Journal of Environmental Planning and Management, 40(6), 739–750, 1997

Bombs and Butterflies: A Case Study of the Challenges of Post Cold War Environmental Planning and Management for the US Nuclear Weapons Sites

MICHAEL GREENBERG, KAREN LOWRIE, DONALD KRUECKEBERG, HENRY MAYER & DARIEN SIMON

Department of Urban Studies & Community Health, Bloustein School of Planning and Public Policy, Rutgers University, New Brunswick, NJ 08901-1958, USA

(Received October 1996; revised February 1997)

ABSTRACT *When the cold war ended, the United States stopped developing, testing and building nuclear weapons at nearly all of its former nuclear weapon sites. The Department of Energy (DoE) began a massive environmental remediation programme, which includes engaging surrounding communities in a future land use planning process. Using the Savannah River site as an example, we show that this process faces large obstacles, especially a legacy of mistrust of the DoE and organizational limitations at the federal and local government scales. These hinder open dialogue about future land use. The authors suggest three planning principles for future land use planning and organizational issues that must be addressed before these can be fruitfully explored.*

Introduction

During the 1940s and 1950s, the US Government obtained over 3000 miles^2 of land, principally in eight states, where it spent over $300 billion (1995 dollars) to develop, produce and test nuclear weapons (Office of Environmental Management, 1994, 1995a). Figure 1 locates 18 major sites where nuclear weapons were developed, tested and produced. The last US nuclear weapon was constructed in 1989. In 1991 the Soviet Union dissolved. Without the Cold War as provocateur, the US government has no real strategic use for most of this land.

The authors of this paper are studying the US Department of Energy's (DoE) weapons complex as part of a five-year co-operative agreement between our universities and the DoE. We are engaged in a broad range of environmental planning and management activities, such as suggesting planning principles, economic modelling, ecologic–economic analysis and studying methods of increasing public participation in land use decision making. This paper focuses on three challenges facing environmental planners and managers who are charged with bringing the former weapons sites closer to the mainstream of American land use decision making. These three challenges may be thought of as lessons we have learned during the first $1\frac{1}{2}$ years of research. We refer to the entire complex of 137 nuclear weapons sites in 34 states and US territories as the

0964-0568/97/060739-12 $7.00

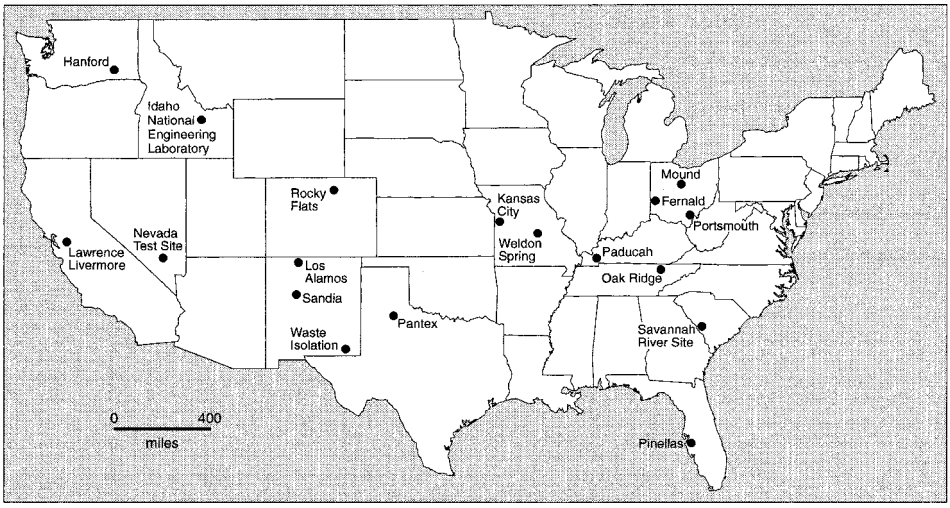

Figure 1. Major nuclear weapons sites.

'complex', and we focus on the 310 miles^2 Savannah River site (SRS) in South Carolina as a case study to illustrate specifics and provide continuity.

Nuclear Bombs and Misleading Images

The first challenge is to adopt realistic images as a guide to planning. Outsiders, like the authors, must set aside images of what a nuclear weapons site is supposed to look like and what the people who live near them are supposed to feel about the site. The parallel challenge to people who live and work near a site is to recognize that negative images of nuclear weapons and energy may discourage businesses from choosing their regions as sites for new production facilities and hunters and fishermen from visiting the site. In other words, both outsiders and insiders must approach each other with realistic images to avoid conflict which could poison the chances of successful planning.

