

The Wildland Urban Interface (WUI) is a common story line in many of today's wildfire events. The WUI concept was formally introduced in 1987 Forest Service Research budget documents but was not acknowledged as a major component for federal fire management until the 2000 National Fire Plan. Although the 1987 introduction was meant to increase research focus on demographic factors influencing fire and other resource management, its California roots can be traced to post-World War II civil defense concerns about fire and water. The author offers a personal perspective on why the WUI concept was promoted by the Forest Service at an inauspicious time for fire research.

THE EMERGENCE OF THE WILDLAND- URBAN INTERFACE CONCEPT

On January 27, 1987, President Ronald Reagan gave his sixth State of the Union address. Reagan's speech was not well received.¹ Forest Service Research—and Fire Research in particular—had suffered through six years of the Republican president's budget request reductions. Although these

proposed reductions were partially offset by targeted (i.e., “ear-mark”) restorations by the Democrat-controlled Congress, Forest Service research funding continually eroded. Fire activity in the previous four years of the Reagan presidency (1983–86) had aver-

aged 51,805 fires and 2,021,846 acres burned and supported the argument that the “fire problem was solved.”² This assumption would be reinforced by fire statistics that showed no discernible upward trend. With the exception of the Yellowstone Fires in

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Scenes like this one from the Wheeler Springs fire on the Los Padres National Forest in 1948 demonstrated to fire researchers that “mass” forest fires could simulate the fires resulting from a nuclear attack. In the 1950s, federal funding increased during a boom cycle of fire research funding over such concerns and then ebbed and flowed over the next several decades.

1988, the public was not overly concerned with wildland fire throughout the 1980s and most of the 1990s. In 1987, Smokey Bear still ruled as the iconic representative of fire management.

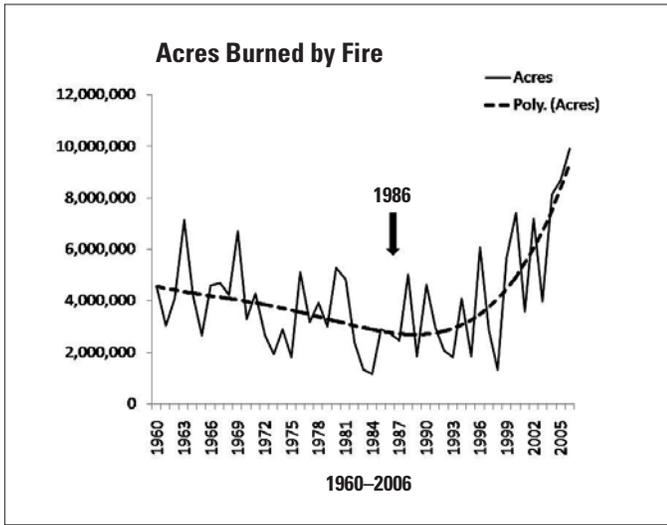
By 1986, national forest timber sales had exceeded ten billion board feet every year since the early 1960s.³ Knudsen-Vandenberg (KV) obligations had crossed the \$100 million annual threshold in FY 1984, peaking at almost \$300 million in FY 1992, and would not drop below the \$100 million threshold again until FY 2002.⁴ Timber sales meant that the Forest Service was a revenue-producing agency of the federal government. Aggressive fire management was justified as reducing losses of the timber resource to the ravages of wildfire. KV funds generated by timber sales were available to be drawn on for fire management when and as needed, with eventual replenishment by supplemental appropriations. When the president delivered his 1987 State of the Union address, the Forest Service fire management was viewed as having achieved fire suppression success at a reasonable cost with funding buffered by timber sales.

However, not all components of the Forest Service fire program were doing well. Fire and Aviation Management dealt with federal land fire management and therefore benefited from the timber-KV-fire funding triangle. Cooperative Fire Management helped state fire organizations, mainly through distribution of surplus equipment, and did not benefit from the funding triangle. Fire research, represented in the Forest Fire and Atmospheric Sciences Research (FFASR) budget line item, had never been associated with the timber parts of the Forest Service and was at one of the low points of its historically volatile funding cycle.

