aid or shelter and freeze to death or suffer mild to severe frostbite. At greatest risk in the community are the elderly, who probably account for nearly half of all hypothermia victims across the nation. According to the Center for Environmental Physiology, a national nonprofit research organization which studies and reports on the effects of heat and cold stress, tens of thousands of older Americans literally “freeze to death” in their own homes each year. Hypothermia in this segment of the population is not a result of prolonged exposure out-of-doors. These deaths are a result of cool indoor temperatures, combined with a number of other potential factors:

- Sedentary, inactive life style
- Hypoglycemic blood levels from improper diet
- Potential use of alcohol, and
- Certain types of prescription drugs.

Older senior citizens are at much greater risk during extreme cold conditions and over 10 percent of Kirkland’s population is 65 or older. Hypothermia can also worsen pre-existing conditions and diseases in older people.

Additional complications or hazards from extreme cold could include:

- Increase in fires from overheated stoves and furnaces
- Heart attacks from over-exertion
- Broken bones from falling on icy surfaces
- Frozen pipes and drains
- Difficulty obtaining critical life support resources, such as food, fuel, and medicines
- Carbon monoxide poisoning from people trying to use portable cooking or heating units in closed spaces or motorists stranded in vehicles
- Death or injury to livestock and/or pets
- Economic impacts on retailing and manufacturing

4. Suggested Mitigation Strategies

Carefully designed community public awareness plans are valuable tools to assist in mitigation of impacts from extreme cold. Fortunately, the weather service continues to perfect their prediction methods and can advise officials well in advance of adverse cold conditions. Successful preparedness plans are those that encompass the entire community and reach the most vulnerable, the elderly and dependent special populations. This can best be done by ensuring the caregiver and service agencies are equipped with the right information and have the ability to implement.

Research done by a collective effort from the Federal Emergency Management Agency, The American Red Cross, and the National Weather Service show that to instill a successful public preparedness ethic, a jurisdiction must:

- Ensure messages are consistent and supportive
- Emphasize what people should do, not what they should not do.
- Repeat message often
- Integrate collective efforts throughout the entire community to maximize credibility and assure program success.

Most individuals are not prepared because they don’t really know how to accurately interpret warning messages and simply do not know what to do. People respond to multiple, consistent messages, which enhances their ability to cope. The public at large can be confused by the messages they receive from authorities, so they must be simple, to the point, consistent and tell people what to do.

The following is a list of specific ideas for use in developing mitigation strategies for a cold weather hazard:

- Develop general, pre-scripted messages and public service announcements that contain tips and guidelines for extreme cold temperatures. FEMA and the State Emergency Management Division has specific information for all segments of the population, some already drafted for use with minimal modification. The safety information covers all types of incidents and conditions.
- Develop specific pre-scripted messages targeted to specific populations such as veterinarians, hardware businesses, homeowners, school children, etc.
- Continue to develop winter preparedness bulletins to disseminate via Fire Dept. and other city departments.
- Organize volunteers for phone-in or visiting services among the facilities where senior citizens reside.
- Organize Health Care Providers/Emergency Service workers to present training and preparedness material to staff in homes for the disabled and/or elderly.
- Establish resource lists of auxiliary heating equipment within and outside the jurisdiction.
- Identify specific alternative shelter facilities if evacuations are necessary for special populations.
- Ensure all emergency workers have had training in recognizing, handling and treatment of hypothermia and other exposure caused injuries.
- Ensure the business community understands power grid re-establishment priorities in the event of prolonged outages.

C. DROUGHT

1. Define the Hazard

Drought is a deficiency of precipitation, creating an imbalance between available water supply and demand. The National Weather Service defines drought as less than 60 percent of normal precipitation over a prolonged period of time. Long periods of dryness decreases soil moisture, lowers water tables, affects the availability of water, and disrupts the environmental processes of an area. Droughts are usually considered temporary, but often re-occur. Thus, depending on drought frequency, a solution might be to reduce demand and/or augment the existing water supply from other sources. Some communities experience water shortages; i.e. a lesser amount of water utilized by the community than normal. These conditions are partially dependent upon existing drought conditions, lack of water storage capacity, and an unwillingness to conserve water during the drought period.

2. Kirkland Experience

Historically, droughts have not had significant impacts in western Washington. Not only is the state known as the Evergreen State, it is also referred to throughout the rest of the nation as the “Rain State”. However, the area can experience periods of drought. The first half of 1985 was the driest six-month period in the last 100 years of western Washington history. During January of that year, pollution levels were higher than normal and the air quality decreased, causing a health risk for people with respiratory disorders.

In 1992, the lack of water was perceived as a drought, but in actuality, it was not. That was because of the nature of the problem. The total amount of precipitation which fell in western Washington was well within norms, but because of the “El Nino” phenomenon, the area experienced a warm winter and the snow pack did not develop normally. Most of the water either ran off or soaked into the ground. This created drought-like conditions, but was not considered a drought.

Kirkland’s water supply is provided by the city of Seattle until the year 2012. The city has upgraded their water distribution system and has joined the Clean Water Alliance to pursue future water supplies as needed. However, during acute water shortages, it is possible to strain existing supplies, since the existing system

also provides water to a significant portion of King County and all of Seattle.

3. Potential Effects

A severe drought over an extended period in Kirkland has the potential to create serious problems:

- Water for fire protection may not be available or inadequate pressure flow
- Reduction of adequate pressure for building sprinkling systems
- Increased fire danger throughout the city (urban and rural)
- Reduction in air quality
- Loss of landscaping on public and private property
- Possible “brown outs” and increased utility rates
- Curtailed use of water for recreation and other ancillary uses

4. Suggested Mitigation Strategies

As Kirkland continues to grow, the demand for water will also have to expand. Many years ago, people thought there was an infinite amount of water for everyone. Today, the limits are beginning to be understood much more clearly. Water is viewed as a very scarce commodity and many researchers and scientists predict water will be more valuable than oil in the next 20-30 years.

Drought mitigation strategies can take many forms. The city has recently completed some much-needed repairs to their existing water distribution system to control leakage and water pressure problems. However, proactive planning strategies involving short and long-term conservation measures need to be implemented before a drought situation hits the jurisdiction. An example of this is the Regional 1% Water Conservation Program begun in 1999, designed to reduce personal and business water consumption in the service area by 1 percent each year through 2010, with a total savings goal of 18 MGD. The program also offers fixture and equipment rebate programs for residential and commercial water customers.

Historically, short-term curtailment of demand can be achieved through a vigorous public information program, which can include both voluntary and enforceable actions. The curtailment is temporary and after a shortage is over, consumers usually resume their former water use habits. Long-term resource management involves efficient use and resource protection strategies designed to effect permanent change of water management and use.

Experience has shown that periods of prolonged hot weather will increase water consumption by at least five percent over normal rates. The jurisdiction should use this as the “worse case” scenario.

5. List the Options and Make Them Known

The city could meet with key utility members and the public and develop a comprehensive list of options. The list could be organized according to three stages of water shortage; minor, moderate, and severe. Then, conservation options could be added, deleted, or modified to fit a utility or jurisdiction’s unique circumstances. Types of actions are identified as follows:

- *Public Information*- develop educational materials and activities on reducing water consumption.
- *User Restriction*- make requests to curtail or eliminate water use by various utility customers and can include rationing (e.g. restaurants may be asked not to serve water except upon request)
- *Government*- identify activities that state and local government agencies (including public water utilities) could undertake to reduce water consumption, such as reduced irrigation of public parks and curtailment of hydrant and main flushing. Also includes development and passage of any ordinances and regulations necessary to promote conservation of water.

- Pricing- adjust rates to encourage conservation (uniform or inclining) and implement pricing incentives/disincentives while shortages are in effect.
- Penalty- levy fines or disconnect service if certain conservation or rationing activities are not followed.

6. Stages of Water Shortages

The three stages of water shortage trigger different strategies for water conservation.

Stage 1: Minor Shortage-Voluntary Measures

This is the first step in reducing water consumption during a potential or actual water shortage. Based on experiences in other states, a five to ten percent reduction in consumption can be achieved with a voluntary program.

Jurisdictional Response:

- Initiate a voluntary reduction program, based on public information and outreach activities.
- Implement a well thought out Public Information Campaign, asking for citizen cooperation to meet conservation goals.

It is important to work with the media to ensure the information on the shortage is reported accurately. Public confidence can erode with inaccurate information.

Stage 2: Moderate Shortage-Mandatory Program

Based on experience of utilities in other states, a 10 to 20 percent reduction in consumption can be achieved with a mandatory program.

Jurisdictional Response:

- Institute mandatory conservation measures, enforceable under the authority of special ordinances, or a revised rate schedule.

Stage 3: Severe- Rationing Program.

Upwards of 30 percent savings can be achieved with a water- rationing program.

Jurisdictional Response:

- Institute mandatory conservation measures, enforceable under the authority of special ordinances, or a revised rate schedule.
- Institute rationing programs through fixed allotments or percentage cutbacks.

This strategy allows maximum amount of water savings possible in the community without severe hardship, enforceable by ordinance. However, it should not be implemented only in rare circumstances.

SPECIFIC STRATEGIES FOR STAGES OF WATER SHORTAGES

Stage	Water Shortage Condition	Consumption Reduction Goal (Percent)	User Restrictions
1	Minor Voluntary Measures	5-10%	<ul style="list-style-type: none"> • Increase meter reading efficiency and meter maintenance • Promote intensive leak detection and repair program • Draft and adopt ordinances banning water waste • Draft and adopt ordinances allowing a utility to declare a water emergency and requiring: <ul style="list-style-type: none"> - fixed consumption allotments or percentage cutbacks (rationing) - all homes and businesses to have retrofitted showers and toilets.
2	Moderate Mandatory Program	10-20%	<ul style="list-style-type: none"> • Reduce water usage for main flushing, street cleaning, public fountains, and park irrigation. • Watering of parks, cemeteries, etc., restricted to nights or designated irrigation days
3	Severe Rationing Program	20-30%	<ul style="list-style-type: none"> • All public water uses not required for health or safety prohibited unless using tank truck water supplies or reclaimed waste water • Pool covers required for all municipal and private pools • Only flush water mains if emergency • Restrict irrigation of public parks, cemeteries, etc. • Reduce system pressure to minimum permissible levels

D. EARTHQUAKE**1. Define the Hazard**

Earthquakes in Washington State, as in other areas of the world, do not follow political boundaries. They tend to cause damage over multiple counties or in the case of "great quakes", they may cause damage over a multi-state or regional area. Current seismic research points to a potentially greater earthquake hazard in western Washington than had previously thought to exist. The belief is that the Puget Sound Region in western Washington has the potential of being effected by earthquakes from the following three sources:

- Downward thrusting Juan de Fuca plate, along the Wadati-Benioff Zone. Many of these, including both the 1949 and 1965 tremors, were located at great depth beneath Puget Sound. Seismologists speculate that an earthquake within this plate could be as large as magnitude 7.5.
- Intra-plate movement within the North American plate under the Puget Sound basin. Based on the historical evidence, speculation is that shallow earthquakes from this zone could also range as high as magnitude 7.5.
- Along the 600 mile Cascadia Fault. The least likely, but less probable in any given year, is a large subduction earthquake at the overlap of the North American and Juan de Fuca Plates. An earthquake of this type could range up to a magnitude of 9 or above. Such an earthquake, probably located off the coast, could cause considerable damage and destruction hundreds of miles away from the epicenter.

When an earthquake is recorded, an epicenter is identified, if possible. The epicenter of an earthquake is the point on the earth's surface directly above the earthquake's focus.

2. Measurement of Intensity and Ground Motion

Earthquakes are measured in two ways. The Modified Mercalli Intensity scale measures the earthquake intensity by the damage it causes. For example: Level 8 on the Mercalli Scale which goes to Level 12 would result in drivers having trouble steering, houses not bolted down would shift on their foundations, tall structures such as towers and chimneys might twist and fall. Well-built buildings would suffer slight damage, with poorly built structures suffering severe damages. Tree branches would break, water levels in wells would change and wet soil on hillsides would crack and slide as well.

The Richter Magnitude Scale is a mathematical scale, which measures the intensity of ground motion. Magnitude 3.5 to 5.4 would be felt, but only minor damage would occur. 6.1 to 6.9 magnitude would definitely be destructive in areas where people live. 7.0 to 7.9 magnitude would be considered a major earthquake that would cause serious damage. Magnitude 8 and above is considered a great quake and would result in total destruction to nearby communities. Because of the logarithmic basis of the Richter Scale, each whole number increase in magnitude represents a tenfold increase in measured amplitude and 31 times more energy being released. A 7.5 magnitude quake would have the released equivalent energy of 1 million tons of TNT. For example, it is estimated that the Great Alaskan Quake of 1964 released the equivalent of 31.6 tons of TNT.

3. Evidence of Regional Quakes

It is generally accepted that Washington State has had over 1000 earthquakes large enough to be felt since recorded evidence began over this last century. These have ranged in intensity from barely being felt to the estimated 7.5 earthquake of 1872, whose epicenter was located under Lake Chelan in the North Cascades.

Research indicates that quakes originating along the Cascadia Fault have generated much greater magnitude subduction earthquakes in the past. Quakes of magnitude 8 and over, while infrequent, appear to have occurred at unequal intervals over the past several thousand years. At least 13 great subduction earthquakes have occurred in the Pacific Northwest over the past 7000 years. Recently scientists in Japan and the US have corroborated evidence that shows the impact from a large quake that hit the area the first part of the 18th century. Assessment of annular growth rings of dead cedar trees confirm that in the year 1700, a great earthquake struck the Pacific Northwest coast and set off a tsunami that flooded coastal Japan.

4. Kirkland Seismic Hazard Areas

The Kirkland Zoning Code (Section 85.13) defines seismic hazard areas as “those areas subject to severe risk of earthquake damage as a result of seismically induced settlement or soil liquefaction, which conditions occur in areas underlain by soils of low cohesion and low density, low density usually in association with a shallow groundwater table.” Seismic hazard areas occur throughout the city, including Totem Lake, Lake Washington shoreline, and in the Juanita and Forbes Creek areas. (See Map # 13 Seismic Hazard Areas.)

5. Kirkland/ King County Experience

On February 28, 2001, a quake of 6.8 magnitude struck the Puget Sound Area. The quake epicenter was located 30 mile SSW of Seattle and 10 miles north of Olympia at a depth of 36 miles. This deep quake occurred within the Juan de Fuca plate, causing extensive damage in many parts of the region, damaging nearly 300,000 homes and disrupting lifeline systems and businesses, particularly in Thurston and King Counties. Although damage in Kirkland was minor; (approximately \$5,000 in damage occurred to Lake Washington Technical College), it would have been much worse if the city was located closer to the

epicenter. Total damage loss to public, business, and household property in the Puget Sound region was estimated between \$2 and \$3.9 billion. Overall damage loss, ranked from most to least extensive included:

- Structural damages to roofs or foundations
- Chimney damage
- Non-structural elements (windows and light fixtures)
- Property losses (driveways, fences, bridges, & overpasses)
- Household contents

King County and jurisdictions within reported losses of over \$170 million. Specific damage included:

- Damage to SeaTac Airport Control Tower shutting down the terminal for 48 hours
- Landslide on the Cedar River forced evacuations because of threat from flooding
- Damage to I-405 at 44th St. in Renton, buckling of pavement, due to earth movement from disruption of ground water patterns.
- SR 509, damage to 1st Avenue S. Bridge, in South Seattle.

A recent study by the University of Washington on impacts to small businesses by the recent quake yielded the following information:

- Human activities were disrupted and indirect costs were hard to estimate, including worker distraction and losses due to down time.
- Approximately 20 percent of small businesses had direct physical losses, four percent losing one percent or more of their annual revenue.
- Building damage was the most common and costly form of direct loss, followed by losses from damage to inventory and/or data and records.

It is also important to note recovery from damage is still on-going in the region and final costs have yet to be determined.

This recent event reminds us that we live in “earthquake country” and cannot forget the need to prepare for another one of this magnitude or larger.

6. Potential Effects From a Large Quake

The effects of earthquakes vary from barely being felt to complete and total destruction, as evidenced in Kobe, Japan. The destruction not only includes physical structures, but the economic infrastructure and lifelines that make society function. The economic consequences would be felt nationally on one hand, and internationally in extreme cases. The objective here is to define broad-based estimates for worse case scenarios that can be addressed in reality based planning. The variation in impacts is dependent on the magnitude and depth of the quake, weather conditions, and proximity to population centers. Other influencing factors include local building codes, age and type of structures, weather, and the time of day which impacts the population-at-risk. For example, the level of damage recorded for the Nisqually quake was considerably lower than would be expected for a shallower, crustal quake of the same magnitude, because of lower than normal precipitation during 2000-2001. Under conditions of average precipitation, saturated slopes would have created landsliding and other forms of ground movement.

In most earthquake loss assessments, the economic effects are usually measured in terms of monetary losses and include only repair or replacement costs of buildings or other facilities damaged during the earthquake. The loss estimates do not include secondary financial impacts from loss of business opportunities or retail revenue. In the case of lifeline facilities, (i.e. telecommunications, natural gas, highways and bridges, electrical power, water, and sewerage systems), loss of opportunity costs may be incurred by the lifeline

operator who is unable to deliver and sell their product or service.

Businesses and industries that depend upon lifelines may also be affected. Blocked transport routes prevent movement of people and commerce. Loss of energy sources, such as electrical power or natural gas may prevent commercial and/or industrial enterprises from operating. Damage to communications systems and water and sewerage systems could also hamper business activity. Many times, losses associated with lifeline failures can exceed repair and replacement costs. There is also the issue of repair time for lifelines and infrastructure. For example, the repair of damage to an electrical power system may require heavy trucks. But damage to the transportation system makes it impossible to gain access to the area. Thus, repair of the lifeline is delayed until access is obtained. Loss estimates must include the combined effects of all lifeline systems.

A major earthquake in Kirkland would present the city with a large number of immediate and serious problems that would need to be solved despite limited time and community resources. These problems would fall under the following categories and consequences:

a. Life Threatening Hazards

- Fire
- Hazardous materials releases
- Downed power lines
- Ruptured gas lines
- Landslides
- Individual exposure to the elements

b. Lifeline Damages

- Severed water/sewer lines
- Interruption of utility services
- Blocked transport routes from subsided streets and damaged bridges
- Grounded air/water transport

c. Aid/Life Saving Problems

- Locating and rescuing trapped victims
- Lack of proper rescue training for responders
- Medical resource shortfalls
- Little or no mutual aid
- Blocked transport routes curtailing use of emergency vehicles

d. Life Sustaining Problems

- Problems providing triage, feeding, and shelter to earthquake or evacuation victims
- Curtailment of normal medical and fire calls
- Obtaining potable water and adequate food supplies
- Utility repairs

e. Economic Disruption

- Unable to re-establish lifeline functions in a timely manner to minimize disruption to businesses and city revenues
- Difficulties in providing timely inspections to ensure safe access for people, goods, and services to Kirkland businesses.

Although Kirkland has improved existing water and sewage systems, a quake of magnitude 7 or above would seriously disrupt vital lifelines and cause considerable impact. Add complications of cold weather, saturated soils, or snow and ice combined with predicted seismic damage could exacerbate problems in almost every area. Historical experience with the 1949, 1965, and 2001 quakes with an epicenter within a hundred miles of Kirkland gives a clue as to the following types of impacts to the jurisdiction:

a. Lifelines

- Extensive fracturing of utility lines with water contamination
- Several weeks of uncollected refuse
- Blocked streets, arterials, and downed overpasses preventing access
- Disruption of natural gas to the city, from three days to a week in some areas.
- Jammed, overloaded, damaged, or ineffective telecommunications equipment for at least three days, probably longer
- Partial or complete destruction of critical facilities such as Evergreen and Overlake Hospitals

b. Buildings

- Heavy damage to un-reinforced masonry buildings and structures. Many unsafe for occupancy.
- Substantial non-structural damage
 - flooding from sheared sprinkler heads in suspended ceiling
 - falling building fixtures and retail products
 - elevators out of service
 - damaged or overturned shelving, file cabinets, computers, and other equipment

Structural damage and ground failures would more than likely be greatest at Yarrow Point, the Downtown marina area along Central, Kirkland Avenue, Juanita, and the Totem Lake Shopping Center. Apartment complexes and other pier-supported structures at the marina would likely collapse partially or completely. Railroad bridges and numerous interchange overpasses could also potentially collapse. Landslide activity could block streets, damage houses, and other structures along Lake Washington Blvd.

7. Search and Rescue

Since Kirkland has limited Urban Search and Rescue capability, search and rescue operations for victims in collapsed structures would have to be accomplished on a triage basis for at least 24 hours until teams from outside the area arrived. Personnel in the city would also be overwhelmed with functions that they are not trained to perform. Neighboring jurisdictions would more than likely be in the same conditions and most of the Puget Sound Urban Rescue Team members would be pressed into service in their own jurisdictions.

Aftershocks would ultimately create additional structural damage and cause a further increase in water, sewer and gas line breaks. Problem compounding non-structural damage in buildings would result and individuals would become extremely fearful of returning to any structure or facility. Estimates exceed 2,000 people that may need shelter and other life support services in the city, and citizens will inevitably challenge the city's blocking of access to unsafe structures.