The mushroom cloud produced by an above-ground nuclear explosion is the awesome and frightening image Americans attach to nuclear materials (Kunreuther *et al.*, 1990, Goin, 1991; Weart, 1992; Hinman *et al.*, 1993). Largely as a result of this powerful image, the vast majority of Americans do not want a high or low level nuclear waste repository or a station that generates energy with nuclear fuel near them. The same concerns are typical of Europeans and Asians (Hinman *et al.*, 1993; Mehta & Simpson-Housley, 1994; Biel & Dahlstrand, 1995; Wiegman *et al.*, 1995).

If the popular image of nuclear materials matched reality, weapons sites like Savannah River would be hostile American gargoyles. But popular images do not match reality. The largest sites, which include Hanford (WA), Savannah River (SC), Oak Ridge (TN), and the Idaho National Engineering and Environmental Laboratory (INEEL), which average over 300 miles^2, have some of the worst contamination problems on this planet. Yet they also have some of the most pristine environments in the US, precisely because public access was denied for half a century. DoE studies suggest that over 90% of the land on these

large sites is not contaminated. Large tracts on the sites could be prime sites for recreation, commercial, industrial and agricultural activities (Office of Environmental Management, 1995a, 1995b, 1996). In short, beast amidst beauty or bombs and butterflies are more apt images of the reality of the largest bomb sites than is gargoyle.

A second popular image that does not survive the reality test is that the nuclear weapons facilities terrify people and make them feel that their property has been devalued. Nevada's ongoing fight against hosting a high level nuclear waste repository illustrates strong local opposition to nuclear waste (Kunreuther *et al.*, 1990, Slovic *et al.*, 1991). Yet our interviews with business, political and environmental groups near the Savannah River nuclear site and news articles reveal that many residents, in some cases the vast majority of residents, of weapons areas are not afraid, nor do they perceive that their region and their property has been stigmatized by the bomb plants (Schill, 1995a, 1995b, 1996; Lowrie & Greenberg 1996a, 1996b). In general, several observers have used the expression 'halo effect' to describe the public's reaction to their nearby nuclear weapons sites. Indeed, many residents do not appear to be averse to the continuation of a weapons function, although our initial surveys show that reprocessing of nuclear fuels is perceived as extremely problematic.

The third popular image that no longer matches reality is that because nuclear weapons facilities pay high wages, they are a buffer against boom and bust economic cycles. The weapons facilities do pay high wages, but they are now seen as every bit as fickle as IBM, AT&T, US Steel, Exxon and other large corporations that have been reducing jobs. For example, regarding the Savannah River Site, the breakup of the Soviet Union and the ending of the cold war challenge has resulted in employment reduction from a peak of over 25 000 in 1992 to less than 17 000 in 1996 (Greenberg *et al.*, 1996). Because of the economic shock, many people who live in the region do not want the DoE and its contractors to pack their bags and leave.

In short, in 1996 the DoE is not perceived as the bogeyman by residents who live near the Savannah River weapons site. The assertion that the DoE sites have potential to be developed for a new nuclear mission, for waste management, recreation, ecological research, non-nuclear industry and other activities is being heard by many nearby populations with a sense of urgency and anticipation, or at least hope for DoE action on their behalf.

Overcoming Previous Missions

The second challenge to environmental planners is to build local and regional planning to the point that it can assemble ideas and information in co-operation with a government agency which has a history of not assembling databases about planning and environmental management and not sharing what they have assembled. Without credible ideas and information, there is no way of developing plans that are sensitive to ecological and human health effects and economic and social priorities.

The process of designing, building and maintaining facilities for weapons of mass destruction created conditions that are anathema to modern environmental planning and management. Regarding Savannah River, for example, on 25 July 1950, President Harry Truman wrote to DuPont De Nemours requesting that DuPont design, construct and operate a new plant to produce plutonium on the

banks of the Savannah River (Bebbington, 1990). Land was obtained and thousands of people were moved, whether they wanted to move or not. Some of them and/or their progeny now want their land back. Even though the South is considered more patriotic than the other regions of the US, this initial land use decision initiated a legacy of mistrust in the minds of some residents of the region.

The development, testing and production of nuclear weapons entails the greatest degree of security, so for more than 35 years of the 44-year history of SRS, the expression 'DoE consultation' was an oxymoron. With rare exceptions, other federal agencies, and state and local interests were held at a distance. Now the agency is working hard to consult with regional and local stakeholders. But it has much less experience at this than other federal agencies, such as the US Forest Service, Department of Transportation, the Environmental Protection Agency, and Housing and Urban Development.