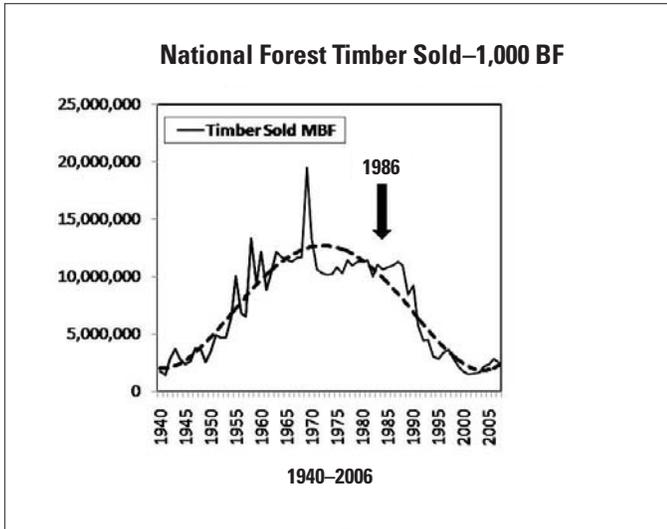
In February 1987, the U.S. Department of Agriculture presented its 1988 fiscal year budget request (“The FY88 Book of Notes”) to Congress.⁵ Beginning on page 22 of the FY88 Book of Notes, Forest Service Research announced that it would “emphasize six research initiatives during 1988.”⁶ The first eventually became the Forest Service Global Change Research Program, and the second was titled the Wildland-Urban Interface. The short description accompanying the budget tables stated, “Where large urban areas are adjacent to State, Federal, and private forest lands, the intermixing of city and Wildland has... brought about major problems in fire protection, land use planning, and recreation impacts.” The budget table showed \$300,000 for this area for fire research in FY 1987, and the president was asking for \$300,000 in FY 1988, a zero percent increase for this important initiative. The wildland-urban interface (WUI) concept was being promoted by the Forest Service at an inauspicious time for fire research.

The WUI initiative drew upon two precedent streams of research concern. The smaller stream, but more important in terms of current WUI programs, is generally attributed to Henry Vaux and colleagues starting in the 1950s, with a focus on water policy conflicts between rural interests and emerging urban population centers in California.⁷ WUI demographics research is clearly derivative of this fundamental driver of societal conflicts over natural resources. The second stream was much more important to fire research in terms of level of effort and funding. This stream derived from nineteenth-century experience with fire in America and from World War II urban fires caused

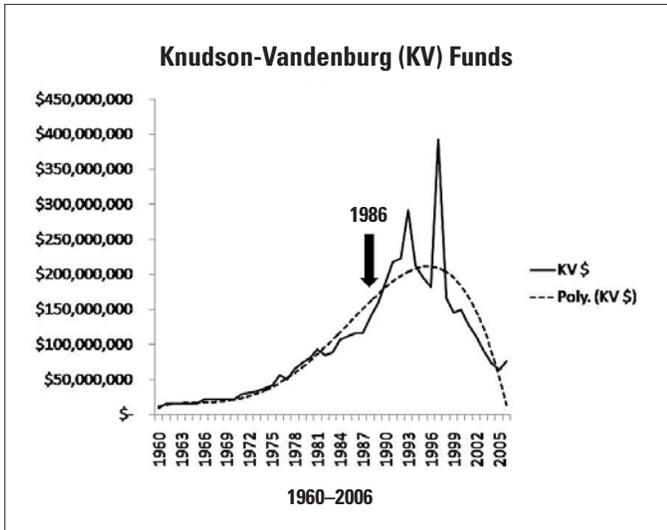
SOURCE: NATIONAL INTERAGENCY FIRE CENTER



SOURCE: USFS "FY 1905-2007 NATIONAL FOREST TIMBER SOLD & HARVEST SUMMARY"



SOURCE: USFS "FY 1905-2007 NATIONAL FOREST TIMBER SOLD & HARVEST SUMMARY"