8. Economic Impacts

Using Kirkland's five financial neighborhoods and only the top three industry sales categories in those economic areas, it is possible to approximate a potential "loss in dollars" impact for the overall business community should a major earthquake occur. The top three industry sales figures were taken from these six categories:

- Contracting
- Manufacturing
- Transportation/Communication/Utilities
- Wholesaling
- Finance/Insurance/Real Estate
- Other

If total lifeline services that support business and industry in each of the financial areas were severed, the potential loss in revenue for Kirkland businesses could total, at the very least, the following amounts:

Current losses are estimated for a seven day period.

"These loss estimates are based on calendar year 2003 revenue figures for the six categories below"

Revenue Category	Weekly Loss
Contracting	\$3.2 million
Manufacturing	\$351,000
Transportation/Communication/Utilities	\$1.3 million
Wholesaling	\$1.8 million
Finance/Insurance/Real Estate	\$464,000
Other	\$272,000
Total Loss	\$7.39 million

Losses to the city on sales tax revenues would likely exceed \$28,000 per day, or \$196,000 per week and destruction of property values could be extremely high.

9. Suggested Mitigation Strategies

Mitigation for potential effects of earthquake must be looked at with a long-term commitment toward changing perceptions about risk in the general public and what can actually be done about that risk. The earthquake threat in the Pacific Northwest is not going to go away. The recent Nisqually quake in 2001 showed that the threat is real and was a “wake-up” call to citizens of the region. Strategies can be conveniently grouped into two categories for discussion; what government can do and, more importantly, what individuals can do to reduce the potential of injury, death and destruction of property. Strategies need to focus on those sensible tasks which, when implemented will make a difference and can be accomplished economically.

Successful earthquake mitigation strategies are developed through a process involving a broad cross section of community interests and functions. Complexity and uncertainty do not fit with simplicity.

Like complex ecosystems, there are no simple answers to problems in developing and implementing mitigation programs. For example, improving and enforcing more stringent building codes will not ensure building integrity by itself. Also, neither will the education of the people to secure specific non-structural building components solve the problem. These and a multitude of other specific activities all contribute and must be orchestrated collectively to truly make the difference.

Initial mitigation initiatives must begin with employees at home. That means developing family disaster plans that include some type of 72 hour preparedness kit along with informational programs that stress both structural and non-structural mitigation measures. Establishing contact points and procedures for notifying

family members outside the area also provide a means to alleviate undue stress. Provision for employee family shelter and other planning options also reduce many of the problems city employees will face in the initial hours and days of an earthquake. Business, industry and government cannot function efficiently in the immediate post disaster environment of a quake if their employees are focused on problems at home that are the result of little or no preparedness.

The business community and the city administration can collectively begin mitigation measures by establishing policies that take the earthquake threat seriously. That means an integrated approach that considers mitigation and preparedness activities in everyday functions. Examples include both structural and non-structural measures for public and private facilities, along with staff orientation, training, and basic skill development related to earthquake response and how to mitigate the effects of earthquake impact.

In the public sector, the city should address earthquake mitigation through a variety of activities ranging from public education on individual preparedness, to the development and continued improvement of the existing city Comprehensive Emergency Management Plan and ensure it adequately addresses all aspects of the planning cycle; mitigation, preparedness, response, and recovery. Issues like land use, building code changes and enforcement as well as utility replacement need attention to detail. Training and planning should receive high priority (focus) as well as monetary commitment and spelled out in written policy that clearly sets the example for the citizens of Kirkland.

10. Specifics

a. Structural Reduction Strategies

Strengthening buildings against earthquake shaking can prevent catastrophic loss of life and severe financial loss. Strengthening techniques are well known to the engineering community and vary according to the level of protection desired. The purpose of most seismic reinforcement projects is to prevent the collapse of the building in an earthquake, not to prevent major damage or ensure the facility's continued habitability. Some proven techniques that could be useful for the city include:

- Retrofitting/strengthening existing structures to provide a higher level of protection

The most complete protection is provided by base isolation, which involves isolating the building from the ground. The expense is generally about five percent of the construction cost on new construction. It can be done retroactively in some cases, but at much greater expense.

- Strengthening un-reinforced masonry or poorly reinforced concrete frame buildings

Techniques generally involve adding steel reinforcements to floors, walls, and roof diaphragms to increase strength, tying structural elements more firmly together, or increasing flexibility.

Any reinforcement program should evaluate if the building is worth saving. Demolition may be a good option if the building has no architectural or historical value and new facilities are planned for construction. The city Building Department, in conjunction with FEMA's Project Impact, currently offer a voluntary Seismic Building Retrofitting Program, which could be expanded in time and reduce the existing hazard.

Structural hazard reduction programs are expensive, but the benefits are significant. Stanford University, the pioneering institution in California seismic safety, found that in the 1989 Lorna Prieta earthquake, reinforced buildings performed well and injury to lives and property damage was dramatically reduced.

- b. Non-Structural Strategies
 - Re-arrange furniture, equipment, and ceiling structures.
 - Bolt cabinets or shelving over 48 inches tall to bulkheads.
 - Install seismic restraint lips on breakable product shelves.
 - Strengthen glass areas and/or replacement with tempered glass and/or safety film.
 - Brace/secure heavy light fixtures or objects.
 - Brace shelving used for books and documents.
 - Use "tie downs" for all electronic equipment, such as those items associated with computer stations.

- c. Lifeline Protection Strategies
 - Strengthen lines and supporting structures by reinforcing or bracing equipment.
 - Augment/improve power grid.
 - Reduce vulnerability of key parts of the system (build in redundancy).
 - Create alternative paths to reduce bottlenecks.
 - Diversify critical facilities.
 - Install automatic seismic shutoff devices in systems subject to secondary hazards.
 - consider natural gas shutoff devices for boilers and/or hot water tanks to reduce chances for explosion or catastrophic leaks.
 - Replace outdated utility pipelines (water, sewer, gas). This should be continued as a priority basis.

- d. Public Education Strategies
 - Develop and implement an earthquake safety program for city officials, business, and industry
 - Hold and encourage regularly-scheduled earthquake drills for schools and public agencies
 - Develop earthquake preparedness brochures and disseminate through utility bill mailing packets
 - Organize neighborhoods and train key residents to distribute preparedness information and undertake specific tasks in case of an earthquake.

An earthquake safety program for city officials, business and industry, and the general public will pay big dividends. Everyone should realize that people typically avoid earthquake preparedness because they do not believe the hazard will affect them, or because they do not believe that preparedness and mitigation action will do any good. Effective emergency preparedness education must therefore emphasize the certainty of the earthquake threat, but avoid exaggeration (no "scare tactics"). Presentations, programs and all educational efforts should have a positive tone, emphasizing the survivability of earthquakes if proper precautions are taken. "Must know information" needs to be differentiated from "nice to know" or "convenient" information.

11. Emergency Equipment and Supplies

Emergency equipment and supplies will greatly enable the city to adapt, survive, and recover from a major earthquake. The type and amount of supplies depends on the agency, response function, intensity of the quake anticipated, and physical location in the city. The equipment and supplies should include:

- Portable emergency communications equipment such as portable UHF and VHF radios, cell phones, CB's, and ham radios. Sufficient batteries, portable chargers and replacement units should also be considered.

- Tools and equipment to conduct emergency repairs or light rescue activities such as bracing timbers, hard hats, pry bars, gloves, hazardous materials cleanup materials, emergency lights and self-contained breathing apparatus.

- Strategically located water and food reserves for emergency responders, operations staff and others key to city operations (24 to 72 hours supply). This should include how the food and water will be heated (cooked) and served. For longer situations, arrangements (memorandums of understanding) should also be made with local vendors for ongoing food and drink supplies.
- Small emergency kits, stored by individuals, with minimum water and food supply, first aid materials, battery- operated flashlight and radio. Each department should procure a larger emergency kit for any locations outside of City Hall.

E. ENERGY AND FUEL SHORTAGES

1. Define The Hazard

An energy or fuel shortage is an interruption of a source of fuel, which supplies the infrastructure, or loss of service for an extended period of time (long enough to require an emergency response for food, water, and heating). It can also be characterized as an unstable or failing of critical, lifeline energy systems, such as fossil fuel or hydroelectric generation. These shortages are sometimes tied to world events, such as the curtailment of oil production in the Middle East that led to the long vehicle lines at gas stations in the early '70's. A shortage of energy in one form can affect and cause shortages in other fuels such as propane, heating oil, and residual oil, which are substitutes for natural gas. These emergencies can threaten both our health and livelihoods. Natural disasters that cause mass evacuations can also trigger shortages, both in fuel for vehicles and electricity for primary functions. Many in the community suffer, particularly the elderly and other resident-bound segments of the population.

An energy crisis will vary with the type of energy resource involved. For example, a lightning bolt could cause an electric power blackout with no warning, or a truckers' strike could be announced with a week or more to plan for the impending fuel shortage.

2. Kirkland Experience

Kirkland has experienced power failures during times of extreme weather (cold, or wind) and vehicle fuel shortages as mentioned above.

3. Potential Effects

Energy shortages and prolonged power outages can impact the city by disrupting economic activity and the lifelines necessary to care for the population. As discussed earlier, under severe cold conditions, individuals, such as the elderly and disabled may become hypothermic, due to pre-existing health conditions and the inability to obtain alternative sources of energy. Hospitals generally have alternative energy sources, such as generators, but priority usage may cause emergency conditions for some patients. City departments would also be hampered; sewage and water systems may function at partial capacity and, a prolonged fuel shortage would require additional restrictions on the use of vehicles, impairing use for emergency response and day to day city functioning.

4. Suggested Mitigation Strategies

In the event of an energy supply shortage or disruption, there is a critical need to reduce energy demand. Two broad types of demand reduction measures are:

- Public appeals for voluntary energy conservation
- Mandatory measures for use during the emergency

Some voluntary public measures for gasoline shortages include:

- Encourage the use of rideshare programs.
- Work with mass transit authorities and increase the use of public transit services.
- Encourage employers to allow flexible work hours and telecommuting.
- Teleconference a meeting in lieu of transport.
- Reduce use of car air conditioner.
- Combine trips when possible.
- Properly inflate tires.

Electricity and/or gas shortages:

- Lower thermostat setting on home water heaters.
- Reduce total electricity in the home.
- Reduce outdoor lighting to essential use only.
- Close off unused rooms and close heating and cooling ducts in these rooms.
- Use appliances at off-peak times.
- Clean or replace heating and air conditioning air filters at least once a month.

Mandatory measures include the following:

- City-wide ordinances that limit the use of electricity, fuel, and/or natural gas.
- Enforcement of ordinances.
- Monitoring of energy usages.
- Establish by regulation priority energy usage, based on essential lifeline functions.

F. EPIDEMIC

1. Define the Hazard

An epidemic is a disease transmitted either by animals or humans, which becomes widespread in a particular place at a particular time. The possibility of catastrophic disease affecting humans or animals within the confines of the city of Kirkland (or the county) is a very real, although seldom considered, threat. Epidemics, both animal and human, are usually introduced through some vector or carrier from outside the immediate area.

An epidemic disease may be something exotic that was brought in with animals either legally or illegally from other parts of the country or world. For the most part, a clean water supply, effective sewage and waste disposal, and aggressive monitoring and treatment of potential disease outbreaks by public health officials have kept the entire region free of serious epidemics. While the effects of disease on large segments of the population have been relatively minor, the potential for large epidemics still continue to exist in this country.

A disease of epidemic proportions in Kirkland would likely be introduced by persons, animals, materials outside the jurisdiction, or by conditions that were created in the city environment for short periods of time. In addition, the potential for an epidemic would increase dramatically in the event of a major disaster, such as an earthquake. In such case, disease could reach a much larger population due to the absence or breakdown of normal sanitation and other intervening factors.

All animals entering Washington State are required to have a certificate of health. For some species, tests or vaccinations are required. However, there is limited control over companion animals entering the city from other states. Thousands of pets move from state to state on a daily basis without any controls because their owners never realize that health certificates are required.

2. Human Disease Experience Factor in Kirkland and King County

Neither the State of Washington nor the city of Kirkland is immune to an epidemic in the human population. Some communicable afflictions, like the flu, pass through on a regular basis. Others appear on an irregular basis, such as measles, or perhaps are still developing as a full grown epidemic like AIDS. Diseases continue to have an effect on the general population's health in the county and some of these are included below with statistics and most recent statistics on number of occurrences.

a. Acquired Immune Deficiency Syndrome (AIDS)

Although relatively new in the county, the disease is considered epidemic at the national level. The current AIDS rate in King County is 13.2 cases per 100,000 population or approximately 232 cases in 2003. Because of the lag in reporting time, the total number is expected to increase, but overall the numbers of confirmed cases have decreased because of new preventive antibiotics.

b. Measles

This childhood disease has been in this country since settlers with a European heritage moved into the state in the last century. Much of it has been controlled, but in 1990, the state experienced the largest measles epidemic since 1979. There were no cases reported in King County in 2003. Although the threat has been diminished in the last few years, the potential for an outbreak is still there.

c. Hepatitis A

This disease is spread by contact with contaminated fecal material (usually through water or food sources) and could easily develop following an earthquake where water supplies could be contaminated by broken sewer mains and other sources of bacteria. There were 30 cases in King County in 2003.

d. Hepatitis B

This is a serious, highly contagious liver disease and is frequent in Washington with outbreaks in King County. Currently the incidence of Hepatitis B is reaching epidemic proportions in many areas of the country. To some degree, that is a reflection of transmittal through blood and body fluids from drug use and sexual contact. There were 35 cases reported in King County in 2003.

e. E-Coli

The large outbreak of this disease in the state in 1993 was caused by tainted hamburger at fast food restaurants and is an excellent example of how an epidemic we are not familiar with can suddenly appear. Something like E-Coli can infect a number of people, and cause a great deal of suffering before authorities even realize what is happening. King County's toll in the last major outbreak was 324 infected individuals and a number of deaths. In 2003, there were 43 cases reported in the county.

The four most commonly reported intestinal diseases in King County, which cause diarrhea or vomiting, are campylobacteriosis, salmonellosis, shigellosis and giardia, all spread from undercooked foods or, like giardia, spread from animal feces.

(1) Campylobacteriosis is a bacterial infection most often spread through undercooked foods and occasionally by animals, including pets. There were 262 cases in 2003 in King County.

(2) Salmonellosis infection usually results from eating contaminated food but can be contracted from

an infected person or pet through inadvertent contact with fecal matter. There were 243 cases reported in 2003 in King County in 2003.

- (3) Shigellosis or bacterial dysentery, is virtually always spread by humans via the contaminated water or food route or even human- to- human contact There were 88 cases reported in King County in 2003. As with many intestinal diseases, this also seems to be cyclical.
- (4) Giardiasis is most commonly spread through water contaminated by animals and is consumed untreated or inadequately treated. Once the infection is established in a community, it is spread from person to person through poor hygiene. There were 124 cases reported in King County in 2003.

3. Animal Disease Experience Factor in Kirkland and King County

While there is evidence of rabies and psittacosis as well as a few other animal carried diseases in King County, most have certainly not occurred in epidemic proportions and would not be expected to do so any time in the near future. In the early part of this century rabies was considered a major problem and sometimes appeared in epidemic proportions here in Washington as well as the rest of the nation. Unlike some other areas of the U.S. where rabies is a problem in raccoon and skunk populations, Kirkland and King County is free of the disease except for the rare case. A llama was reported to have had the disease in Redmond in 1994 and a horse in 1992, but there has not been an outbreak in the animal population in Kirkland anytime in recent history. There were no reported cases in 2003 in King County.

Psittacosis, an infectious disease causing diarrhea and wasting away in birds, is another potential problem. It manifests itself in humans as atypical pneumonia accompanied by a high fever. It has on occasion been brought into the country with migratory flocks or through birds imported by pet stores for sale to the general public. No cases were reported in 2003.

Lyme disease, a new disease in humans, is carried by deer ticks and also by other animals as well. The eastern part of the state is more vulnerable to the disease, but evidence is beginning to show that many tick species can operate as vectors for the disease in the western part of the state. There were 2 reported cases in King County in 2001.

Diseases imported from other countries could create the real problems in the future. Many diseases which we have not worried about for years, if not decades, still exist in many parts of the world. History reflects that the incidence of animal epidemics is not over yet. The severity of such a disease will depend on continued vigilance for early detection.

a. Potential Effects

The impacts of any disease capable of reaching epidemic proportions are varied and speculative at best. Very importantly, the impacts could include loss of life or some type of debilitation for the victims, as well as economic hardship for individuals and their families. Lost work time affects not only the employee but also the employer. Loss of productivity due to individual illnesses is a major business problem today without taking into account the effects of a widespread major epidemic. All of this would also cause a strain on current public health and medical resources in both the city and county.

If the current upward trend in AIDS cases continues for the foreseeable future, the impact will not only strain medical resources, but also those charitable organizations that support patients without other resources. This ultimately could put a greater financial drain on the medical system. Kirkland could also be subjected to the loss of pets and livestock from brucellosis or “mad cow”(Bovine spongiform encephalopathy) diseases.

Another issue, which is often overlooked, is the possibility that an animal epidemic may not just be relegated to the animal population. Rather, it might be zoonotic, or transferable to the human population. Two examples of zoonotic diseases, which have recently become prominent are Lyme Disease and AIDS. There are other new viral strains, such as the West Nile Virus and Asian Bird Flu. Both of these diseases have their roots in animal species and apparently were only recently transferred to human populations. Another example, mentioned above, rabies, is an obvious case of a zoonotic disease which has been with us for centuries. It is also very possible that many of the epidemics which have decimated portions of the world's population, had their origin in animal populations.

4. Emerging Infectious Diseases

At the midpoint of the twentieth century, infectious diseases appeared to have been controlled by improvements in sanitation, antibiotics, and immunization. However, by the early 1990's health experts no longer believed the threat was receding in the United States or elsewhere on the planet. Recognition has grown that many modern demographic and environmental conditions, as well as the ability of microbes to evolve and adapt, favor the appearance and spread of new pathogens. Increased numbers of people and commodities moving throughout the world also contribute to the spread. Some noted emerging infectious diseases include:

- Hepatitis C, chronic. Over 1000 cases in 2003 in King County.
- Hantavirus- This virus, carried by deer mice, can cause severe pulmonary symptoms in humans and can progress to life-threatening adult respiratory distress syndrome.
- Mortality is about 40%, even with intensive medical support. Washington has had a total of 22 hantavirus cases and eight associated deaths since 1993.
- West Nile Virus. In 1999 an outbreak of mosquito borne virus affecting birds, horses, and humans was identified in New York. Passive surveillance began in Washington in 2000. There have been no reported cases, but there is evidence the disease is spreading north.
- Asian Bird Flu- Recent cases reported in Thailand and China, none here, but officials are concerned, since it is highly contagious.

5. Suggested Mitigation Strategies (Human Disease)

Basic mitigation measures should include:

- Implement inspection, maintenance, and repair programs of sewage and waste disposal systems after disaster events.
- Promote and endorse childhood and adult immunization programs.
- Support and provide health education for the public in the schools.
- Develop information programs at the community level to address disease transmittal and prevention through proper hygiene.
- Target particular vectors of individual diseases such as drug usage for such things as AIDS infection and Hepatitis B.
- Develop and enforce strict health standards for food service employees and eating establishments.
- Maintain strict health standards for food products.
- Utilize accepted methods of disposal and/or sterilization for potentially infected or contaminated medical waste products.

6. Suggested Mitigation Strategies (Animal Disease)

Mitigation for preventing epidemic diseases from animals include:

- Prevent diseased animals from entering the city of Kirkland, or Washington State.
- Enforce health certificate requirement for every animal entering the State.
- Educate the public on legal requirements and the rationale for obtaining health certificates for exotic animals, especially avian fauna.
- Develop and implement an aggressive program to vaccinate animals in an effort to prevent diseases within the local populations
- Work with the U.S Department of Agriculture Animal/Plant Inspection Service and the Washington Dept. of Agriculture in detecting, controlling and diagnosing animal diseases.

G. FIRE (CONFLAGRATION)

1. Define The Hazard

This Analysis does not focus on the everyday fire response hazard in Kirkland. The problems and response-related planning issues for fire in Kirkland have already been studied and discussed in the city's 1991 Fire Protection Master Plan. That document is being used extensively to guide the city's direction and focus for fire protection into the year 2000 and beyond.

Kirkland has changed dramatically in recent years with respect to the threat of fire. In the past, the community was primarily made up of mostly single story or two story structures located in easily accessible locations. Now Kirkland is an urban community comprised of large shopping centers and complex residential and commercial centers that blend natural environment with man-made structures. With an expanding population and the search for privacy and semi-isolation, some limited areas of wildland (natural/urban) interface, brush pockets and wooded ravines exist in very close proximity to multi-tenant buildings and private residents. The threat from fire and related secondary effects has created a very real potential in some areas.