The DoE weapons sites were not subject to local zoning or similar land use regulations. and their transportation system was not geared to serving surrounding or regional markets. The agency collected considerable amounts of data about their sites. Little, if any of it, such as land use and soils maps, and employment data were available to planners and developers for over 40 years. US Geological Survey maps blanked out the major weapons sites. It is as if a group of people who hated planners designed these sites as a challenge to the profession.

That challenge unofficially began in 1989 when the DoE created an Office of Environmental Management for the purpose of addressing the environmental legacy of 40 + years of making weapons (Office of Environmental Management, 1995a). The agency clearly understands that the nexus among land use, site remediation and outreach is central to this mission (Office of Environmental Management, 1996). Indeed, we think that this nexus has become the second, if not first, mission of many DoE sites. The change during the last 10 years is nothing short of remarkable. All of the major sites are in the process of preparing a list of land uses that are compatible with site functions as well as to local populations (ibid.). The DoE is currently considering zoning and various other planning and management devices, and the idea of developing 10-year site plans. At the site scale, instead of staring at a map with the Savannah River site blanked out, we now have a large wall map that locates reactors, hazardous waste sites, infrastructure, bald eagle nests and various other land uses at Savannah River. This publicly available map would have been unheard of during the cold war. In fact, everything mentioned in this paragraph was unheard of a decade ago. Overall, in less than 10 years the DoE sites have gone from single-function, closed enterprises to places that are trying to encourage the collaborative planning techniques of public participation, consensus-building, monitoring, impact analysis and planning evaluation in order to define viable land uses.

Nevertheless, the DoE has prominent obstacles to climb. The biggest, we think, is a legacy of mistrust. For example, surveys of public reaction to the Department's efforts to transport and store radioactive waste have found high levels of distrust (Slovic *et al.*, 1991; Kraft & Clary, 1993; Binney *et al.*, 1996). Regarding weapons sites, we surveyed all the municipal and county governments within 10 miles of one of the 18 major sites (Figure 1). One of the questions asked the extent to which planners judged that "local residents trust DoE representatives and the information they provide". On a scale of 1 to 5,

where 1 and 2 were "strongly disagree" and 'disagree' that the DoE is trusted, 39% perceived that residents did not trust the agency. Only 14% reported that residents trusted the agency. Furthermore, many planners were distressed by the fact that they feel inadequately informed about what the Department is doing on nearby sites. A telltale bottom-line question asked the planners if "the DoE's future plans agree with [their] goals for the site". Only 14% agreed that they did, whereas 17% disagreed with the Department's on-site planning. Notably 70% were neutral, which means that the vast majority of planners who responded are open-minded about future on-site land use. In other words, the DoE still has an opportunity to develop a process that will effectively incorporate local planning.

Mistrust of secrecy and top-down planning is not the only problem. The DoE is in charge of the sites. But it interacts with other federal organizations and large private contractors. For example, commercial nuclear facilities at former weapons sites are under the control of the US Nuclear Regulatory Commission. The US Forest Service manages more of the SRS than the DoE because of the great amount of forested area. DuPont, Westinghouse, Bechtel and other major contractors are paid by the DoE to manage many of the activities. Each of these organizations has viewpoints about future site uses that need to be integrated. If the federal agencies and their contractors cannot speak with a consistent voice, local stakeholders will become more convinced that they cannot be trusted.

SRS also illustrates the difficulties of land use planning at a site where local planning is not well developed. Some counties and many municipalities do not have a planner, staff and computing facilities required to hold up their end of a working relationship with the Department. Furthermore, our interviews disclosed rivalries among municipalities, counties and states that clearly make it difficult for the Department to engage in co-operative planning with the local governments. In the case of Hanford, tribal nations are a completely independent political entity that has views about land use that are different from mainstream America (Fenske & Mercer, 1997). The surrounding regions need to develop planning programmes and principles that will permit them to effectively work with the DoE. Overall, reuse of the sites involves multiple layers of co-ordination at a variety of spatial and organizational levels that is unprecedented at places like SRS. (See also O'Riordan (1988); Openshaw *et al*. (1989); Blowers (1990); Ehrlich & Birks (1990); and Pasqualetti (1990) for other examples of the difficulty of planning when nuclear weapons and energy are involved.)

Selecting Realistic Planning Principles

A third challenge is to develop plans that work at both the complex and individual site scales. At the complex level, this requires the agency to assess the present allocation of environmental management priorities and budgets across the different sites and programmes. At the local level, this requires a multidisciplinary group of local stakeholders to work together with the DoE to consider a full range of plausible land use options.