Few realized at the time of the 1987 State of the Union message that 1986 would mark a watershed for fire management, with the years ahead bringing a new era of increased fire activity. At the same time, there was a drop in K-V funds because of falling timber sales. The "Poly" line in the graphs produces a smoothed view of the data and better reflects long-term trends.

by incendiary bombing strategies.⁸ Civil defense interest in possible mass fire involving flammable wildlands, proximate urban areas, and ignition from nuclear bombs prompted a significant amount of fire research from the 1950s through the 1970s. California was the nexus of both streams of WUI precedent research. C. P. Butler summarized the issue as "Houses built in canyons and up and down steep hills covered with native vegetation pose a fire hazard from large Wildland fires.... Threat is accentuated because the interface separating the two classes of inflammable materials is...not the responsibility of any agency."⁹ "Fire at the Urban-Forest Interface," the title of a chapter in *Volume II: Fire in Forestry*, by Craig C. Chandler and others, published in 1983, represents the earliest textbook mention of the WUI fire concept this author can find.¹⁰ Both Butler and Chandler were closely associated with research organizations (Stanford Research Institute spin-off groups and the Forest Service Pacific Southwest Station, respectively) that conducted civil defense fire research. Chandler, the lead author of a 1963 report on mass fire resulting from nuclear attack,¹¹ went on to serve as FFASR director until his retirement in 1983. The 1987 launching of the WUI research initiative is more clearly understood when associated with a California-based history of intermingling of urban-rural natural resource conflict and fire research funding for studies of mass fire from nuclear attack.

THE BOOM-OR-BUST FUNDING CYCLE

At the time that the president's 1988 budget request was released, the U.S. Forest Service Fire Research Program had been going through several years of funding decline. Since the Forest Service program was the only sustained national wildland fire research program in the United States at that time, it meant U.S. wildland fire research as a whole was in budgetary decline. Forest Service FFASR work was concentrated at dedicated fire laboratories in Macon, Georgia (the first to open); Missoula, Montana; and Riverside, California. A fourth laboratory in East Lansing, Michigan, was planned but never built. Additional fire research activities, mostly related to timber, were ongoing at several other locations.

Each of the three fire labs was built specifically for fire research and thus housed specialized facilities. Macon focused on fire use, Missoula on fire impacts in natural systems, and Riverside on fire impacts on people and communities. Funding contraction during the Reagan years eventually led to the closing of Macon and the inclusion of nonfire research at the Riverside facility. The mid-1980s proved to be both a nadir for agency fire research fortunes and the time when the foundation was laid for the reinvigorated fire research that emerged in the 1990s and first decade of the twenty-first century. It was also the time when, hindsight shows, fire activity began the upward trend that now dominates Forest Service and other agency budgets and marked the beginning of a transition from natural resource-driven (i.e., timber) fire management to one increasingly dominated by concerns for life and property.

I had assumed responsibility for the fire research program when I was appointed director of FFASR in December 1986, after serving as acting director for nine months. FFASR had developed ten initiatives in the previous four years under the leadership of my predecessor, Charles W. Philpot, including one for a program of research on what we called the wildland-urban interface and

another on climate change. During the development of the FY 1988 budget request, we lobbied hard for these initiatives to be included in the Forest Service budget. As a result, there appeared in the FY88 Book of Notes the first published reference to the wildland-urban interface as a topic of importance for wildland fire. The use of initiatives was meant to reproduce previous funding success pathways for fire research.

Following World War II, \$81,000 was budgeted for Forest Service fire research nationwide, sufficient to support about thirteen full-time technical employees.¹² In each of the next three postwar decades, Forest Service fire research would grow as a result of funding booms—followed by busts—which were driven by forces external to the main Forest Service interests of timber and watersheds. In the 1950s, the boom came from surplus military equipment and engineers and led to aerial fire suppression technologies, as highlighted by Operation Firestop.¹³ But as the 1950s came to a close, fire research funding sharply dropped as the new aerial fire suppression technologies were put into operation.