The majority of fires, which are dealt with on an annual basis by the fire department, are relatively small, but due to staffing, the total number of calls, and federal and state mandates, mutual aid companies are usually called. Real problems could arise however if a fire occurred at the end of a particularly long, dry season and covered a broad area, perhaps some wooded steep terrain and/or combined with multiple tenet dwellings. Although unusual in its characteristic, underlying conditions, conflagration or firestorms are certainly a real possibility in some areas of Kirkland. This would be especially true in the aftermath of a major earthquake, windstorm or extended dry period with accompanying winds.

2. Kirkland Experience

Calls for fire service in the city numbered 7,151 in 2003. Although a good portion of those calls were medical related, the increase is still significant for fire response calls. Although Kirkland has not experienced a major conflagration that destroyed multiple dwellings or structures in a single fire, or large tracts of natural land, the potential is still there. Recent examples that have occurred in other surrounding jurisdictions and across the state point to the need for constant vigilance and preparedness for this reality. In December of 1993, the city of Seattle experienced a near miss in the Magnolia area of the city. The dry summer of 2004, brought about a number of fires that destroyed farm buildings in both King and Snohomish counties. Rough, steep land area combined with narrow streets, poor access, low water pressure, and housing structures directly adjacent to natural vegetation, created a recipe for potential widespread fire and destruction. Fortunately, they were able to control it in the early stages.

The summer of 2004 and October of 1991 are good examples of the types of fire scenarios and lessons learned from their impact on the wildland/urban interface. The most notable were those that occurred in 1991. Fires fanned by winds gusting over 60 miles an hour swept through a four county area in eastern Washington. Ninety- two separate fires were started in Spokane, Stevens, Ferry, Okanogan and Pend Oreille

counties. Analysis of the northeast Washington fires of '91 indicated that more than 90 percent of the fires started when winds blew down power lines or when trees or limbs fell into power lines. This scenario caused numerous fires in a short duration of time and all suppression resources were rapidly committed.

Response personnel experienced great difficulty in assessing the magnitude of the fires due to poor visibility caused by the wind swept fires and blowing dust. Once the fires were established, fire brands from the burning tree and brush fuels became airborne and ignited other combustibles ahead of the active fire areas and rapidly increased the rate and area of spread. One hundred eight homes were lost in Spokane County alone.

The conditions that caused the fires in Spokane County, although unusual, were not rare and continue to occur in jurisdictions throughout the state. Several years of dry, drought-like conditions had existed in the area for over 5 years. That essentially meant lower- than- average precipitation. During the spring of that year, heavy rains had produced an abundance of high grass crops that were now dry and aided in flash fuel supplies. Over 40 days of no precipitation was the final factor, combined with the winds and downed power lines to produce a formula for conflagration. Most of the home losses occurred within the first four hours before massive assistance could respond.

Other similar situations have occurred in Colorado, Michigan, North Carolina and notably in the Oakland/Berkeley Hills area of California at the same time the fires occurred in Spokane County. In all cases, issues that deal with wildland (natural)/urban interface in the community have been at the forefront of causal factors. Many of those same factors, such as lack of adequate clearances of combustible vegetation around structures, combustible roofing and siding materials adjacent to or within areas of thick natural vegetation, exist now in specific locations within the city of Kirkland. While perhaps small in area, these sites are none-the-less dangerous in their potential for destruction of property and lives.

Areas considered susceptible to conflagration must also include some older structures directly adjacent to one another that contain balloon type construction with few or no fire breaks, etc. A few of these still exist in the downtown area and are gradually being upgraded or removed.

There are specific areas within Kirkland that have the potential for large conflagration type fires. They are:

- St Edwards State Park
- Edith Moulton Park
- Holmes Point Neighborhood
- Big Finn hill park
- Kingsgate Park
- Forbes Creek Area
- Bridle trails State Park
- O.O. Denny Park
- Goat Hill Area

3. Suggested Mitigation Strategies

Fires will continue to occur in residential areas that border natural zones of vegetation and steep terrain. The very same characteristics that make certain areas of Kirkland attractive for housing and comfortable living, also make it very susceptible to destructive firestorms or conflagration. Much can be done however, to reduce potential and ultimate losses if fire breaks out in some of the areas identified in Kirkland. Many of the lessons learned from other incidents that have occurred across the state or nation are not new lessons, but often ignored, because people think it will not happen to them.

One of the most frequent comments offered by homeowners as an explanation for not preparing for a "true storm type conflagration" is that the fire department will "handle it" if it starts and I call. Once ignited and without immediate attack by fire personnel, most fires under firestorm conditions would be uncontrollable by any firefighting forces for a period of time. Strategies should include the following:

- Develop and implement public education programs for urban and suburban areas of the city.

Education programs need to stress fire safety, prevention, and individual responsibility. As with any credible community education program, preventive efforts should be consistent, pervasive at every level and frequently offered from a variety of media. Basic concepts should begin in early childhood education and continue through adult life.

- Set-up programs where evacuation drills are held on a regular basis.

It is important for families to know how to react properly when a fire occurs and to have evacuation plans for individual households. Each family should hold their own drills on how to exit a house safely under a variety of conditions.

- Inspect and enforce maintenance of fire alarms and sprinkler systems where applicable.

Need to consistently and on a regular basis remind the community to check fire suppressant systems.

- Encourage homeowners to maintain and keep areas cleared of vegetation around all dwellings.

The most consistent factor associated with structure loss of the homes studied was the distance between the structure and adjacent combustible vegetation. In most cases the distance to flammable fuels was 20 feet or less.

- Ensure fire apparatus can gain access to dwellings in fire-prone areas.

Another factor consistently present in most cases was restricted roadways and driveways that limited response and operational choices for firefighters. This last factor is often ignored in pursuit of privacy and the intended look of isolation from surrounding neighborhood homes.

Some specific actions include:

- Minimize the potential or actual losses in areas adjacent to wildland type terrain with natural vegetation, steep banks, and brushy canyons or hillsides.
- Discourage or improve narrow, steep or winding roads or driveways that can obstruct firefighting equipment.
- Recommend or encourage noncombustible, fire resistant siding, decking, trim and roofing materials and boxed in eaves and metal screen vents.
- Encourage screens beneath porches, decks and the main house.
- Keep chimneys above the roof line with spark arrester half inch mesh.
- Encourage water faucets on at least two sides of the house and one at each outbuilding.
- Clearly mark the entrances to private property.
- Recommend the clearance of all flammable vegetation from a safety zone of at least 30 feet around houses and outbuildings with grasses kept low.
- Discourage continuous canopy cover of property or structures.
- Remove limbs away from roofs and chimney.

Other mitigation measures to be considered include:

- Augment sprinkler systems, especially on older buildings, which may not have been renovated in decades.
- Expand the use of smoke detectors to all construction, both new and renovated.
- Provide free or reduced cost smoke detectors for needy sections of the community.
- Increase the use of fireproof or fire retardant materials in construction.

H. FLOODING

1. Define The Hazard

Although the city of Kirkland has no major streams or rivers that create seasonal or flash flooding conditions for its residents, there are numerous locations within the city which can and do experience high water problems of some kind. The threat of inundation to residents and/or businesses in Kirkland is potentially very real. Excessive precipitation, melting snow, culvert obstruction, and/or excessive runoff from impervious surfaces increase peak flow and quantity of runoff and could cause potential damage from flooding in low-lying areas, roads and housing developments.

Several large perennial streams, as well as smaller spring-fed brooks, are located within the city and all drain westerly towards Lake Washington. All, or portions of, ten drainage basins are within current city boundaries (see map showing Drainage Basins). They are:

1. Yarrow Creek
2. Houghton Slope B
3. Carillon Creek Basin
4. Houghton Slope A
5. Moss Bay
6. Kirkland Slope
7. Forbes Creek
8. South Juanita Slope
9. Juanita Creek
10. Sammamish

The largest streams are Juanita and Forbes. A portion of the Juanita and Juanita Creek Basins are partially outside the city limits. (See Map # 14 Drainage Basins & Steams.)

There are four mapped areas in Kirkland that contain 100 year floodplains. They are:

1. Areas around Totem Lake
2. Forbes Creek Valley
3. Peter Kirk Park
4. Vicinity of Yarrow Bay

In addition, there are a number of flood hazard areas defined by the city. These areas, subject to inundation in any given year, include riparian areas along streams, lakes, and wetlands. A Natural Resource Inventory was conducted in July, 1998 to identify wetlands and other sensitive areas in the city. The inventory was updated in 2003, with the production of the Natural Resource Management Plan, which maps wetland areas and sets forth management strategies to protect the existing and future environmental values. Over 25 wetlands have been identified within the jurisdiction. The following locations include wetlands of significance:

- Yarrow Bay area
- Near Everest Park
- Forbes Lake
- Totem Lake
- Along Forbes Creek
- Heronfield Wetlands

(See Map # 15 Streams, Floodplains & Wetlands.)

These areas and adjacent lands uses are prone to flooding during significant rain events.

2. The Kirkland Experience

Flooding is no stranger to Kirkland residents. The city has had a long history of flooding at various levels in key locations and continues to experience problems with runoff and standing water. Historical records indicate that serious flooding occurred as far back as 1942. Some events of significance include:

- Flooding of City Hall in December, 1959
- Serious flooding in '68, '71 and '72, with some resulting damage to city records and documents

In 1959, the city experienced the worst rains, floods and mudslides in 17 years. City Hall, which was then located at 215 Central Way, had more than a foot of water surrounding it and the city Sewer Plant, numerous homes and streets were inundated with water. The potential for that flooding problem at the location on Central Way has now been mitigated with a system of storm drains and culverts. However, drains and culvers can become plugged and the potential of water in exceeding of carrying capacity for the drainage system is certainly there.

In recent years, it has become apparent as development increased throughout the city, that the ability of the land to absorb water has seriously been affected despite standards for runoff collection and dispersion. Quick runoff afforded by roads, parking lots, buildings, and other impermeable surfaces have caused some flat or slightly depressed terrain to collect more water than it did a number of years ago. Those who have built in these areas may have to learn the hard way that storm drains become plugged and the city may no longer be able to guarantee that they will remain dry. This increase in the flood potential within the city will probably become more significant as growth continues. Recent problem areas have been at NE 38th St. & Lake Wash. Blvd and Totem Lake Blvd & 120 Ave NE. In addition, the city Public Works staff checks 45 different "trouble spot" locations around the city after significant rain events. A description of mapped drainage basins, their size and amount of existing impervious surface follow:

Yarrow Creek: This southernmost drainage lies partly within city boundaries, with most of the area in the city of Bellevue to the south. Three wetlands have been identified within this basin, which are located both in Kirkland and Bellevue. Bridle Trails State Park is located at the headwaters of Yarrow Creek, which winds south of I-405 through Bellevue, and then, flows northerly into a significant wetland at Yarrow Bay and discharges into Lake Washington.

Cockran Creek: Flows from Watershed Park in Kirkland westerly into another significant wetland area at Yarrow Bay. The basin covers approximately 579 acres, with 26 percent impervious surface.

Houghton Slope A (NW College Creek): One wetland occurs within this basin, which is entirely within the city limits and contains numerous unnamed streams which discharge into Lake Washington from pipe flows of considerable distance. The basin is approximately 514 acres, with 46 percent impervious surface.

Kirkland Slope: A portion of the significant wetland at Juanita Bay has been identified with this basin, which is entirely within the city limits. The basin covers approximately 211 acres, and covered with 43 percent impervious surface.

Moss Bay: Entirely within the city limits, this urban drainage basin contains ten identified wetlands. The headwaters of Everest Creek flow from springs and seeps westerly into Lake Washington. Much of its length is piped, with outfalls into Lake Washington. The basin is approximately 1,487 acres in size and covered with 43 percent impervious surface.

Forbes Creek: Nine wetlands have been identified within this basin which lies entirely within the city. The headquarters of Forbes Creek begins east of 1-405 and flows northwesterly through three significant wetlands and Forbes Lake and then 2.5 miles westward, crossing under 1-405 and draining through more significant wetlands into Lake Washington at Juanita Bay. Numerous small streams drain into Forbes Creek on its route. The basin is approximately 1,837 acres in size and covered with 34 percent impervious surface.

South Juanita Slope: This basin is entirely within the city and contains two mapped wetlands and one unnamed stream. It is approximately 287 acres in size and covered with 41 percent impervious surfaces.

Juanita in City: This basin contains two mapped wetlands and flows from Norway Hill, south of Bothell, southerly to enter Lake Washington at Juanita Bay in Kirkland; the basin is approximately 1,429 acres in size and covered with 48 percent impervious surface. Juanita Creek and its tributaries drain the northern portion of the city before emptying into Lake Washington. Headwaters to the eastern tributary begin in hillside springs east of Totem Lake. This 1.5 mile long tributary flows westerly through Totem Lake and significant wetlands west of 1-405 where it joins the main channel at NE 129th and 100th NE.

Houghton Slope B: This basin is approximately 134 acres in size, with 38 percent impervious surfaces.

Carillon: This basin is approximately 106 acres in size, with 37 percent impervious surface.

Sammamish: This basin is approximately 293 acres in size, with 36 percent impervious surface.

3. Potential Effects

Damage and potential impacts to flooding in Kirkland, while not as devastating as other areas in Washington, is nonetheless significant, because individuals and/or businesses could not only be inconvenienced, but damaged and financially hurt. The historical record shows what could happen if the area experienced record rainfall or snows. Excessive runoff with resultant flooding could impact telephones and communications, power supplies, roads, rail lines, and other business related lifelines. Transport of top soils, erosion, undermining foundations, damage to non-structural components like flooring, carpets, walls, furniture, vehicles and personal property are all part of the damage that could be expected.

4. Current Mitigation Policies

The city has recently updated the Comprehensive Plan which will guide future development for the near future. The Plan recognizes that "natural systems serve many essential biological, hydrological, and geological functions that significantly affect life and property in Kirkland." Maintaining the systems is a crucial and worthwhile endeavor. Healthy systems that preserve vegetation, protect wetlands, and reduce runoff from impervious surfaces go far to mitigate the effects of flooding.

Some policies set forth in the Comprehensive Plan and the Natural Resource Management Plan include:

- Supporting comprehensive management of activities in sensitive and hazard areas to avoid risks or actual damage to life and property.
- Using a variety of techniques to manage activities affecting water and the land to prevent degradation and minimize risks to life and property.
- Requiring developers to provide site-specific environmental information to identify possible on and off-

site methods for mitigating impacts.

- Working with city residents, businesses, builders, and the development community to promote low impact development to minimize surface water runoff.
- Minimize the construction of impervious surfaces.

Specific tools to implement strategies for flood mitigation include those outlined in the City's Critical Areas Regulations. Chapter 90 of the Kirkland Zoning Code applies to activities, work, and conditions in or near any stream, wetland, frequently flooded area, or lake in the city. Chapter 15.52 requires post-development storm water flow onto adjacent properties not to exceed pre-development flow to minimize impacts.

The city has taken some important steps toward establishing policies and enforcement tools to mitigate flooding threats, by recognizing that flood control does not require expensive, inflexible alternatives, such as diking, dredging, or damming of natural water systems. The next step is to develop specific tools to implement the policies. Some suggestions include:

- Conduct a regular review and update process of the existing Critical Area Regulations.
- Monitor runoff from drainage basins and design educational tools to promote best management practices.
- Recognize the "uniqueness" of each drainage basin and modify policy to address unique flood hazard problems.
- Utilize volunteer groups, such as "Stream Teams" to monitor and restore critical stream segments.
- Periodically review all ordinances, especially those that protect wetland areas.
- Develop and disseminate public information on sensitive areas in the city.
- Consider city purchase of sensitive areas to prevent development and maintain their value for flood control.

I. HAZARDOUS MATERIALS (FIXED SITE & TRANSPORTATION)

1. Define The Hazard

A hazardous material is any substance which has been determined to be capable of posing a threat to the life, health, and safety of the general public if exposed to the substance through spillage or dispersal in the atmosphere. These "hazardous materials" are chemical compounds in gas, solid or liquid form that are used to create the everyday products in our homes that benefit the American standard of living. Dispersal or spillage of these chemicals could result from something as simple as overturning a container at a business establishment or the result of an accident on the freeway or roads leading into Kirkland. Hazardous materials have brought the issues of emergency management and preparedness to the doorstep of every individual in our society. The problem is pervasive throughout the country and is not likely to go away anytime in the future. As more and more chemicals are produced, stored, transported and used in our cities, the potential threat can only go up.

There are additional categories of substances within the family of hazardous chemicals and materials that further describe their characteristics and threat to people. One of those categories is known as "Extremely Hazardous" or EHS chemicals. These substances have the potential for causing death or irreversible toxicity after very short exposure to small amounts. These are the most dangerous because they are acutely toxic. Other categories of chemicals include explosives, gases, flammable liquids, flammable solids, spontaneous combustible materials, wet reactive, oxidizers, radioactive materials, corrosives and biological hazards, such as etiological or infectious materials. It must be noted that any of these substances are dangerous and could cause death or severe injury under the right circumstances.

In 2002, the U.S. reported an average of 7,000 hazardous materials transportation incidents per year, with about 82 percent of them are caused by highway accidents. This includes 14 deaths and economic damages

that run into the millions. Fixed site releases in this country number over 80,000 annually and result in nearly 600 injuries and 15 deaths, on average.

2. The Kirkland Experience

Incidents involving hazardous materials within King County and the city jurisdiction can be expected to increase in the future because of the growth in demand for chemical substances to meet the regions business and industrial needs. These incidents occur during transport and from accidental releases at industrial sites. In addition, unregulated household chemicals present a significant danger due to improper disposal or distribution. Individual dumping of pesticides, gasoline, oil, solvents, anti-freeze and paint products all contribute to potential contamination of both soil and water within the city.

3. Fixed Site Contamination

In addition to releases from transport or industries, it is not uncommon for property (meaning the soil) to be contaminated grossly through past use or disposal of hazardous materials. Sites contaminated with hazardous materials can present a major hazard to people, structures and the environment. The State Department of Ecology is primarily responsible for investigating reported contamination and monitoring follow-up action, under the Model Toxics Control Act.

A database, maintained and updated by Ecology's Toxics Cleanup Program, lists all known and potential hazardous waste sites being investigated for possible cleanup actions, describes a site's affected environment (e.g., groundwater, surface water, air, soils and/or sediment), and their status. The Department of Ecology ranks listed sites and focuses cleanup efforts on the most serious cases. Cleanup sometimes takes years due to lack of standards to guide cleanup, time required for in-depth site analysis, or legal disputes over liability for the cost of cleanup.

Some cleanups are handled privately. If a bank or insurance company is involved in a property transfer, it often insists that full-scale site investigation and cleanup be conducted to minimize its future liability. Banks often require assurances that the new owners will not be responsible for large cleanup bills at some time in the future, which could result in loan default. Federal and state laws make banks equally liable with former property owners for cleanup on foreclosed properties.

The latest data (February, 2004) lists three sites currently in different stages of cleanup in the city. All have been "ranked," meaning their relative risk has been assessed; two ranked "5" for lowest risk and one a "4", next lowest. These sites are located at Katco Sales, Rose Hill Plaza, and Kirkland Avenue Lake Street Trunk Sewer site.

4. Leaking Underground Storage Tanks

Underground tanks are a common means of storing petroleum and other hazardous materials. Stored products in these locations include motor fuels, heating oils, solvents and lubricants. Leaks from underground tanks or their piping can have a variety of adverse impacts on human health and the environment. When tanks leak, toxic chemicals can contaminate soils, groundwater, and surface water as well. In addition, vapors from gasoline leaks can migrate into sewer systems or the basements of buildings, contaminating the air and introducing the risk of fire and explosion.

As of September, 2004, the city had 34 sites in the city of Kirkland. The majority show contamination of groundwater. Twenty out of the total have had cleanup conducted to Ecology's satisfaction and the remainder are in different stages of remediation.

Although there have not been any major spills or transportation accidents related to hazardous materials in Kirkland in recent years, that does not rule out the possibility or probability that such an occurrence will happen.

In 1986, Congress passed the Superfund Amendments and Reauthorization Act (SARA). Title III of this legislation requires that each community establish a Local Emergency Planning Committee (LEPC) to be responsible for developing an emergency plan for preparing for and responding to chemical emergencies in that community and to provide "right-to-know" information to the public on hazardous chemicals in their region. The emergency plan must include the following:

- An identification of local facilities and transportation routes where hazardous material are present;
- The procedures for immediate response in case of an accident (this must include a community-wide evacuation plan);
- A plan for notifying the community that an incident has occurred; the names of response coordinators at local facilities; and
- A plan for conducting exercises to test the plan.

The plan is reviewed by the State Emergency Response Commission (SERC), with the Dept of Ecology as Lead Agency and publicized throughout the community. The LEPC is required to review, test, and update the plan each year.

As of January, 2004, there are 13 known facilities in the city of Kirkland where hazardous materials of one type or another stored, manufactured, transported or used in sufficient quantities to require some site planning and pre-incident knowledge. Some of these chemicals are considered extremely hazardous and others are dangerous. Currently, the city fire department has information on all of these sites and can use the information to respond to any fires or incidents that occur at any individual facility. This information is shared by the King County Local Emergency Planning Committee (LEPC) and Fire response units.

5. Effects

Any situation that involves hazardous materials has the potential to escalate into a very dangerous situation. The properties of chemicals, motor fuels, explosive gases, radioactive substances and other hazardous materials range from highly flammable to extremely toxic. Most have the potential to contaminate the air, water, soil, and can be especially harmful to human, animal and plant life.

The Department of Ecology provides a 24 hour spill response service to deal with nearly all types of environmental emergencies. State law requires all spills to be reported to the Military Department's Emergency Management Division by the responsible party. This in turn will result in notification of Kirkland's Fire Department Emergency Management Division, where notification and appropriate action will then be taken. In Kirkland, hazardous materials incident response is varied, depending on the nature of the incident. Less serious incidents have warranted a single engine response, with personnel trained to an Awareness and Operations level of competence. For more serious incidents, a full response is dispatched. In this case, all available members of the Eastside Hazardous Materials Response Team (ESHMRT) respond to the incident, each member trained as a Hazardous Materials Technician. The hazardous materials posing the greatest risk are fuel oils and gases. Gasoline, diesel, propane, and natural gas are the most common and most volatile.

Generally, throughout the state, there is a lack of recognition and support by elected and appointed officials and managers to upgrade local government capability to respond safely and efficiently to incidents involving chemical hazards. In Washington State, fewer than twenty five percent of response agencies have some form of emergency action plan and fewer yet have actually tested or used their plans. The "go it alone" macho

philosophy must be replaced with knowledge, training and a coordinated effort among local, state and federal agencies. The consolidated effort of Kirkland, Redmond and Bellevue to establish the Eastside Hazardous Materials Team is just such a progressive endeavor.

In all likelihood, the highest probability event that would involve hazardous materials in Kirkland would result from a transportation accident on 1-405 or the adjacent arterials feeding the city. A study by the Puget Sound Regional Council has identified the following hazardous materials as those most frequently transported on the highways by tank trucks through the Puget Sound corridor:

Chlorine	Liquid Oxygen Ammonia	Flammable Liquid
Anhydrous LPG -Propane	Gasoline	Corrosive Liquids
Hydrochloric Acid	Fuel Oil (Diesel)	Flammable Gas
Sodium Chlorate	Sodium Hydroxide	Non-Flammable Gas
Nitric Acid	Petroleum Distillate	Oxidizers
Phosphoric Acid	Kerosene (Jet Fuel)	
Toxic Flammable Liquid	Sulfuric Acid	

Given Kirkland's low number of fixed facilities with hazardous materials and the nature of manufacturing in the jurisdiction, fixed site releases appear to be of minimal potential. However, potential fires in facilities where multiple hazardous materials are stored could cause extensive problems anywhere downwind. Dangerous fumes and smoke from burning chemicals are often hard to estimate and predict and could necessitate evacuations in homes as far away as a mile or more under certain wind and humidity conditions.

Evacuation, either precautionary or response related could potentially involve hundreds of people and significant portions of residential neighborhoods adjacent to or near routes where hazardous materials are transported. The number of people affected would largely depend on the time of day, day of the week, and specific location of the incident. Mass care, involving shelter, feeding and transport of some individuals could also be involved. Although the Team has not responded to a major incident at the time of this writing, they routinely respond to smaller spills and incidents and actively participate in operationally relevant training.

6. Suggested Mitigation Strategies

Three requirements are imperative to successful hazardous materials management:

1. A continued awareness and planning program at the local level to develop capability and knowledge about hazardous materials, not only in the responder ranks of the fire department, but throughout all agencies.
2. Continued support and participation in the Local Emergency Planning Committee through the provision of guidance, planning assistance, education and training necessary to build a region-wide hazardous materials prevention, response and recovery program. It is the ultimate responsibility of each local government to ensure that its emergency response personnel are trained and prepared.
3. Provision of specialty equipment and funding to implement the needed training. The LEPC's should be equipped to provide training on a regional basis.

J. HEAT WAVE

1. Define the Hazard

While the average citizen in Kirkland normally does not think of the area as one subject to intense heat,

anomalies in the average weather patterns do create conditions that can be described as "extreme" in terms of heat. A Heat Wave can be defined as a period of time, lasting several weeks or more, where temperatures average ten degrees or more above the average high temperatures.

2. The Kirkland Experience

In July, 1994, the Kirkland area registered temperatures just above 100°F on several occasions. Fortunately, the humidity remained low for that period. Those temperatures, combined with relatively high humidity, can create potential serious medical problems for certain segments of Kirkland's population. Meteorological records for the last ten years around Kirkland indicate frequent temperatures at or near 100 sometimes occur over a four-month period from June through September.

3. Potential Effects

In a normal year, about 175 Americans die from the effects of summer heat. In 1952 nearly 1,500 died and nearly 1,000 in 1954. In the disastrous heat wave of 1980, more than 1,250 people died across the nation. And these were direct casualties. No one knows how many more deaths were triggered by heat wave weather or how many diseased or aging hearts succumbed to the added stress of heat. Heat waves bring great stresses to the human body and there are many aged and infirm who cannot cope normally with this type stress.

North American summers are hot and it is not unusual to see heat waves in one or more sections of the country every year. Areas that normally have high humidity and high temperatures create a doubly dangerous situation. Some of the worst and most catastrophic heat waves however, have occurred in very dry conditions. Considering the tragic death toll in past years, the National Weather Service has stepped up its efforts to more effectively alert the general public and appropriate authorities when prolonged excessive heat and/or combined humidity episodes will occur.

Based on the latest research findings, the National Weather Service has devised the Heat Index (sometimes referred to as the "apparent temperature"). The Heat Index, given in degrees F, is an accurate measure of how hot it feels when relative humidity is added to the actual air temperature. (See Heat Index Chart this section.)

Important: Since Heat Index values were devised for shady, light wind conditions, exposure to full sunshine can increase Heat Index values by up to 15°F. Also, strong winds, particularly with very hot, dry air, can be extremely dangerous. Note on the Heat Index Chart the shaded zone above 105°F. This corresponds to a level of Heat Index that may cause increasingly severe heat disorders with continued exposure and/or activity. The "Heat Index vs. Heat Disorder" table relates ranges of Heat Index with specific disorders, particularly for people in higher risk groups. Studies of heat syndrome indicate that it occurs at all ages, but, other things being equal, the severity of the disorder tends to increase with age. Heat cramps in a 17 year old may be heat exhaustion in someone 40 and a heat stroke in a person over 60.

Heat disorders generally have to do with a reduction or collapse of the body's ability to shed heat by circulatory changes and sweating, or a chemical (salt and trace mineral) imbalance caused by too much sweating. When heat gain exceeds the level the body can remove, or when the body cannot compensate for fluids and salt lost through perspiration, the temperature of the body's inner core begins to rise and heat related illness may develop.

Heat disorders exhibit a range of severity, but share one common feature: the individual has overexposed or over-exercised for his or her age and physical condition in the existing thermal environment. Acclimatization has to do with adjusting sweat/salt/trace mineral concentrations, among other things. The idea is to lose enough water to regulate body temperature, with the least possible chemical disturbance.

Stagnant atmospheric conditions associated with heat waves trap pollutants in urban areas and add stresses of severe pollution to the already dangerous stresses of hot weather. In addition, the urban landscape retains the heat and intensifies the impacts. In many cases, this causes a tremendous health problem of yet undiscovered dimensions. The elderly are also at risk because of costs associated with air conditioning and cooling. Analysis of the 1978 Texas heat wave shows that some elderly people on fixed incomes found the cost too high, turned off their units, and ultimately succumbed to the stresses of heat.

Elderly persons, small children, chronic invalids, those on certain medications or drugs (especially tranquilizers and anticholinergics), and persons with weight and alcohol problems are particularly susceptible to heat reactions, especially during heat waves in areas where a moderate climate usually prevails.

It is also noteworthy that power demands at peak times of the day during hot weather can meet or exceed those used in the cold of winter. Potential power outages in extreme heat waves can create tremendous complications in both individual and business environments.

To use the heat index charts, find the appropriate temperature at the top of the chart. Read down until you are opposite the humidity/dewpoint. The number, which appears at the intersection of the temperature and humidity/dewpoint is the heat index, or how hot you really feel.

Heat Index Chart (Temperature & Dewpoint)																
Dewpt	Temperature (° F)															
(° F)	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
65	94	95	96	97	98	100	101	102	103	104	106	107	108	109	110	112
66	94	95	97	98	99	100	101	103	104	105	106	108	109	110	111	112
67	95	96	97	98	100	101	102	103	105	106	107	108	110	111	112	113
68	95	97	98	99	100	102	103	104	105	107	108	109	110	112	113	114
69	96	97	99	100	101	103	104	105	106	108	109	110	111	113	114	115
70	97	98	99	101	102	103	105	106	107	109	110	111	112	114	115	116
71	98	99	100	102	103	104	106	107	108	109	111	112	113	115	116	117
72	98	100	101	103	104	105	107	108	109	111	112	113	114	116	117	118
73	99	101	102	103	105	106	108	109	110	112	113	114	116	117	118	119
74	100	102	103	104	106	107	109	110	111	113	114	115	117	118	119	121
75	101	103	104	106	107	108	110	111	113	114	115	117	118	119	121	122
76	102	104	105	107	108	110	111	112	114	115	117	118	119	121	122	123
77	103	105	106	108	109	111	112	114	115	117	118	119	121	122	124	125
78	105	106	108	109	111	112	114	115	117	118	119	121	122	124	125	126
79	106	107	109	111	112	114	115	117	118	120	121	122	124	125	127	128
80	107	109	110	112	114	115	117	118	120	121	123	124	126	127	128	130
81	109	110	112	114	115	117	118	120	121	123	124	126	127	129	130	132
82	110	112	114	115	117	118	120	122	123	125	126	128	129	131	132	133

Note: Exposure to full sunshine can increase HI values by up to 15° F

4. Suggested Mitigation Strategies

Specific mitigation strategies center around public education and outreach efforts aimed at all segments of the community on a regular basis through a variety of media. The programs should be pervasive and disseminated through both public and private organizations. All programs need to be well thought-out and developed and/or reviewed by emergency medical staff before dissemination. In general, the material should cover the following topics:

- Reduction of strenuous activities, how to slow down
- Dietary suggestions (avoid lots of protein that increases body metabolism and increases water loss; eat less)
- Provide guidelines for fluid consumption and salt tablet intake
- Identify large air-conditioned private or public buildings that can serve as a temporary shelter arranged through the City Emergency Management Division.
- Sun exposure warnings and guidance on color and clothing types

The National Weather Service has continued to increase its capability to predict these weather and temperature related phenomenon. They will initiate alert procedures when the Heat Index is expected to exceed 105°- 110°F (depending on local climate) for at least two consecutive days. This should, in all likelihood, allow local authorities to begin collective public information efforts prior to the onset of this type of heat. In Kirkland and the Puget Sound area, that threshold temperature will likely be lower because of the humidity and normally lower temperatures. Coordination with the weather service would be prudent for planning purposes.

K. LANDSLIDE (ROCK-MUD-SOIL-VEGETATION)

1. Define The Hazard

Landslides are masses of dirt, rock, mud, or vegetation, which slip down hillsides or cliffs. It is one form of earth movement. Other types can be generally classed as:

- Landslides - A sudden motion of the ground, which may cause surface faulting, ground shake, and ground failure
- Mudslides - A sticky mixture of water and earth or dust down steep slopes
- Ground subsidence - Any vertical displacement or downward movement of a level ground surface

It must be noted that excessive precipitation, heavy snowstorms with freeze-thaw cycles, and alteration of existing groundwater patterns can cause any of the above events to occur. However, the emphasis here is on landslides, since they are commonly triggered by heavy seasonal rains or local earthquake activity and are the most common form of land movement with the potential to inflict great damage to land and people.

High landslide hazards generally exist where:

- Slopes are between 15 & 40 percent
- The area has experienced previous landslide activity
- Areas with slopes greater than 15 percent
- Areas where stream or wave action has undercut banks or shoreline
- Imbedded groundwater lenses or impermeable clay

2. Significant Regional Events

Some recent events include:

- Severe winter storms during December, 1996 through March 1997, resulting in slides that damaged or

destroyed 8,000 homes. Over 100 slides were recorded in King County over a two-month period.

- January 15, 1999, a slide in southern Snohomish County derailed five cars of a freight train, interrupting cargo traffic for nine days and passenger transport for several weeks.
- November-December of 1998; number of small slides in King County near SeaTac Airport closed northbound lanes.

3. Kirkland Experience

Kirkland is no stranger to the threat of landslide and its associated dangers, either. Rainfall of significant depth and duration, construction activities, and seismic events all have the potential of causing soil to shift or slide. Early historical accounts in the Kirkland area reflect a fairly consistent presence of landslide activity in the city, usually the result of extensive rain, construction and/or seismic activity. Major flooding in 1942 caused numerous water-related slide activities in the city, and two children were killed in a landslide that occurred on 5th Avenue West in 1947. Major flooding again struck in December of 1959 and brought slides over Lake Street and 5th Avenue West. Sporadic incidents of soil and mudslides have occurred on Finn Hill and other locations like the one that occurred in November of 1966. That incident was said to have been caused by construction in the area combined with excessive runoff and erosion.

Many times, prime view property exists in areas most susceptible to landsliding, making losses from landsliding events even more costly. The city has recently mapped areas that have experienced landsliding in the past, or may in the future. They are:

- Houghton Slope in the Lakeview neighborhood
- Finn Hill
- The south side of the Forbes Valley
- Slopes northeast of Totem Lake
- The Highlands neighborhood

There are other areas of the city where moderate landslide hazards exist. These areas are on slopes between 15 and 40 percent, underlain by relatively permeable soils or highly compacted glacial till. These sloped areas are generally stable, but seismic activity or a significant rainfall event could trigger landsliding. (See Map # 8 Landslide Areas.)

4. Potential Evidence/Effects

Typical effects of landslides include damage or destruction of road segments, railroads, sewer and water lines, outbuildings, homes, public buildings, and in rare cases, they do catch people unaware and kill. Many of the losses caused by landslides may go unrecorded, due to lack of claims made to insurance companies, lack of media coverage, or cleanup that was noted as maintenance.

In some cases where knowledge of previous slide areas go unnoted, developments were allowed and eventually had to be moved because of unstable foundations and constant slow movement. Strong shaking during earthquakes, explosions and vibrations of heavy machinery can jar and loosen upper layers of soil and hard-packed sediments, making them less stable. Loss figures from landslides are not available for the city of Kirkland, but judging from the past records, the bill has been substantial and likely to be ongoing.

Landsliding usually follows perceptible creep deformation along the surface, or within the slide mass. In other words, before a slope fails, signs of impending failure can be seen. Residents of buildings on or near slopes should be alerted to signs of possible impending slope failure.

Any one or more of the following signs can indicate historical or recent landsliding activity:

- Doors or windows that begin to stick or jam.
- New cracks in plaster, tile, brickwork, or foundations.
- Outside walls, walks, or stairs pulling away from building.
- Slow developing and widening cracks in the ground or in paved areas.
- Breakage of underground utility lines.
- Movement or tilting of fences, retaining walls, utility poles or trees.
- Split tree trunks or stretched roots.
- New water seeps or bulging of the ground at the base of slopes.
- Hummocky or uneven terrain.

5. Suggested Mitigation Strategies

Kirkland currently has a Critical Areas Ordinance, which controls or prohibits development in sensitive areas. However, without constant vigilance and attentive oversight, these sensitive areas have a good chance of being overlooked, neglected or disregarded to one degree or another. More effort needs to focus on preventing further development in, on, or directly adjacent to areas prone to landsliding throughout the city. There are other mitigation methods that can assist the Kirkland development community who have previously built in landslide-prone areas. They include:

- Developing and providing literature through appropriate city agencies to assist citizens to recognize landslide hazards and where to get advice to stabilize their property.
- Encouraging the maintenance of existing vegetation, both above and on steep slopes.
- Maintaining drainage-collect runoff from roofs and improved areas and convey water away from the steep slope or to the beach in a carefully designed pipe system.
- Undertaking a regular schedule of inspection and maintenance of drainage systems.
- Place septic system drain fields or irrigation systems outside areas between a structure and the edge of the hazard area.
- Retain natural drainage systems.

L. LOST, MISSING, OR TRAPPED PERSONS

1. Define The Hazard

Each year, literally thousands of incidents relating to lost, missing or overdue people of all ages and descriptions are reported to local authorities. Many are considered abductions or kidnappings and are specifically handled as missing persons with criminal implications through law enforcement and other investigative channels at local, state and federal levels. However, the most significant number of incidents involve situations like walkways from Senior Centers or home environments (Alzheimer's patients etc.), or children who wander away from a park, their back yard or a playground through some set of innocent circumstances. People of all ages have become the focus of a search because an accident trapped or incapacitated them in some way. Sometimes it is very difficult to determine whether the incident has criminal implications or not. For this reason, it is essential that any local jurisdiction have clearly defined procedures and protocols for investigating and carrying out a search effort of any kind.

2. The Law and Responsibilities

Washington State Law (RCW 38.52) defines search and rescue (SAR) as "the acts of searching for, rescuing, or recovering by means of ground, marine, or air activity any person who becomes lost, injured, or is killed while outdoors or as a result of a natural or man-caused disaster." This broad based definition brings with it a number of complications in Washington State that require established policy and planning at the local level if successful response is to be expected in search and rescue operations. RCW 38.52 also gives specific responsibility for search and rescue to the Chief Law Enforcement Officer of every local jurisdiction. In

some cases, this provision is fraught with complications because of training and operational capabilities vested with other emergency response agencies (i.e. fire departments). In most cases, technical rescue responsibilities are vested with the fire department simply because of their equipment, training and practical capability. Search operations for missing persons are usually managed by law enforcement personnel.

3. Search and Rescue Defined

The acronym SAR (search and rescue) actually denotes two separate functions. The first is search and entails looking for lost overdue, stranded or trapped individuals in a variety of environments. These environments can vary between densely populated urban areas, collapsed or destroyed structures, and large tracts of timbered or woodland areas. Search has developed into a sophisticated science involving a great many modern investigative techniques. Statistics from previous situations, probability theory, human behavior, interviewing, terrain evaluation, and tracking are but a few of the standard tools used in modern search.

Once someone is located during a search or they are trapped, stranded, or in need of medical aid and assistance in a difficult location, the second term in the acronym comes into play. Rescue utilizes proven procedures along with a high degree of technical skill for victim retrieval. With known victims in known locations, the principle problem involves devising the most expedient method of removing that individual from danger to a place of safety and medical treatment. Here again, environments for rescue can vary greatly from urban to wilderness.

Both standard and technical rescue situations can involve trapped people in structures impacted by earthquake or other hazards, building collapses in general, confined space situations, trench or other excavation cave-ins, fire rescue from high-rise structures and a whole host of technical situations varying from ice, water, underground and steep embankment extrication.

Technical rescue is unique in many ways and presents many training and operational pitfalls. The very nature and inherent dangers of many rescue environments not only require a diversity of technical knowledge and training, but a myriad of equipment and safety devices. Response to many of these rescue situations are also covered in the Occupational Safety and Health Administration regulations (OSHA) and National Fire Protection Standards with tremendous legal and financial ramifications. Current expectations from the public encompass any and all situations relating to rescue and as a result the City's "standard of care" has continually expanded.

There were approximately 173 missions in King County in 2003. These figures do not include situations or incidents that occur in national or state parks, incidents where local law enforcement take care of the situation and doesn't call in outside resources, and also those incidents that involve the Coast Guard in marine environments. Search and rescue training and operational response constitute a major financial and functional impact on many jurisdictions in King County and the state as a whole.

4. The Kirkland Experience

Kirkland Fire has responded to trench and excavation rescue environments in the past and continues to do so. However, available response resources are limited and the city relies on mutual aid, as does its neighboring agencies, to produce a full complement of rescue personnel. The continued potential for these types of operations is high due to the tremendous amount of construction and utility work carried out by private contractors, Public Works and homeowners throughout the city. Kirkland Fire has, and continues to, respond to situations that involve confined space. To date, people within the city have been extricated from manholes, vaults and lift stations with additional potential for incidents in abandoned wells, cisterns, mine shafts, culverts and many types of industrial site containers, just to name a few. Current laws on Confined Space Rescue call for specific levels of personal protection and expertise which the department has attained.

By definition, many Public Works employees, industrial and construction workers, homeowners and children all enter types of confined spaces on a regular basis. Some of these create rescue situations and some don't. The Fire Department is named as confined space rescuers by the city's Public Works Department. Eighteen fire personnel have been trained to Technician level of certification for confined spaces and sixteen to Technician Trench Rescue level. Situations involving workers, hobbyists, thrill seekers or just outdoor enthusiasts create the most frequently performed type of technical rescue operation; that of rope rescue. The Fire Department has twenty personnel certified in high and low angle rope rescue. Most of Kirkland's experience in this area of rescue has involved construction workers and recreationists. Previous records indicate response to approximately four high angle rescue situations a year.

As mentioned earlier in the section on earthquake hazard, the city of Kirkland and the surrounding areas are prone to earthquakes and the corresponding collapse of buildings and other structures. This hazard type can create collapsed buildings with associated trapped people. However, collapsed structures can be, and often are, caused by poor or improper construction, violent weather, landslide or other destructive forces.