During the 1960s, the boom came from civil defense fears driven by the Cold War. Increased funding revitalized a moribund Forest Service fire research program.¹⁴ The civil defense link was officially established in December 1955 when the National Academy of Sciences (NAS), responding to a formal request from the Federal Civil Defense Administration, established the eight-member Committee on Fire Research “to simulate and advise research directed toward the development of new knowledge and new techniques that may aid in preventing or controlling wartime and peacetime fires.”¹⁵ A. A. Brown, then Forest Service fire research director, was one of five NAS committee members with a background in civilian fire. The Kennedy administration moved civil defense into the Department of Defense in 1961, renamed it the Office of Civil Defense, and increased its budget by \$200 million.¹⁶ This budget increase provided the funds for Project Flambeau, a Forest Service-led project that boosted and sustained fire research into the late 1960s.¹⁷ The reason for the funding increase was the belief that “mass” forest fires could simulate the fires resulting from a nuclear attack. The most catastrophic U.S. fire disaster was the October 1871 Peshtigo Fire, and the second most significant was the August 1910 Big Blowup in Idaho and Montana.¹⁸ Although the Peshtigo fire has been historically obscured by the coincident occurrence of the Great Chicago Fire, the Big Blowup led to national forest fire management policies that dominated the twentieth century and are still driving fire management practices today through accounting practices based on acres burned. By 1969, Flambeau had come to a close and fire research was in full bust mode.

The next boom came out of the 1970 Southern California fires that would now be characterized as WUI fires. That last boom went to FIRESCOPE (FIrefighting REsources of Southern California Organized for Potential Emergencies), which was funded by the Congress in 1971, with \$675,000 appropriated for the fire lab in Riverside.¹⁹ The funding came after the 1970 fire season when, during a thirteen-day period, sixteen lives were lost, seven hundred structures were destroyed, and more than one-half million acres burned. FIRESCOPE was always promoted as an “all emergencies” response system, in keeping with the well-established ties between Forest Service fire research and the civil defense community. FIRESCOPE provided pioneering efforts in fire management use of remote sensing, automated weather

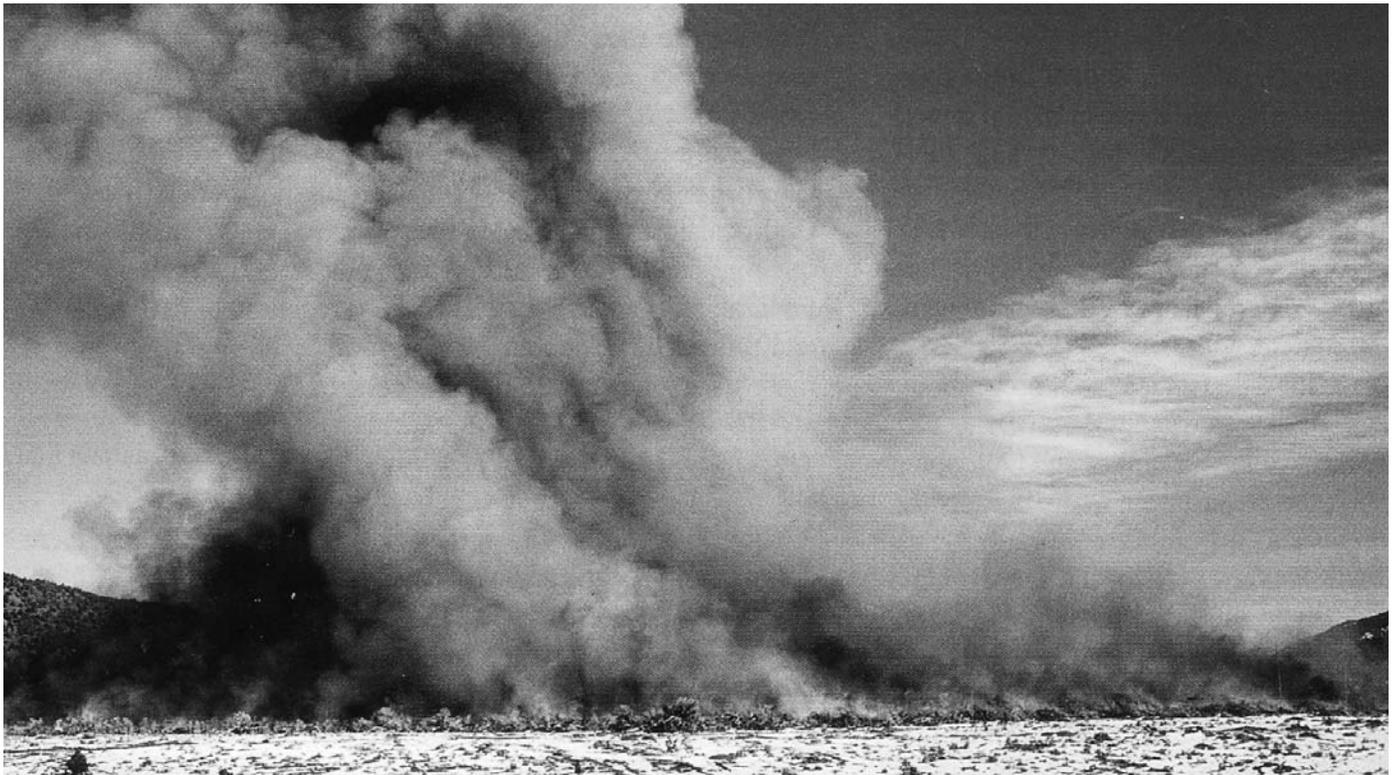
station, and telecommunications technologies, but its most well-known features were the Multi Agency Coordination System (MACS) and the Incident Command System, which became the National Interagency Incident Management System that is in wide use today. FIRESCOPE remains a functioning operational entity in California.²⁰ After the research component of FIRESCOPE wound down in the late 1970s, funding for the components of Forest Service fire research that were primarily driven by concerns associated with wildland fire impacts on communities dried up. The post-World War II era of cooperative ventures between Forest Service fire research and the civil defense community also came to an end with the creation of the Federal Emergency Management Agency, the eventual successor to the Office of Civil Defense, in 1979.²¹

MASS FIRES AND CIVIL DEFENSE

The fluctuations in support for wildland fire research by civil defense agencies reflected a larger three-decades-long struggle within the federal government over the effects of nuclear bombs, as described by Lynn Eden.²² The struggle was basically framed by the need to predict the potential payoff (destruction) caused by given bombing approaches. Two camps evolved, one focused on nuclear blast damage and the other on nuclear fire damage. During World War II, bomb weaponry was for the most part conventional (nonnuclear). Strategic planning during World War II involved development, production, supply, and delivery of either high-blast impact bombs or incendiary bombs, the latter of which was typified by bomb-caused firestorms in Hamburg, Tokyo, and Dresden. Nuclear weaponry, with the bombing of Hiroshima and Nagasaki, was capable of inflicting both blast and fire damage. That, and the absence of further empirical data, shifted the strategic argument to theoretical predictions (with some limited experimentation) of the amount of damage that could be achieved with a given suite of nuclear weapons. If x amount of damage was predicted from nuclear blast effects, and y amount of damage was predicted from nuclear fire effects, the accuracy and relative magnitudes of x and y became the critical bases for the amount (number and size) of nuclear weapons to be produced and deployed.

Military intelligence was divided into “blast” and “mass fire” camps. The blast camp gained the upper hand by convincing decision makers that the other camp could not reliably predict mass fire effects from nuclear blasts. Those arguments were largely based on the premises that environmental (mostly meteorological) conditions were too variable for reliable damage prediction and that the mix of fuels (both wildland and urban) was too complex to reliably incorporate in models. The wildland fire research community (mostly the California contingent) was approached to help quantify mass fire effects and eventually realized a research funding opportunity. The establishment of the NAS Committee on Fire in 1955 formally recognized the cooperative potential. Funding for nuclear fire effects research would go on to be only a small percentage of funding for nuclear blast effects research. Further, the fire research was funneled through the civil defense arm of the government. But when that arm was moved under FEMA, its ties to military intelligence were devalued.