While the region is blessed with the Puget Sound Urban Rescue Team, which is made up of members from jurisdictions throughout the Puget Sound, Kirkland has limited personnel trained in structural collapse rescue. That means that the city is virtually dependent on outside resources for effective rescue operations in structural collapse. That could result in time factors for effective response in situations of this nature to exceed 24 to 48 hours.

Search situations involving lost children, walkaways from assisted living centers, or Alzheimer's patients all present potential for search incidents within the boundaries of Kirkland. Based on statewide statistical data and that collected in King County, incidents involving search are quite frequent near the Kirkland area of the Eastside. King County statistics reflect over 173 incidents countywide in 2003, with two cases in Bothell and one in Redmond. This represents over 75,000 hours of response time for volunteer SAR workers with another equal amount for training and does not consider the vast time spent by law enforcement personnel.

According to the King County Sheriffs Office, King County normally handles all search incidents within the county, which includes the City of Kirkland. By mutual aid agreement, the Sheriffs office has agreed to run all searches within Kirkland and surrounding jurisdictions, even though state law gives that responsibility to the Chief of Police.

Potential situations involving search and/or technical rescue include the following categories:

- a. Industrial and City Workers:
 - (1) Falling or entrapment on platforms, equipment, towers or other high structures during inspections or ongoing work.
 - (2) Falling into or entrapment in pits, trenches, vaults, tanks, lift stations, abandoned wells, cisterns, mine shafts, culverts and other subterranean locations.
 - (3) Entrapped, engulfed or buried by soil, sand, loose product or slurry.
 - (4) Incapacitated (unconscious, heart attack, stroke, etc.) while working at heights, depths or other compromising environments requiring technical rescue expertise.
- b. Citizens:
 - (1) Falling from heights, embankments, or other steep terrain.

- (2) Stranded, incapacitated, or trapped people that have climbed trees, poles, towers or other tall structures.
- (3) Vehicle incidents involving inclines or steep embankments.
- (4) Children playing in trees, culverts, pits, construction sites and other dangerous areas.

It is not unusual for literally hundreds of people to be involved in a single rescue operation, depending on the location and hazardous environment involved. Some rescue incidents have necessitated a full mutual aid response from surrounding jurisdictions, several law enforcement patrol units, a number of medical aid units and heavy equipment with operators. Management of any technical rescue situation requires experience and in-depth knowledge of specialized environments.

5. Search

Searches for lost or missing persons can escalate tremendously in a very short period of time. Relatives or friends of prominent citizens, in combination with a well meaning but uninformed press, can blow any situation out of proportion very quickly. It has not been unusual in searches that have occurred around the country for small children and older Alzheimer's patients to escalate into thousands of people combing neighborhoods, canyons and brushy timbered areas. A massive search effort of this nature needs very close scrutiny and above all, tight local controls on tactical operations in the field. The key to effective management in these cases relates directly to proper management techniques and training.

Lost, overdue, trapped or incapacitated individuals in difficult or unknown locations will undoubtedly plague emergency responders within the city in the future. Previous experience and county statistical data prove this. Some of these situations can clearly be prevented by education and good public information. However, the laws of probability and population numbers indicate a significant continuation of these types of situations. In this regard, the city of Kirkland has essentially two choices:

- a. Rely on outside resources entirely for technical rescue and search operations.

While this is an acceptable alternative, it is not without complications and negative effects. The factor of time is probably one of the biggest drawbacks to this alternative. Each of the surrounding jurisdictions including King County have ongoing operational responsibilities and because of that, their priority is certainly with local response. In cases that involve regional situations like earthquakes or other natural hazards that might cause people to be trapped or missing, time factors for effective response from outside Kirkland could be as much as 24 to 48 hours. This definitely exceeds survival rate time factors established for other successful rescue operations in case study disaster incidents.

In everyday technical rescue situations, even though Kirkland Fire Department collaborates with other jurisdictions to form a regional rescue capability, time can be a crucial factor in making a successful life saving response. Even if Kirkland decides to rely on outside resources, it is essential to have a trained cadre of expertise to assess situations, make logistical plans for support and operational capability, identify resources and set up the scene for effective rescue operations.

In the area of search, even though Kirkland may have an agreement with King County to conduct and/or manage any search operations, essential first notice information gathering, investigation and interviewing will normally have to be conducted by Kirkland Police.

- b. Commit city resources to establish a level of expertise and capability within the city's Police and Fire departments to safely conduct and manage search and/or technical rescue operations.

While at first this may seem economically infeasible, it may well provide a level of response capability that at least establishes a basic level or "standard of care" that serves Kirkland's best interest. This could mean a trained cadre of Fire Department personnel with technical rescue skills and also Police Department capability in the management arena to initiate and maintain effective search operations.

- Adopt official policies relative to all actions that deal with search and rescue.

6. Suggested Mitigation Strategies

Legal precedents, the "Doctrine of Engendered Reliance," and various liability cases all emphasize the importance of policy guidance and specific training standards relative to response functions.

Although it may be financially unrealistic to expect Kirkland to field and continue to fund a fully operational technical rescue team, it does make sense to have key personnel trained to a level of expertise that contributes substantially to the regional capability. These trained personnel certainly would also provide initial action response that could be crucial or life saving in the final outcome of any incident. At present, it is questionable as to the capability of Kirkland resources to adequately handle any search and/or rescue situation.

- Review mutual aid agreements to ensure availability of adequate SAR resources.

Kirkland has limited resources and capabilities to respond to SAR operations. This is all the more reason to develop existing capability and plan for known shortfalls. Mutual aid must be a substantial part of the planned SAR efforts for Kirkland and should be maintained at current levels or higher.

M. SNOW AND ICE STORMS

1. Define The Hazard

Although Kirkland's climate is characterized by mild temperatures, a defined rainy season and considerable cloudiness, snow and/or ice storms of major consequence do occur. Usually winter storms do not produce snow or freezing rain unless the storm track moves in such a way as to bring cold air directly out of Canada or pressure system differential spills an extreme cold influence from inland in the state. Ice storms (freezing rain) are by far the rarer of the two occurrences, but they do occur. These events are caused by rain falling on objects in a below freezing temperature environment.

2. The Kirkland Experience

Probably the latest example of winter's fury was evidenced in January of 1996. Although not as severe as some of the winter conditions in the past, the storm and cold weather period was a reminder of the potential. Damage occurred to facilities in Kirkland, including Lake Washington Technical College. Records indicate that Kirkland had experienced over 21 inches of snow in a 24 hour period and as much as 57 inches over a one month period.

Ice storms (freezing rain) occur when a moist, warm mass of air passes over freezing air at ground level. Rain falling from the warm air mass is cooled as it falls through the cooler air and freezes as it hits the ground or other objects such as trees, power lines and streets. If a true inversion develops, these ice-laden trees, power lines and streets may not thaw out for days.

Recent heavy snow and ice conditions have occurred in the general Puget Sound area and have produced significant accumulations in November, 1960; January, 1972; January, 1980; November, 1985; and December, 1990. The last significant ice storms or freezing rain combinations occurred in January of 1979. While certainly not as susceptible as some other parts of the state, Kirkland still has the potential for

crippling severe snow and ice storms.

3. Potential Effects

A heavy snow warning usually means an expected accumulation of 4 inches or more in a 12-hour period, or as much as 6 inches or more in a 24-hour period. Warnings of snow flurries, snow squalls, or blowing and drifting snow are important mainly because visibility may be reduced and roads are expected to become slippery or blocked.

A blizzard is the most dangerous of all winter storms. It combines cold air, heavy snow, and strong winds causing drifting and low visibility. A blizzard warning is issued when the Weather Service expects considerable snow and winds of 35 miles per hour or more. A severe blizzard warning means that a very heavy snowfall is expected, with winds of at least 45 miles per hour and temperatures of 10°F or lower.

Damage and/or impact of winter storms of this nature will obviously vary with the magnitude and length of the weather system. Snow or ice, accompanied by strong winds and low temperatures, could virtually paralyze the City for many days and cause serious economic damage. The longer the storm or system, the greater the economic impact merely from the lack of business.

Damages could include broken pipes, downed trees, broken power and telephone lines along with the associated blocked and impassable streets. An increase in traffic accidents with injuries and even deaths on extremely slick or ice-covered roads would also be very likely. Another distinct danger to some individuals would be the potential for asphyxiation from trying to heat homes with non-traditional heating devices. As mentioned in the Cold Wave section of this report, there could also be a correspondingly high probability of increased deaths and problems associated with hypothermia if the region experienced widespread power outages. This includes loss of livestock primarily by dehydration. Demands for natural gas could cause additional problems as it did in January of 1996.

During the extreme winter storms that hit the city in late December of 1996, tremendous damage was done throughout the city from excessive snowfalls and the extreme weight of the snow that became saturated with rain. Collapsed carports, storage buildings, marinas, businesses and private homes caused more dollars in damage throughout Kirkland than any other disaster in its history. Nine counties in Western Washington were declared disaster areas by the Governor.

4. Suggested Mitigation Strategies

As with the Cold Wave hazard, one of the primary weapons against potential problems that could result from severe winter storms is knowledge and public awareness. The National Weather Service has become more sophisticated in predicting the severity and path of developing storms, giving communities time to prepare and assemble the resources needed for response. Public and private programs that inform citizens and stress emergency preparedness should be developed and disseminated. Local energy companies, city departments, and community organization can assist in implementing the programs. Attention needs to be given to special populations of concern, such as the elderly and/ or disabled. Other specific suggestions include:

- Avoid damage to power and telecommunication systems from heavy snow and ice by burying lines.
- Require high standards for insulating buildings, outlined in required building permits.
- Insulate to protect pipes, windows, and doors.
- Provide inspections and maintenance operations to prune trees throughout the city to prevent damage to homes, power, TV and telephone lines.
- Institute early warning/alert systems and storm watch messages.
- Undertake fire and safety inspections to provide helpful winter preparedness, as part of the procedure.

Self sufficient and well informed citizens create much less burden on city resources and response agencies when hazardous weather occurs.

N. TERRORISM AND/OR BOMB THREATS

1. Define the Hazard

Terrorism distinguishes itself from other forms of violence and hazards by the fact that the intended target is not actually the victim or facility that is seized or attacked. The real target is beyond the terrorist's reach and the victim is simply a perceived symbolic attack on that target.

Terrorists consider the military, police forces and the establishment as their adversaries. These groups are perceived as the protectors of society, and terrorists believe successful terrorist acts against them demonstrate the vulnerability of that society. They believe successful acts also help demonstrate the effectiveness of terror as a agent of change.

Terrorism involves a criminal act, often symbolic in nature, intended to influence an audience beyond the immediate victims. It is the calculated use of violence to attain political, religious, or ideological goals by instilling fear or using intimidation or coercion. Terrorism may be used by individuals or well-organized groups to obtain their goals when other means such as political process, demonstrations or media attention have failed.

In a democratic society, any increase in security is a subtle gain for terrorists. Their goals are usually one or all of the following:

- To take away the very freedoms that comprise a democracy;
- To derive wide spread publicity; to raise large sums of money to generate revolutionary or incremental change.

If they are captured or killed, the publicity, property damage or casualties they have caused may allow the operation to be considered a success by other terrorists and their leaders.

Not all terrorist acts are committed by political or hard-core terrorists, but carried out by a criminal element seeking personal, rather than political gain, or by individuals who are mentally imbalanced. Understanding how terrorist groups differ is important to any planning efforts that might be designed to counter these acts of violence.

Broad based categories and descriptions of terrorist types include the following:

Political Terrorist Groups (national & international).

Extremist Protest Groups - i.e. ROTC facility bombings during the Vietnam War or bombing and burning of medical clinics where abortions are performed.

Organized Criminal Groups - kidnapping & extortion.

Miscellaneous Criminals - robberies gone bad (hostage situations etc.)

Disoriented Or Mentally Imbalanced Persons - violent people with personal problems trying to be noticed for a cause.

Disgruntled Employees - Hostages, bombings or killings to gain revenge.

None of these categories are mutually exclusive. Even someone characterized as a hard-core crusader often moves into acts of criminal behavior to finance the crusade.

2. September 11, 2001 Terrorist Attack

On Tuesday morning, September 11, 2001, the U.S suffered an attack on the World Trade Center Twin Tower Buildings by radical Islamic terrorists (Al Qaeda) who hijacked three jet airliners and crashed them into the twin towers. Another plane hit the Pentagon and a fourth, bound for the Capitol, crashed in a field in Pennsylvania. Over 2,000 people died in this incident and it changed American's perception of terrorism forever. Not only did we go to war in the Middle East, but, since that time, strategies have been and will continue to be formulated and policies implemented to protect ports, public buildings, and transportation systems. This dramatic event has caused Americans to examine their level of individual freedom and the sacrifices we have to make to ensure we maintain our current way of life. It also forced our government to form a Department of Homeland Security to provide resources for protecting life and property throughout the nation.

3. The Kirkland Experience

In the past, there have been a number of bomb threats in the community with corresponding evacuations. The city police department has had experiences with pipe bombs, mailbox bombs and other similar incidents, including armed, barricaded subjects. A bank robbery situation resulted in an evacuation and subsequent involvement with the FBI and bomb squads from outside the jurisdiction. There also has been one recent incident of note. The King County Journal reported on April 14, 2004 a man living in Kirkland was arrested for possessing the toxin ricin. The report goes on to say the man suffered from a mental illness and wrote of his desire to "end all life on earth" and had mailed his sister that he had found a way to "poison the water supplies." It is not known whether the threat was specifically against the city or if the individual could have carried out the threat, but points to the potential for this to happen if security measures are not in place for critical lifeline systems.

4. Potential Effects

These incidents, along with other gang activities, are important reminders that Kirkland is really part of the greater Seattle area and subject to the same potential criminal or terrorist activities that King County and surrounding communities may experience.

Kirkland City Hall, with all of its new trappings and expanded services, is particularly ripe for access by undesirable or malicious elements. The general public has access to nearly all of the city's internal offices, storage spaces, utility cutoffs and internal building workings without ever passing an employee or security source. Additional security measures have been implemented in and around the municipal court facility.

Methods employed by terrorists include bombing (including the use of letter bombs, pipe bombs, and firebombs) kidnapping, assassination, hijacking, and theft of funds and materials for political purposes. U.S. domestic terrorist groups generally gain funding from bank robberies, armored car robberies, donations from sympathetic supporters, the sale of pamphlets, and group members fees, dues or donations. By far, the most commonly used tactic by terrorists is a bombing or threat of using a bomb. They are popular weapons because they are cheap and easy to make, adaptable to a variety of uses, and difficult to detect and trace after the event. It is estimated they account for over 70 percent of all terrorist activities recorded over the last decade. Individuals can set a bomb to go off at a later time, and thereby minimize the chances of injury. At the same time, this allows time for escape, and potential evidence to be consumed by the

explosion.

Specific common tactics include:

- The use of threats, harassment, and violence to serve as methods of systematic persuasion and to create an atmosphere of coercion and/or fear.
- The use of unprovoked attacks.
- The selection of targets and acts which gain maximum publicity and have maximum propaganda value.
- The use of elements of surprise to overcome countermeasures.

In keeping with the general terrorist philosophy of exposing the vulnerability of society, terrorist groups have targeted symbolic entities such as military installations, government buildings and officials, and the offices of corporations doing business with the government. Recently, however, there has been a shift of focus to energy suppliers, nuclear plants, centers of financial trade (World Trade Centers), and international embassies.

Common targets in the community for terrorist activities would include:

- Gas pipelines and support facilities
- Electrical power lines and transmission facilities
- Water reservoirs and storage facilities
- Communications lines and facilities
- Chemical storage sites
- Equipment warehouses
- Computer facilities
- Rail lines and cars
- Transportation depots
- Trucking facilities
- Government officials
- Corporate executives
- Police
- Dependents of police
- Federal, state or local government buildings

The vulnerability of the population or government of any local jurisdiction to terrorist acts is wide and varied. Any attempt to analyze potential terrorist threats that could possibly affect life, property or the environment would cover the list of hazards already identified in most jurisdictional threat assessment documents. It is well to remember that one of the most serious domestic terrorism incidents in this country was in a small high school in the state of Wyoming, far from the urban, high density population areas usually thought of as prime targets for terrorists. The unpredictable nature of terrorist acts are what make them so insidious. The overriding desire on the part of the terrorist for high visibility within the media coverage, rather than monetary or actual programmatic gain, makes the probability of predicting any community's points of greatest vulnerability almost impossible.

From each potential target in which some act of terrorism, violence or threat was enacted, there are dozens of collateral, or secondary effects that could be expected. Disruption of power, pollution of water, communications failure, explosion, and fire are but a few of the possibilities that could be considered. In turn, nearly all of these will affect people, property and the environment, which impacts the economy and the social structure of the community.

The destruction of the World Trade Center Twin Towers by hijacked aircraft in New York and the deaths from the release of anthrax on the East coast served to shatter the illusion that the United States is immune

from international or domestic terrorism. This is not to imply or suggest that the City of Kirkland may or may not be a target for these types of criminal acts. These events can only embolden and inspire other groups who have a hatred for the U.S. and wish to bring violence to this country and its levels of government.

Special interest terrorist groups remain a potential threat to virtually all factions and locations of our local, state and federal government. These special interest terrorist groups are characterized by their focus on a specific cause or issue. Examples include groups that advocate criminal or terrorist type activities in order to support environmental issues or animal rights. Another prime example relates to the violence and killings associated with abortion clinics and the right-to-life issue.

5. Suggested Mitigation Strategies

In all probability, Kirkland has the biggest potential and vulnerability to terrorist type activities that may be instigated by individuals who fall in one of these categories: Miscellaneous criminals, disoriented or mentally imbalanced persons and even disgruntled employees. Tactics in these situations usually involve bomb threats or detonations, hostage situations or even personal attacks on individuals or property. The following strategies should be considered to mitigate the threat:

- Develop well-defined policies and procedures that provide basic ground rules and tactical guidelines for department personnel to use for dealing with incidents of this nature. In the event of a bomb threat, hostage situation, or similar event, employees need to know exactly what to do.
- Conduct annual exercises that deal with terrorist type incidents to instruct and provide a good foundation for appropriate individual behavior.
- Beef up security in all public buildings through personal employee vigilance and observations.
- Develop well thought out and exercised evacuation drills with police and fire department personnel to sharpen skills in bomb searches and assist in quick detection.
- Develop mutual aid agreements with outside expertise to assess all options and provide another level of response.

It must be noted the city has taken an important step in beefing up their security. The recently developed Water System Security Vulnerability Assessment is an example of what needs to be done for other critical lifeline components.

The identification of terrorism indicators can provide information for developing mitigation actions ahead of the actual terrorist act. Specific conditions that may indicate a potential for politically motivated violence in specific localities are identified below.

Note: Many of the indicators may appear as the normal exercise of people's rights, but when taken into context with other activities, they may become indicators of potential violence.

6. Events and/or indications of potential terrorist activities:

- a. Dissent for political, social, or ethnic reasons. Charges brought against local government.
- b. Formation of radical groups, branches or national subversive groups, or secret societies.
- c. Anti-government, anti-U.S. agitation; intimidations of government or U.S. as the root of problems.

- d. Meetings, rallies, and demonstrations being organized; grievances taking political overtones; inflammatory speeches and charges made; provocation of authorities to intervene, police or military brutality charged.
- e. Appearance of anti-establishment posters, leaflets, underground press, re-shaping people's concern into politicization of social causes.
- f. Use of known personalities as draws for rallies, especially those identified with radical causes.
- g. Increased activism in political spheres at colleges and universities.
- h. Threats against public works, utilities, transportation; threats of violence against prominent personalities.
- i. Increased purchase of high performance weapons; appearance of automatic weapons, especially of foreign manufacture and/or reports of stolen firearms and explosives; raids on armories or sporting goods stores.
- j. Violence against property, looting, destruction, arson; especially during demonstrations, marches or mob actions.
- k. Violence against persons, murders, attempted murders, beatings, threats, abductions, public targeting of people.
- l. Open attacks on police, military and other symbols of authority.

The United States and all of its jurisdictions, because of its size, porous boarder, open society, and official involvement in the global political arena, is vulnerable to all sorts of terrorist activities. Potential terrorist networks are in place and certain groups have the motivation to commit terrorist attacks all across the country, either in opposition to foreign policy, or out of hatred of particular ethnic groups and residents here. Although the size of the country and the diversity of the society tend to cushion the country against some of the negative ramifications of domestic terrorism, the effect on society of individual acts may be pronounced.

While much of the threat from international or domestic terrorism is well beyond the purview to Kirkland's responsibilities or capabilities, smaller, isolated incidents such as bomb threats, hostage situations or ethnic hate crimes hold the potential for mitigation and/or prevention. The fears, frustrations, and concerns of potential victims are real and personal, regardless of the role he or she plays in an incident. There are no strict rules of behavior, but there are certain do's and don'ts that may affect the outcome of a hostage or bomb threat situation, and employee education and training will determine the success of the outcome.

It is apparent that certain factions in our society, organized groups or individuals acting on their own, will continue to use violence and criminal acts to make their views known. Acts of terrorism, large or small, have created a level of awareness never before experienced in this country. It is imperative that federal, state, and local governments, through their respective law enforcement agencies, remain vigilant for those individuals and groups who would commit violent criminal acts in furtherance of their political and social objectives. Training, cooperation, and coordination among diverse local, state and federal police organizations are a major weapon against this type threat.