Although the nuclear blast camp came to dominate strategic weapons planning and civil defense funding support for wildland



Smoke from a Project Flambeau “burn.” The fire represents a block of homes in a residential neighborhood ignited by an atomic explosion. Project Flambeau, an Office of Civil Defense–funded, Forest Service Research–led field experiment was meant to simulate “mass” fire in urban settings—a foreshadowing of today’s wildland-urban interface.

fire research dried up after Flambeau, the research legacy carried forth into FIRESCOPE, twenty-first-century fire management, and the WUI initiative. Some interesting side notes also need to be mentioned. One involves the ongoing relationship between fire and climate. As mentioned before, in the same budget year that the Forest Service introduced its WUI initiative, it also introduced a climate change research initiative. The climate-fire relationship has now moved to the forefront of federal agency thinking in regard to fire and is becoming central, along with WUI associated demographics, in twenty-first-century fire management planning.²³ “Nuclear winter” emerged as a different aspect of the fire-climate relationship in the early 1980s. Several of the scientists involved with nuclear fire effects in the previous decades applied their models to potential longer-term atmospheric effects of a full-scale nuclear war. The predicted effects from individual nuclear bombs were scaled up for multiple events.²⁴ The involvement of the publicly popular scientist Carl Sagan helped bring the issue to prominence and was reinforced by the November 1983 broadcast of the television movie *The Day After*. Opening images of nuclear effects included pine trees being hit by the blast shockwave, from film footage taken during Project Flambeau. Several authors associated with the nuclear winter debate and with earlier nuclear fire effects research have recently reemerged and coupled their effects models with “a modern climate model and new estimates of smoke generated by fires in contemporary cities to calculate the response of the climate system to a regional nuclear war”; with a prediction of “significant cooling and reductions of precipitation lasting years, which would impact the global food supply.”²⁵

THE PAST TWO DECADES

The Forest Service Research component of the FY 1988 federal budget contained two initiatives that in retrospect laid the research foundation for two primary drivers of twenty-first-century fire management—climate change and demographic change. Both initiatives were attempts to ensure an improved funding future for Forest Service fire research from anticipated science trends and new budget packaging of previously successful research thrusts.

The climate change research initiative was specifically intended to retain and enhance a funding base that had been dedicated to acid rain research under the National Acid Precipitation Program, which FFASR Director Philpot had obtained. We knew that this funding would likely expire when its research results were applied to planned amendments of the Clean Air Act. The arrival of the George H. W. Bush administration in 1989, two years after Reagan’s 1987 State of the Union address, ushered in a dramatic change in environmental leadership that included the 1990 Clean Air Act Amendments, which in conjunction with the 1990 initiation of the U.S. Global Change Research Program led to a rapid transition from acid rain to climate change research as the principal environmental research thrust of the federal government. The FY 1991 budget (introduced in February 1990) was the first budget plan fully crafted by the new administration and contained significant new funding for Forest Service climate change research, some of which was targeted for fire and climate science. During the George H. W. Bush, William J. Clinton, and George W. Bush administrations, climate change research was subject to strident political debate. Federal fire management did not acknowledge

Vulnerability to WUI fires like the 8th Street Fire in 1996 helped earn Boise, Idaho, tenth place among U.S. urban centers on the place-based vulnerability index. The fire consumed 22 square miles. Nearly twelve years to the day on the opposite end of town, the Oregon Trail Fire destroyed ten houses and damaged nine more, and killed one person.



COURTESY OF THE BUREAU OF LAND MANAGEMENT, IMAGE IDFREBARRY005.JPG

the potential impacts of climate change on fire in any of its major planning efforts from the 1980s through the 2000 National Fire Plan. Only since 2007 has climate change gained somewhat equal footing with fuels buildup as a stated concern of fire managers.