O. VOLCANIC INCIDENTS

1. Define The Hazard

Volcanic activity occurs when a vent in the earth's crust allows the ejection of molten lava and gases or ash is ejected. Characteristically, a conical hill is formed, but the appearance of a volcano may vary, due to the type of material ejected.

Most people in Washington State would have probably laughed in the late seventies if asked if they thought there was a threat to citizens from volcanoes here in the Pacific Northwest. That all changed on May 18th, 1980, when Mt. St. Helens erupted.

We now know and respect these sleeping giant hazards for what they truly are and also what they can do. Of the volcanoes located in Washington State, five are classified as active and one is designated dormant. These mountains are considered active if they have erupted within recent historical time, or are showing present signs of activity. By this definition, Mt. Baker, Mt. St. Helens, Mt. Rainier and Glacier Peak are all active. Dormant volcanoes are those that have not shown signs of erupting within the last 10,000 years. Mt. Adams is considered dormant, but has the capabilities of renewed activity. Both the active and dormant volcanoes of Washington State are classified as composites. Composite volcano eruptions are characterized by explosive emissions of steam, cinder ash, or lava flows.

While the counties and jurisdictions directly adjacent to these mountains certainly bear the brunt of direct life-threatening occurrences from an eruption, there are other hazards and secondary complications that constitute a very real threat to other parts of the state, including the city of Kirkland. A good example of this was evidenced in eastern Washington during the Mt. St. Helens eruption. Virtually the entire Puget Sound area was spared all but a dusting of volcanic ash in 1980 simply because of the prevailing winds.

2. The Kirkland Experience

Since Mt. St. Helens was the only volcanic eruption in this region in recent recorded history, the city has not had any previous experience in dealing with this hazard. As mentioned above, it was only because of the wind direction at the times of the different eruptions that prevented Kirkland and the greater Seattle area from getting a good coat of volcanic ash. Portland, Vancouver, and jurisdictions along the Pacific coast and counties due east and north of the Mountain all experienced ash fallout. A significant portion of Eastern Washington and its jurisdictions all experienced this phenomenon.

3. Potential Effects

The degree of hazards or complications caused by a volcanic eruption in Kirkland would depend on several key factors. The first would be the location of the eruptive mountain. The ash fall experienced during the Mt. St. Helens event revealed that heavier ash and pumice debris will be closer to the eruption, with lighter powder type deposits being carried with the winds up to greater distances. Areas of Yakima and Grant Counties received as much as 16 to 24 inches of ash during the St. Helens eruptions. A one inch deep layer of ash weighs an average of ten pounds per square foot. In heavy deposit areas, this would put large roof areas at risk of collapse in some cases. Some warehouses in Moses Lake were in danger of collapsing from St. Helens deposited ash. Ash is probably not a threat to Kirkland, since Mt. Baker and Mt. Rainier are far enough away for a significant ash threat and the deposit would be primarily talcum powder type ash and dust. In general, ash fallout is harsh, acid, and gritty and will often have an unpleasant odor. Although the gases are usually too diluted to constitute danger to a person, the combination of acidic gas and ash may cause lung damage to the very young, very old or infirm, or those already suffering from respiratory problems. Short term exposure to volcanic ash has not been found to be harmful to persons in normal good health.

On rare occasions, ash clouds can combine with rain and result in a diluted sulfuric acid solution that may cause minor burns to the skin, eyes and mucous membranes of the nose and throat. Acid rains may affect water supplies, strip and burn foliage, strip paint, corrode machinery, and dissolve fabric. Heavy ash fall in

Yakima from Mt. Helens completely blocked out the daylight.

Sudden demand for light and other utilities combined with the ash's capability to disable power substations, communications links, and telephone equipment could cause widespread power and communication outages. Ash clogs water courses and machinery of all kinds, especially engine intake filters and can bring all transportation to a halt in a local area. It is slippery wet or dry and because it is carried on the wind and air currents, ash in the local area will be a hazard to machinery and transportation for months after the eruption. Ash from St. Helens that was removed to areas outside of Moses Lake, was essentially blown back into town the next time the wind reached sufficient speeds. Secondary problems of ash removal, cleanup and disposal could create a tremendous economic burden for recovery.

4. Suggested Mitigation Strategies

Communities that were inundated with ash fall during the St. Helens event provide good examples of what was needed to combat the effects of this hazard. Some lessons learned include:

- Inventory and identify sources for procuring dust masks.

Thousands of dust masks were procured and distributed throughout the ash fall areas in the state and these masks are an essential element of the planning process for this hazard.

- Inventory and identify sources of air filter systems.

The State Patrol and other key agencies developed specific techniques for improvising air filter systems on their vehicles that would run in the ash-clogged areas. Trucking companies found great success with oil bath filters and improved on these for shipments into areas of heavy ash fallout.

Cities that dealt with the ash utilized a tremendous number of front-end loaders, dump trucks, street sweepers and tanker trucks to sweep and wash the ash off of streets, sidewalks and buildings. Numerous fire hoses were used in the cleanup process and eventually, replaced.

Although the ash was certainly not toxic, accommodations had to be made for stabilization of the deposits so that wind and moisture would not carry it back into the cities. The ash was used for fill in many areas and mixed with other soil components for dispersal and even distribution.

In general, the most effective way to mitigate the effects of this hazard would be to develop a comprehensive planning process that uses lessons learned from many communities hit with large quantities of ash during the St. Helens eruption. Mutual aid agreements, up-to-date resource inventories, established procedures for dealing with this event and a comprehensive public information program would certainly mitigate against any long term effects for the city. Despite prevailing thoughts to the contrary, volcanic ash fallout in Kirkland is a very real possibility.

P. WINDSTORM

1. Define the Hazard

Western Washington and the Puget Sound Basin are extremely susceptible to high winds with associated damage and destruction. These windstorms may accompany precipitation of one kind or another, but often they are just hours or day- long periods in which winds may reach in excess of 90 miles per hour somewhere in the Puget Sound area. When accompanied by moisture in the form of rain or snow, these storms can be of even greater danger and causes devastating impact to transportation and communication capabilities. With greater and greater accuracy, the National Weather Service has gained the capability to track these

windstorms and also to predict the wind speeds that may be experienced.

2. The Kirkland Experience

Although windstorms with destructive speeds occur in the Puget Sound area, it is very difficult to predict the exact locations, speed and gust potential that the city may experience. The maximum wind speeds clocked at the nearest recording station to Kirkland reflect top sustained speeds of 66 miles per hour in November of 1981. Actual speeds at some locations in Kirkland may well have passed that mark. During the December, 1995 windstorm, the city was fortunate and only received intermittent gusts to 60 miles per hour, while surrounding areas had winds that reached 80 to 90 miles per hour.

Probably the most well known historical storm in the western part of the state for years, was the Columbus Day Storm of 1962. Winds throughout the coastal areas varied between 80 and 100 miles per hour and the destruction went well into the millions. In 1979, another storm of major magnitude hit the area and local sustained winds reached in excess of 50 mph. That was the same storm that destroyed the Hood Canal bridge, with gusts that reached 120 mph. In January of 1993, the region was hit again by the Inauguration Day Windstorm in combination with a winter storm. The area experienced wholesale power outages and the magnitude of the impact in numerous locations around the state prompted a Presidential Declaration. All of these and many more point to the areas susceptibility to high-speed destructive winds.

3. Potential Effects

There certainly is enough experience with the windstorm threat to anticipate probable primary and secondary effects. Fallen trees, debris blocked streets and roads, downed power and telephone lines, widespread power outages, broken windows, structural damage (roofs, etc.) and crippled communications systems for emergency services are all part of the what could be expected with a major windstorm. Fallen trees and limbs on houses, cars and streets are usually the biggest damage- causing agent in these storms.

Secondary effects include damaged and broken water and sewer mains from uprooted trees, with the ultimate outcome of reduced fire suppression capability. If streets are blocked, transportation will be stalled and many emergency response resources may have difficulty responding. The potential of electrical contact with downed wires by individuals on foot or in automobiles is very real and has resulted in a number of deaths in the Puget Sound region during past windstorms.

The end results also relate to lost revenues in retail and wholesale businesses for the area, not to mention the cost of reparation and replacement of damaged city property.

4. Suggested Mitigation Strategies

As with nearly every other hazard mentioned in this document, public education must be at the heart of any responsive preparatory program for this threat. The National Weather Service can warn of impending hazard, but what citizens do specifically is their own responsibility. Some specific suggestions include:

- Develop and disseminate a public education and information program which instills initiative and priority in individual citizen preparedness efforts.
- Utilize emergency response personnel to inform nursing homes and others of need of specific preparedness strategies.
- Secure doors and windows with protective tape or wood when storm is imminent and periodic inspections of building roofs.

- Bury power and telephone lines to avoid complications in extremely high wind conditions and save long term repair and replacement costs.
- Maintain and prune trees to allow growth of stronger root systems and prevent damage to homes, as well as power, TV and telecommunication lines.
- Provide courtesy inspections for private property owners to provide incentives for them to implement further mitigation strategies.

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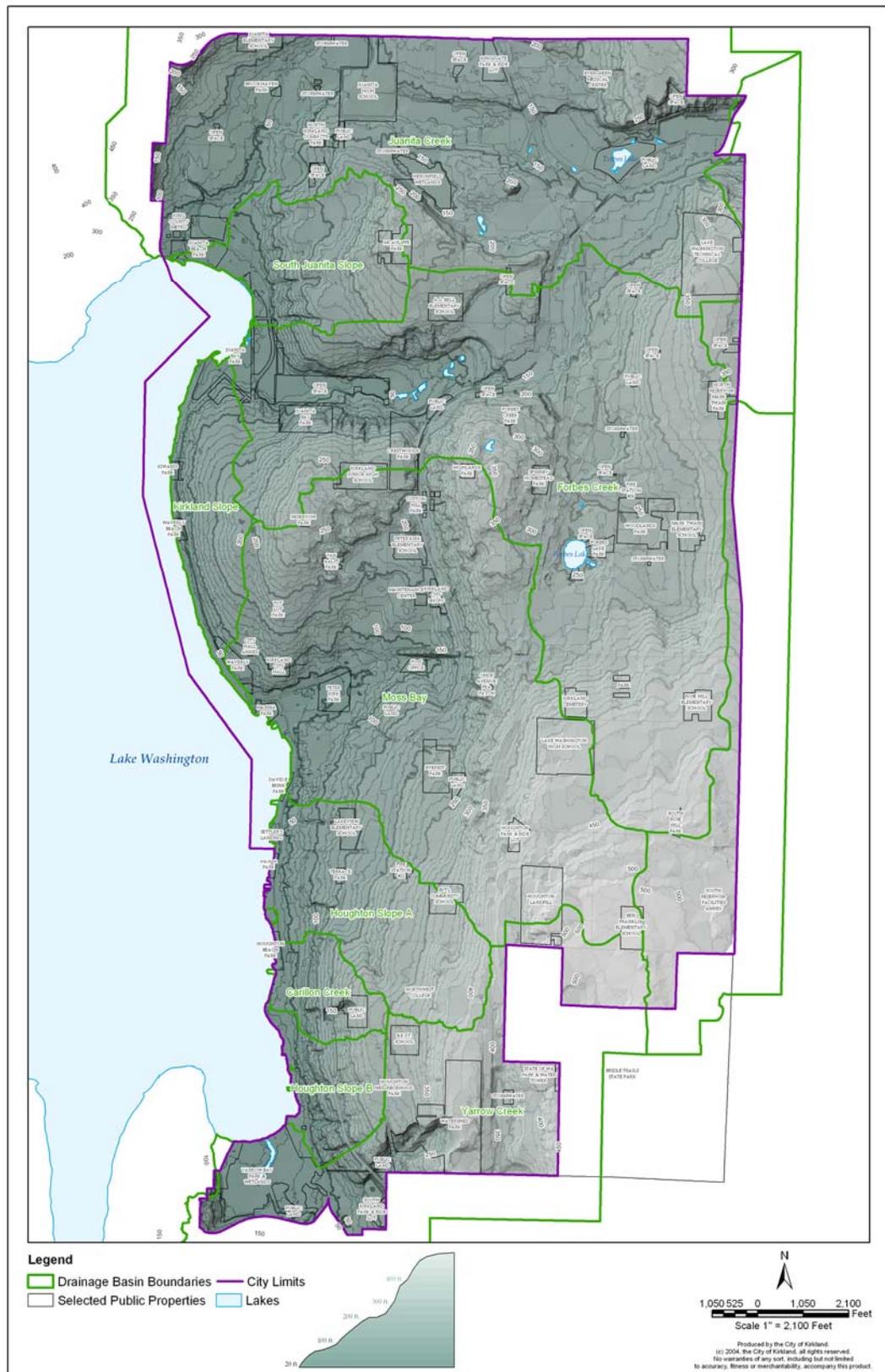
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MAPS

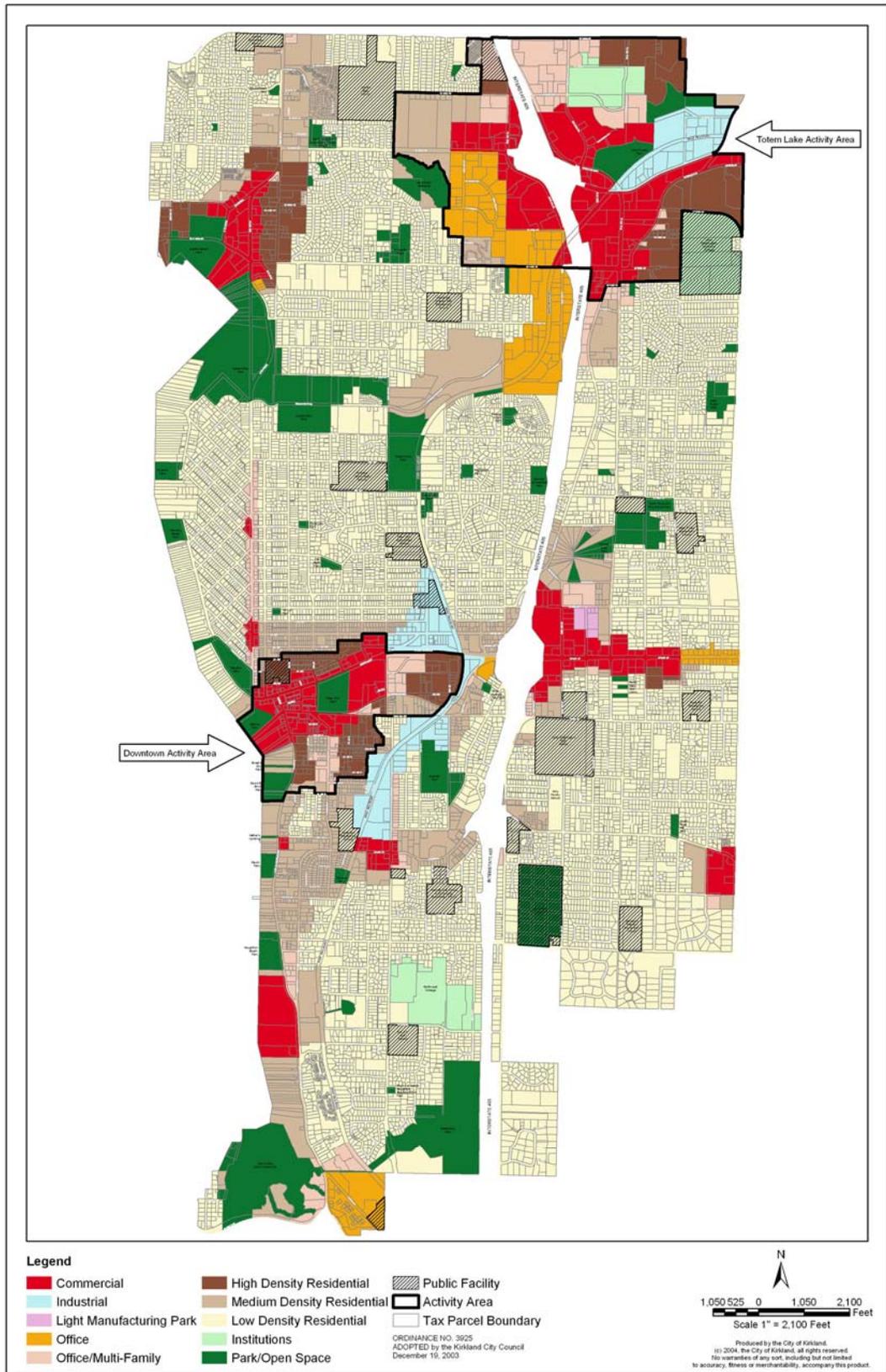
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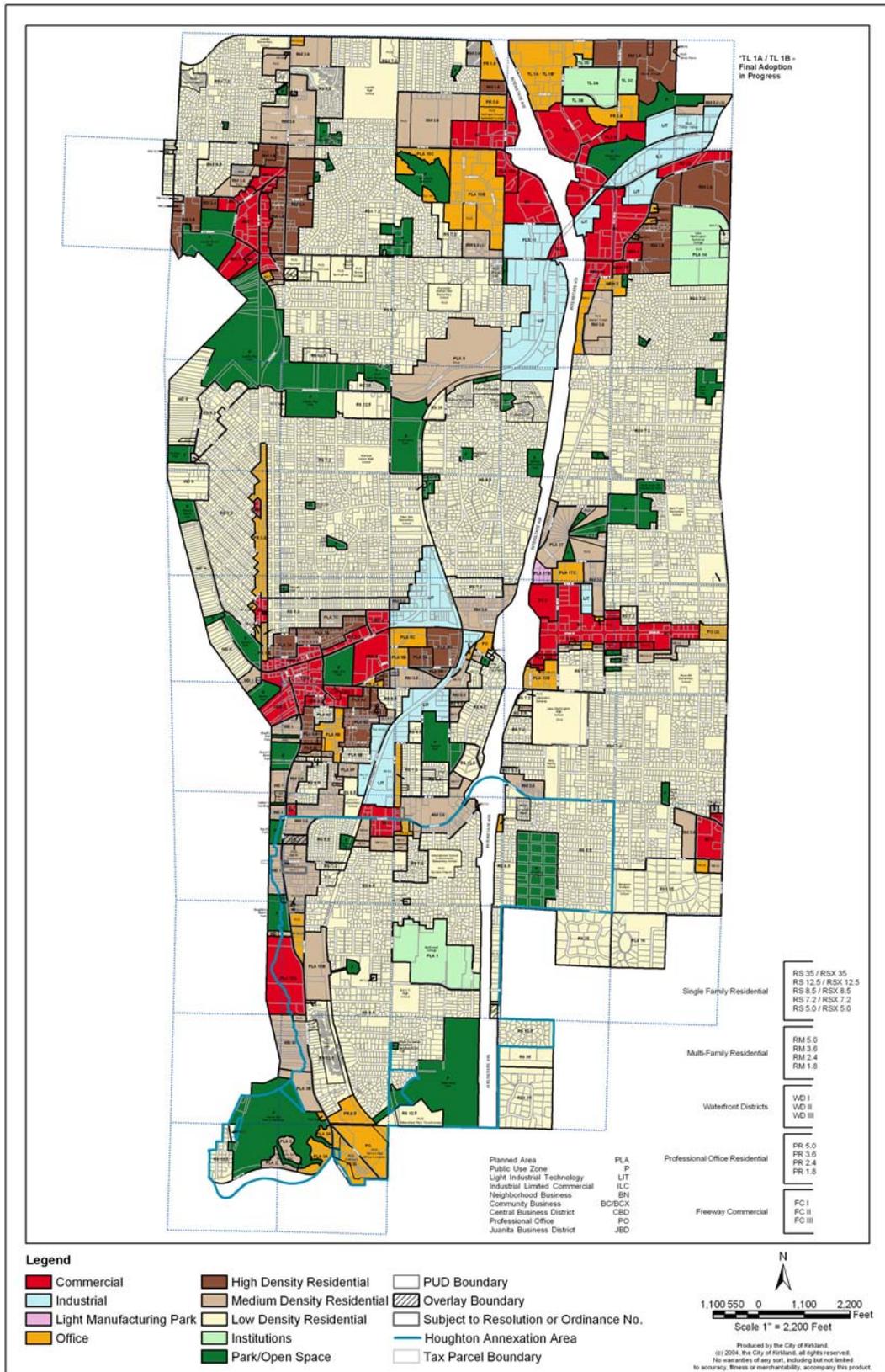
Hazard Assessment Maps
Figure 1 - Topography

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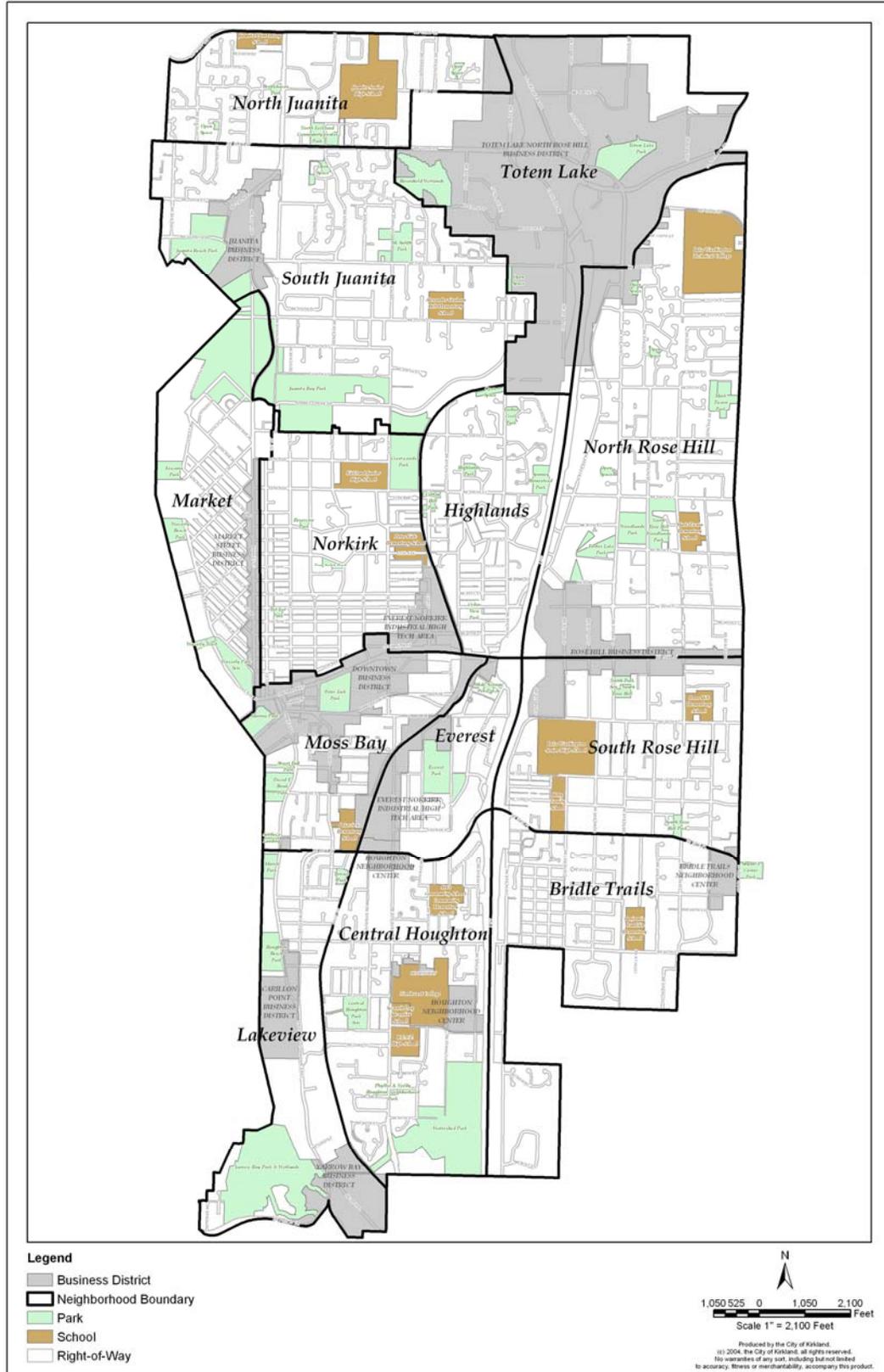
Hazard Assessment Maps
Figure 2 - Comprehensive Land Use Map

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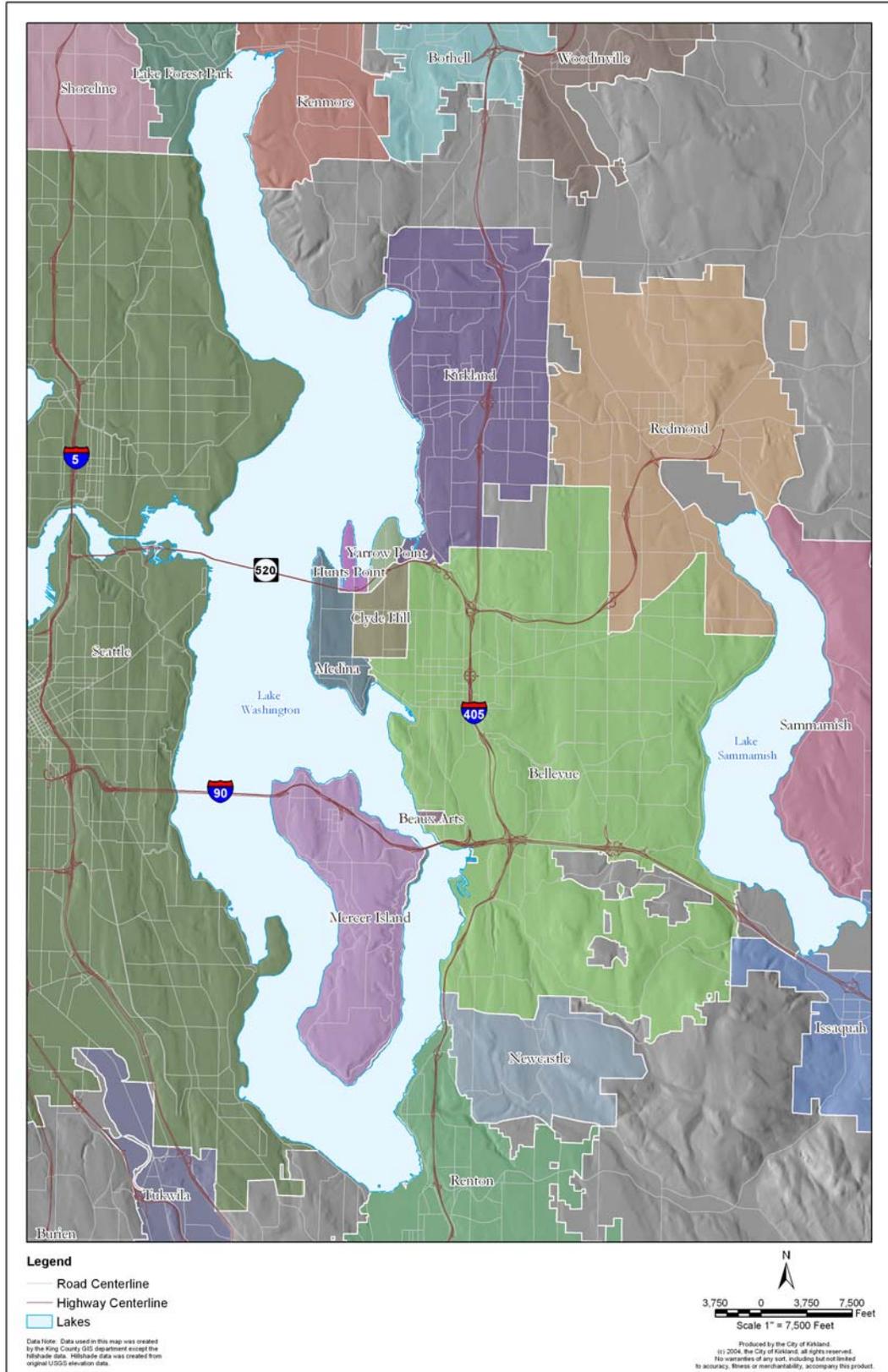
Hazard Assessment Maps
Figure 3 - Zoning Map

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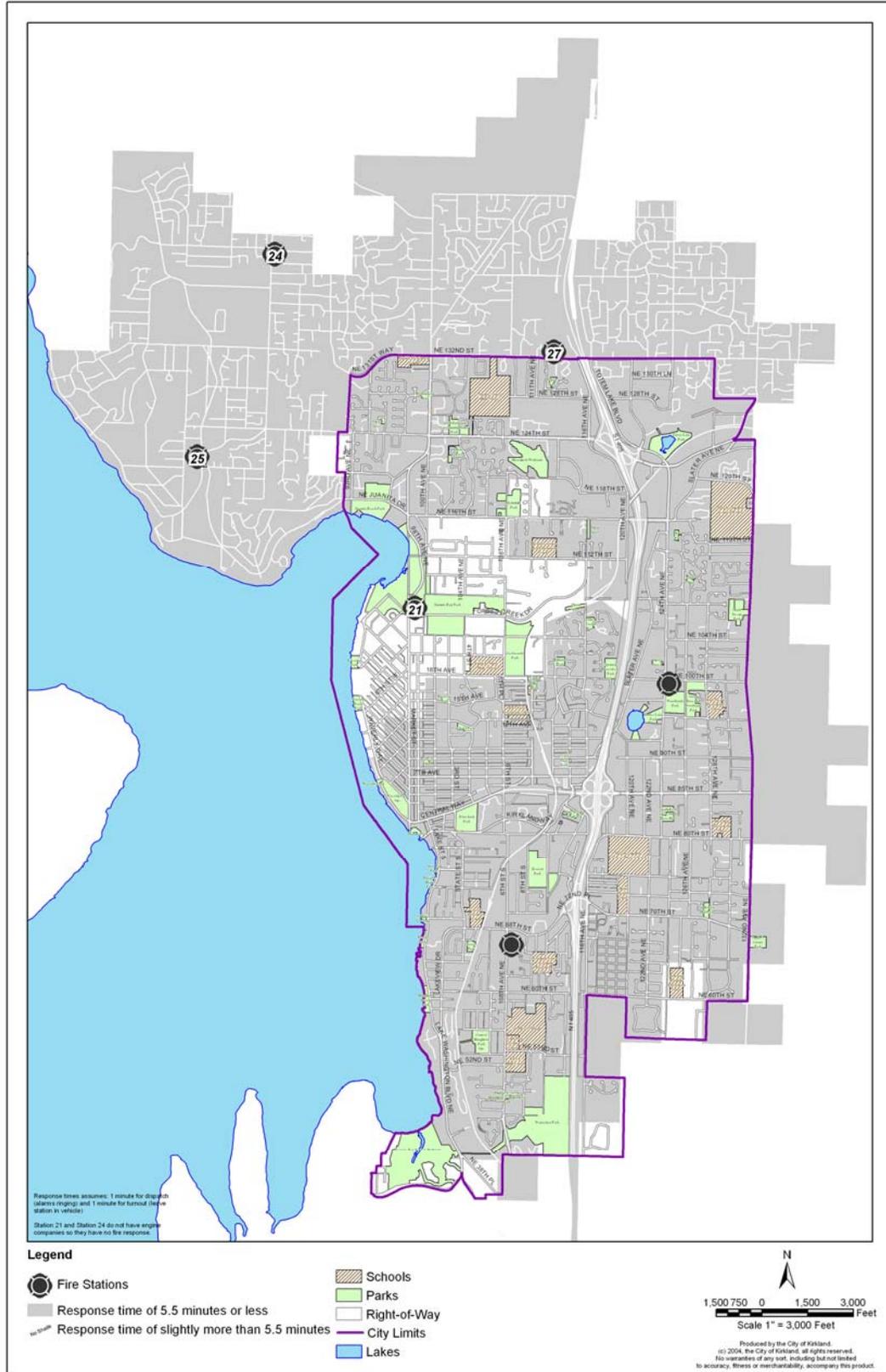
Hazard Assessment Maps
Figure 4 - Business Districts and Neighborhoods

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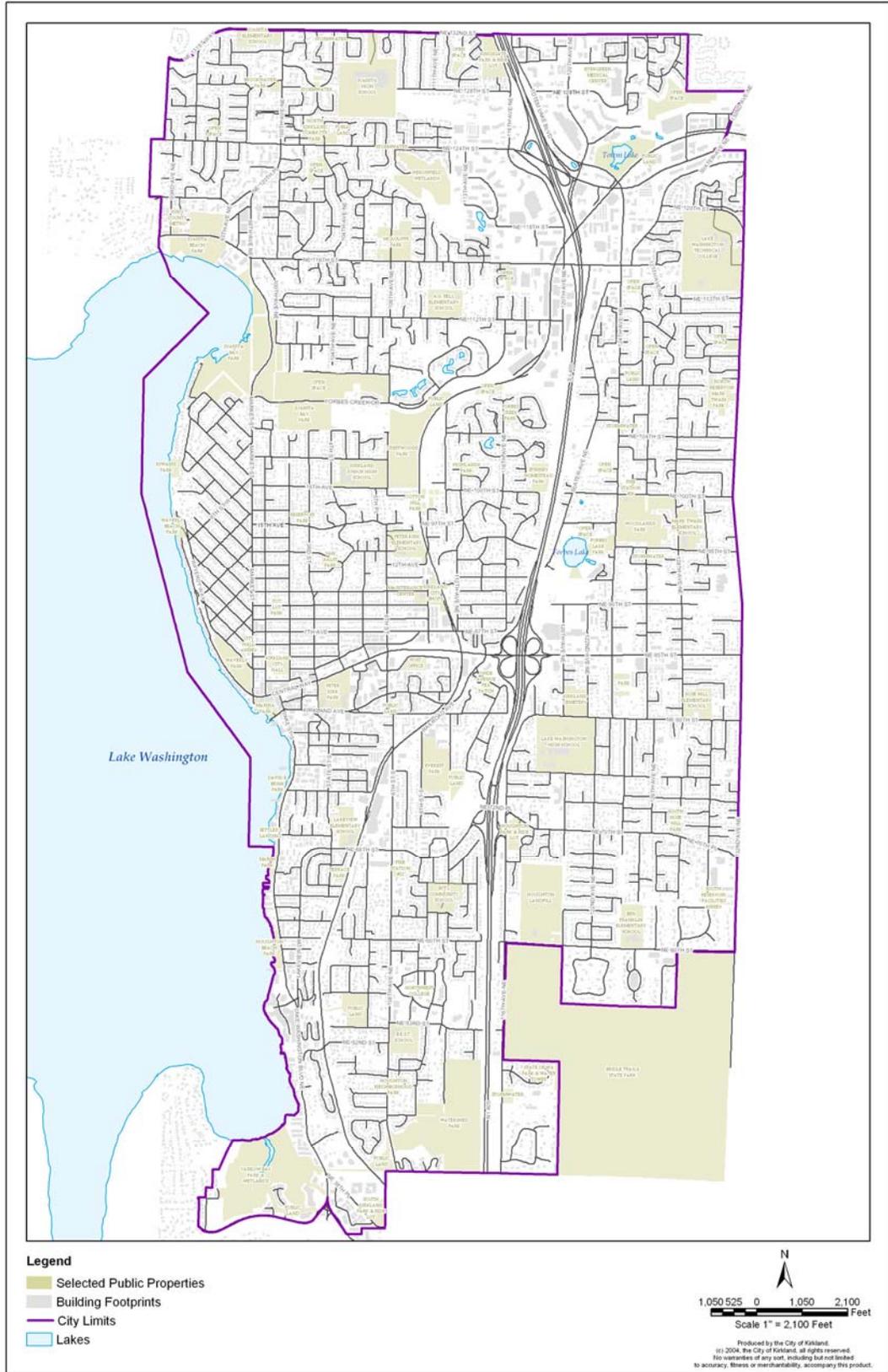
Hazard Assessment Maps
Figure 5 - Kirkland Vicinity Map

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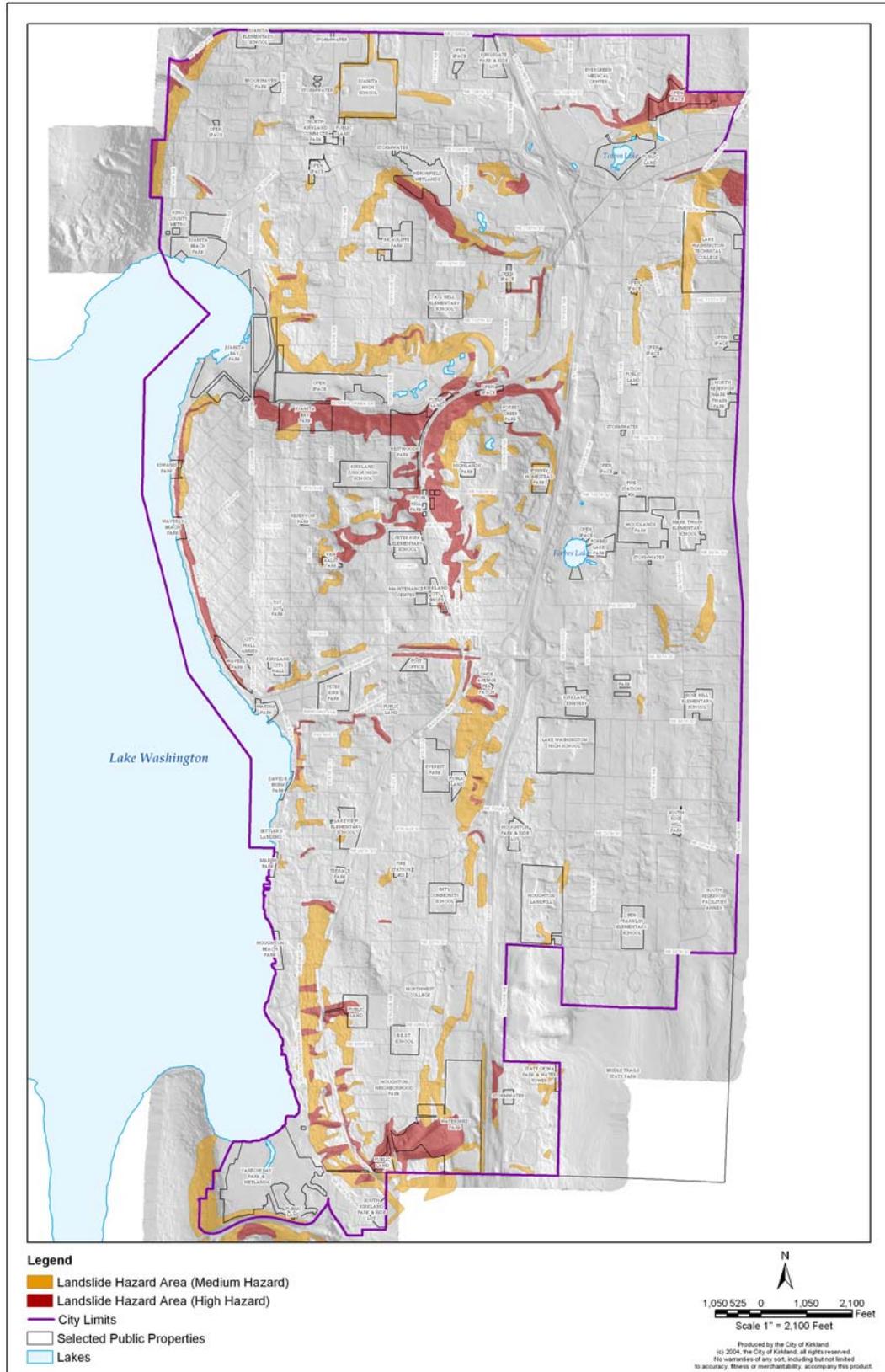
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Figure 6 - Fire Response Map

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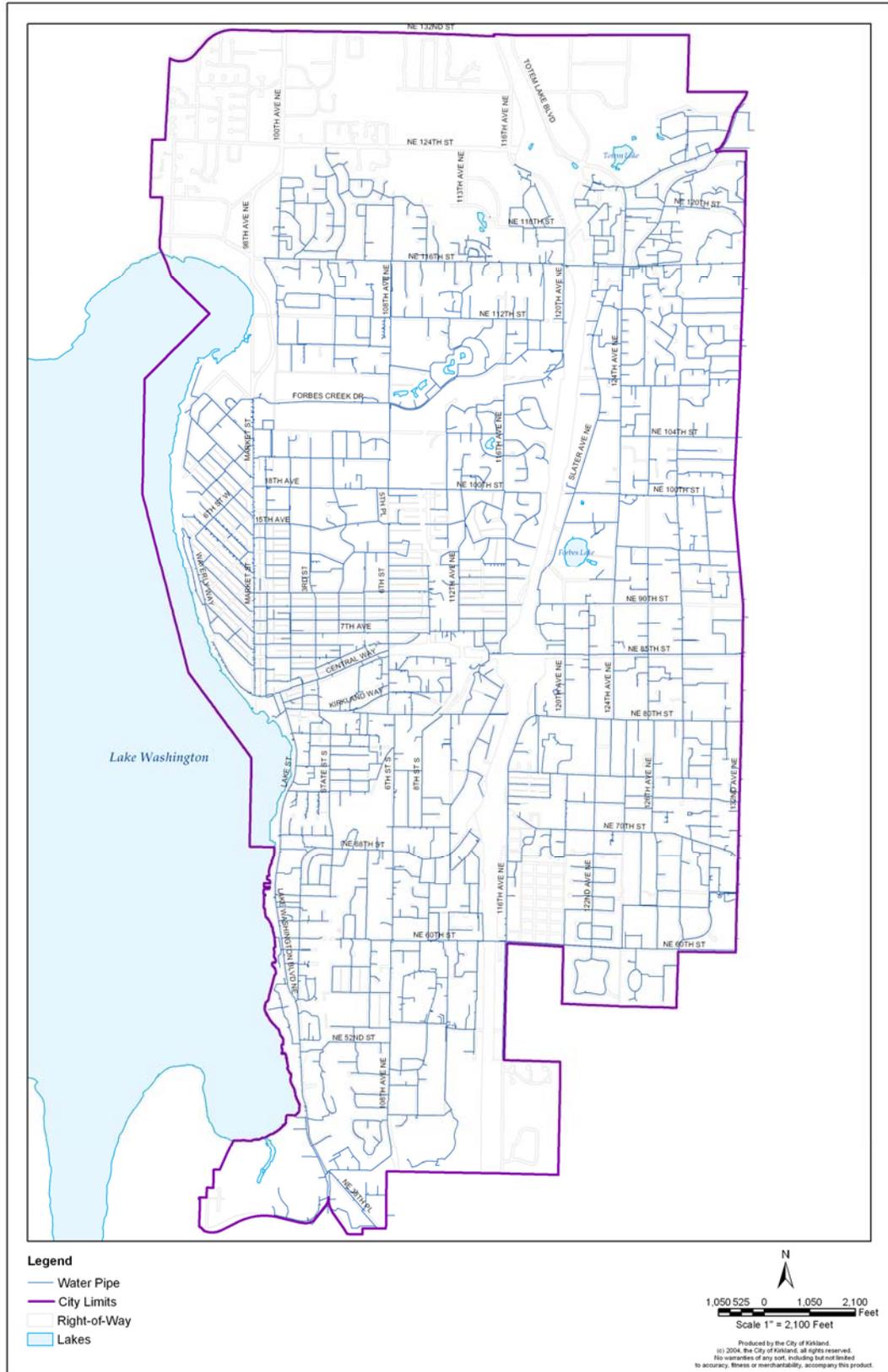
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Figure 7 - Street Map