The WUI initiative has had a very different pathway to acceptance. Although it has failed to gain almost any funding for Forest Service fire research directly, it has emerged as a major driving force for fire management planning and policy. When we launched the initiative, our major concern was our ability to define an actual demographic research program that would quantify the issue. We hoped that fire spread models would be able to fully incorporate both wildland and structural fuels to seamlessly predict WUI fire behavior. That has been very slow in coming. But WUI quantification pioneered by Susan I. Stewart, Volker Radloff, and their colleagues has fully redeemed our mid-1980s hopes and then some.²⁶ Although fire managers have, and continue to be, the primary applicers of WUI demographics research findings, those findings are beginning to affect a much wider range of natural resource issues. Demographics information, displayed with geographic information systems (GIS) technologies and coupled with satellite remote sensing imagery, is informing planners, managers, and policy makers in ways made possible by the 1987 WUI Forest Service Research initiative. Budget-driven consolidations have led to only one fully dedicated national fire staff in Forest Service headquarters. The former Cooperative Fire Management responsibilities were combined into that staff and placed under the deputy chief for State and Private Forestry. The FFASR fire research responsibilities now reside in the Forest Management Sciences staff under the deputy chief for Research and Development. The Joint Fire Science Program and the National Fire Plan had injected significant new funding into fire research since their creation in 1998 and 2000, respectively, and that funding has led to a flow of new research findings about WUI and most other fire topics. WUI and climate change concerns are now clearly center stage for fire management.

The WUI initiative received only two years of stand-alone prominence in Forest Service budget documents. During the time that strategic military interest in nuclear fire effects waned,

wildland fire management was slowly learning to adjust its strategic focus from protection of timber resources to more heuristic considerations of fire as an ecosystem process. The basic argument made to support this shift was that decades of aggressive fire suppression had resulted in vegetation changes that put many fire dependent western wildland ecosystems at increased risk from catastrophic fire. The widely reported Yellowstone fires of 1988 provided the impetus for policy debate regarding the importance of fire in restoring and maintaining ecosystem health. The following February, President George H. W. Bush presented his FY 1990 budget. The FY 1990 Book of Notes in support of Forest Service research provided a precursor for later fire management shifts in emphasis by subsuming WUI under a new “Catastrophic Forest Fires” initiative. The initiative noted that “Fire is a natural part of most of our Wildland ecosystems; in fact it is necessary for their continued health and vitality, it must be managed to avoid catastrophic results.” Why were catastrophic fires felt to be increasing? “Some of the contributing factors are persistent drought (a possible indicator of global climate change); fuel buildups (particularly in wilderness areas); the effect of insects, disease and pollutants on Wildland vegetation; and the ever increasing trend toward development and human activities in Wildland areas.” During the next decade, federal wildland fire management strategic thinking focused on fuel buildup and returning fire to fire-dependent ecosystems. As forest policy shifted from timber extraction to ecosystem sustainability, fire came to be viewed as a needed elixir as well as a threat. WUI received mostly lip service until the 2000 National Fire Plan and climate change received mostly sneering lip service until very recently. During the twenty years since the WUI concept was formally introduced, fire suppression costs have escalated while fire managers face a twelve-month fire season with increased WUI risks.²⁷

But the question remains: Has putting WUI demographics on the wildland fire research strategic agenda really improved strategic fire management decision making? The current fire costs being borne by the Forest Service and other federal and state agencies seem to be pointing to a Rubicon where demo-

graphic trends will dictate a choice between natural resource and WUI fire suppression priorities. Recurrence of historical fire research interests may influence that choice. At the time the ideas in this paper were originally being presented during the 2008 Annual Meeting of the American Society of Environmental History held in Boise, Idaho, a report in the journal *Risk Analysis* assessing Boise as one of America's urban centers most vulnerable to terrorist attack was receiving moderate press coverage. Boise ranked tenth among 132 U.S. urban centers in terms of a calculated "all hazards" place-based vulnerability index and was the only western urban center placed in the high-risk category.²⁸ Boise received its surprisingly high ranking because of the threat from WUI fire and dam failure, a threat made real by the Oregon Trail Fire in August 2008.²⁹ Updating of the long relational concern between nuclear fire impacts and what we now know as the WUI may further emphasize support for traditional wildland fire management natural resource objectives. □

William T. Sommers has been involved with wildland fire research and management for thirty-five years. His career with the U.S. Forest Service from 1973 until his retirement in 2000 included assignments as director of Forest Fire and Atmospheric Science Research (FFASR) and chair of the interagency National Wildfire Coordinating Group. He is currently director of the EastFIRE Laboratory at George Mason University. The author thanks Dr. Peter J. Roussopoulos for his very helpful review of a draft version of this manuscript.

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