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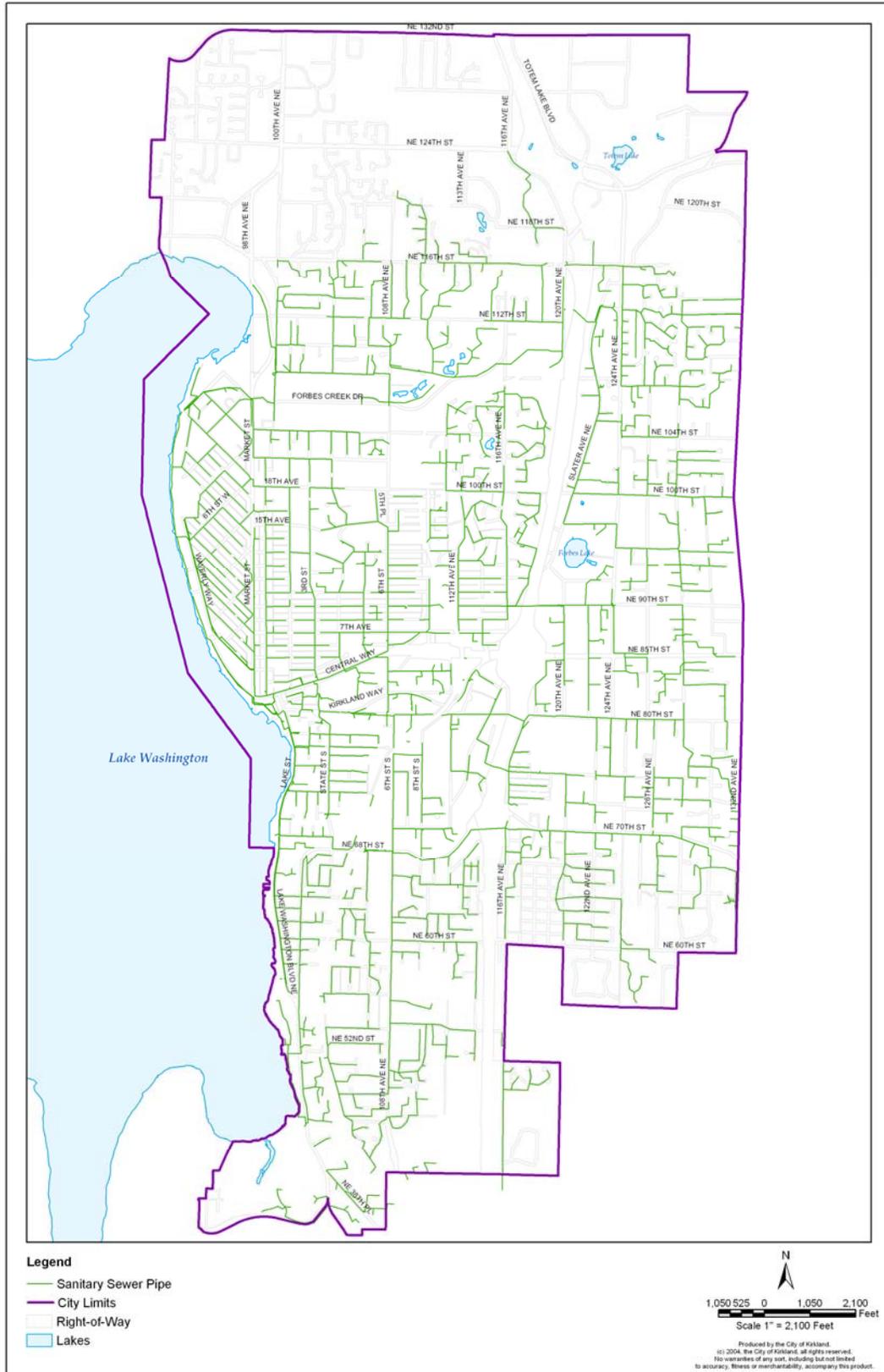
Hazard Assessment Maps
Figure 8 - Landslide Hazard Areas

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Hazard Assessment Maps
Figure 9 - Kirkland Water System

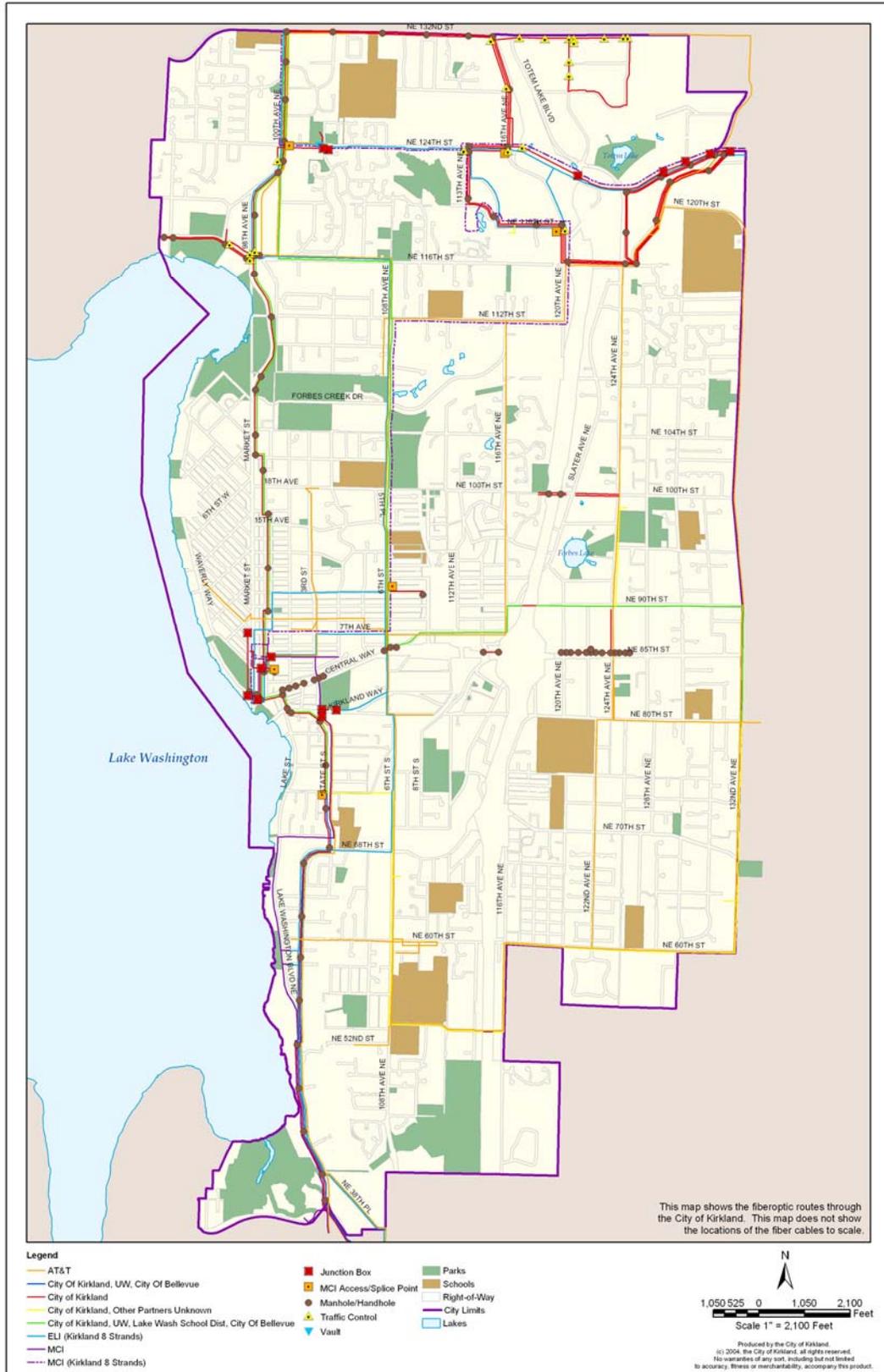
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Hazard Assessment Maps
Figure 10 - Kirkland Sanitary Sewer System

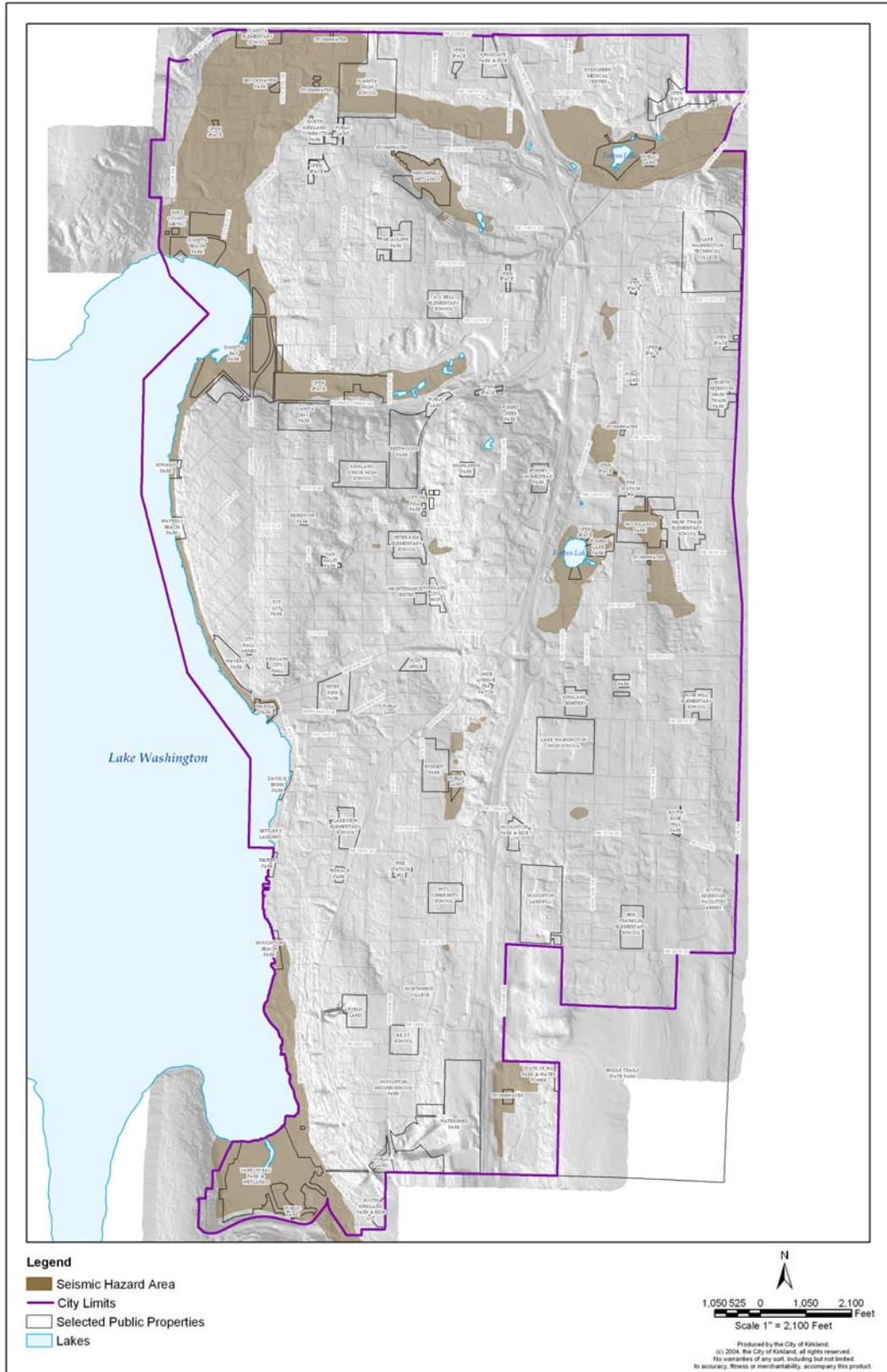
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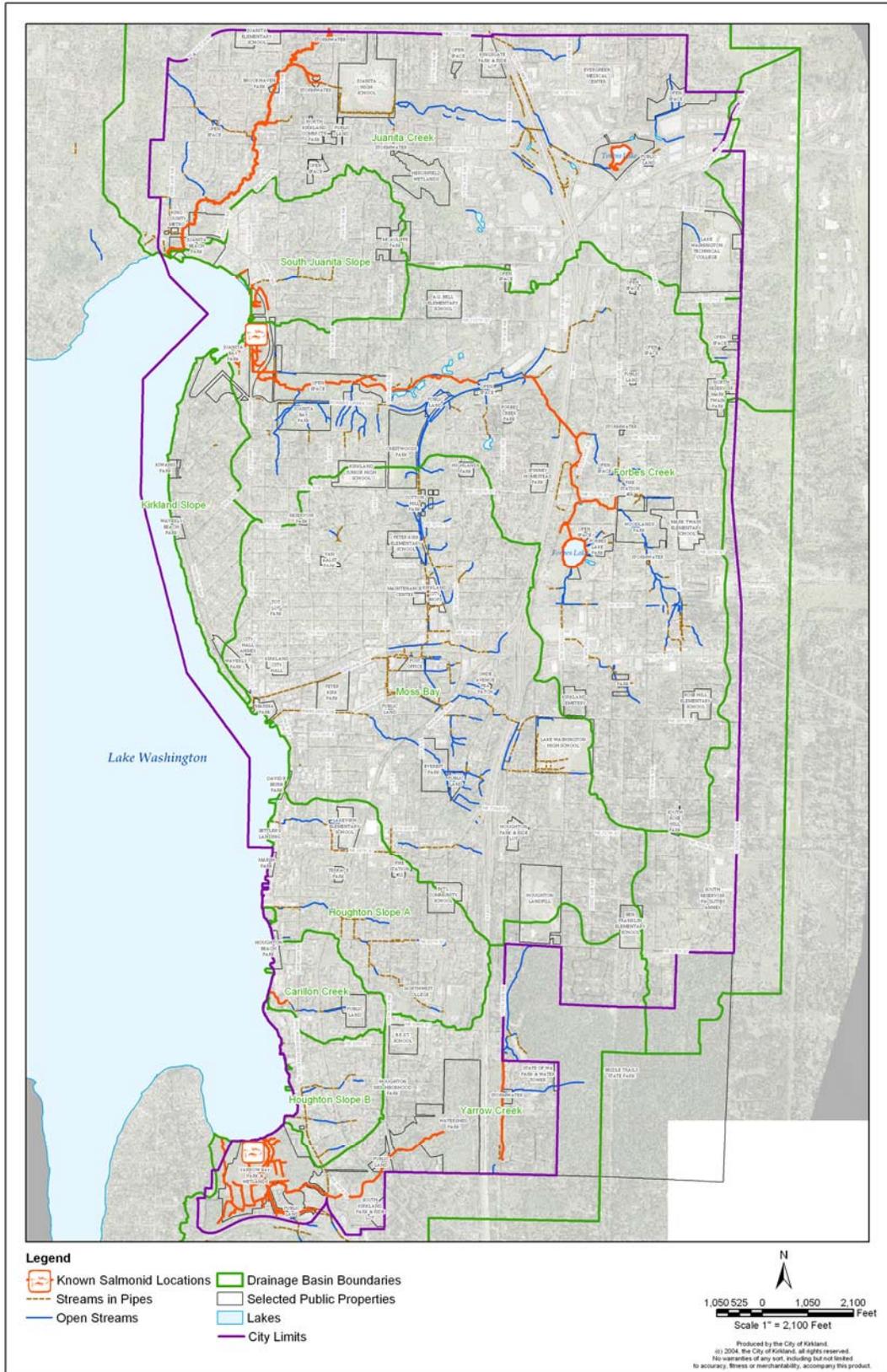
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Figure 12 - Kirkland Fiber Optic Network

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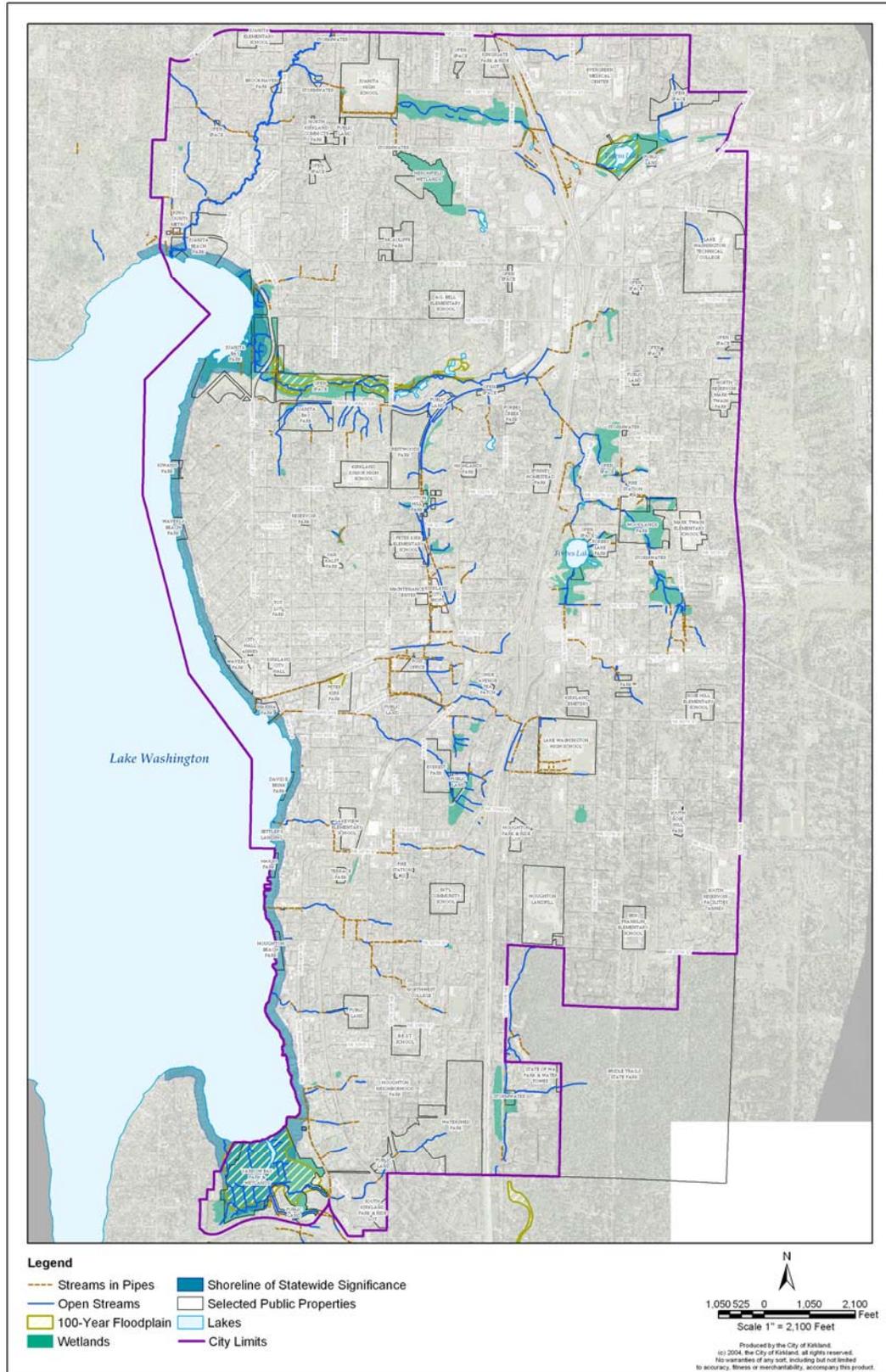
Hazard Assessment Maps
Figure 13- Seismic Hazard Areas

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Hazard Assessment Maps
Figure 14 - Drainage Basins and Streams

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Hazard Assessment Maps
Figure 15- Streams, Floodplains and Wetlands

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