The DoE's mission to develop and produce nuclear weapons is on hold, but it would be naive to assume that weapons-related activities will not return in some form. On-site planning for reindustrialization and recreation, for example, will be constrained at some sites by the need to maintain spaces and structures for developing and producing nuclear weapons materials. Although details have not been published, the DoE clearly wants to consolidate its weapons functions.

Savannah River, for example, is one of the sites that would be considered for a continuing national security function. Any new strategic function, such as the proposed so-called 'triple-play' reactor which would produce tritium, generate electricity and destroy plutonium, clearly is a high priority for the DoE compared to watching butterflies and building private industries.

In *Closing the Circle on the Splitting of the Atom* (Office of Environmental Management, 1995a), former Secretary Hazel O'Leary noted that the agency has a "moral obligation" to deal with the health and safety legacy of 40 + years. The recently opened facility at Savannah River that solidifies radioactive wastes by mixing them with molten glass illustrates the reality that spaces and facilities will be required to reclaim and isolate radioactive materials, clean-up contaminated soil, equipment and buildings, and buffer the larger sites to prevent the public from approaching the weapons and environmental functions. The DoE estimates a complex-wide mid-range base cost of $230 billion over 75 years for remediation, with low and high ranges of $170 billion and $330 billion, respectively (Office of Environmental Management, 1995b).

To place these numbers in context, the estimated cost of the five DoE environmental management programmes at Hanford, Savannah River, Oak Ridge, Rocky Flats and the Idaho National Engineering and Environmental Laboratory is more than the cost of the analogous hazardous waste programmes for over 10 000 sites managed by the US Environmental Protection Agency, the US Department of Defense and all the states. The DoE waste management programme is the second largest debt programme assumed by the US government. Only the national debt is larger.

Given these costs and the size of the national debt, statements about DoE supporting land use initiatives that are not directly linked to cleanup are understandably equivocal. For example, six pages after former Secretary O'Leary's strong statement about the need to address environmental and safety problems, then Assistant Secretary for Environmental Management Thomas Grumbly posed the following question: "Should we exhume large volumes of contaminated soil in order to allow for unlimited use of the land in the future?" (Office of Environmental Management, 1995a, p. xiii). The DoE estimates that it will cost $225 billion (1995 dollars) to remediate sites for industrial use, which it calls a "modified containment" strategy; $375 for recreational land use which it calls a "modified removal" strategy; and $500 billion for residential/agricultural land use, which is called a "greenfields" strategy because it would remove all buried waste.

Statements about economic development funds are at best equivocal. For example, the prologue to the recent DoE appropriations bill instructs the agency not to divert funds meant for cleanup to economic development. At SRS, the small amount of money provided for economic development outside the site, $25 million in FY96, was proposed mostly to help organize the local communities, not to fund development.

Despite legal and moral obligations to remediate contamination, the DoE's environmental management budget is stressed. For example, the 1996 fiscal year budget for waste remediation at SRS was $1.2 billion in fiscal 1996. The site asked for $1.4 billion in fiscal 1997 and was given $0.9 billion. Furthermore, the agency was threatened with dissolution, and it is not clear where its land use planning functions would fall if it were dissolved. So despite an agency budget of $16 + billion of which $6 + billion is for environmental management, it is

unrealistic to assume that the DoE is going to have the funds to support major on-site land use programmes or major off-site economic redevelopment programmes.

What then should the DoE, still master of these lands, do? For planners this question leads to a search for planning principles that can be used to guide a plan for an agency which once had among the deepest pockets, but no longer does. We offer three broad choices.

The first of three plausible planning principles is *enhancing environmental management*, or *EM+*. The DoE has signed agreements with state governments, the US Environmental Protection Agency and tribal nations that legally obligate it to spend environmental management funds in specific places. The agency currently invests 21% of its environmental management funds at Hanford, 21% at Savannah River, 10% at Oak Ridge, 10% at Rocky Flats (CO), 8% at the Idaho National Engineering Laboratory, and 30% at all the other locations. These funds primarily are used to control dangerous wastes in tanks, maintain the infrastructure that controls high level wastes, and a variety of other serious contamination problems. Little goes to deliberately enhancing land uses that would serve the surrounding populations.

As an example of EM+, let us assume that the agency plans to spend $30 billion over the next five years for ongoing EM and that an additional $3 billion is dedicated for enhancing on- and off-site land uses and economic activities. These enhancement funds would be used for building roads and other infrastructure that would facilitate recreation, grazing, industry and other land uses. Using the existing EM allocations, a total of $630 million of this added $3 billion (21%) would go to Hanford, $630 million to Savannah River, $300 million to Oak Ridge, and so on. We call this principle 'EM+' because it adds the amount for enhancing on- and off-site land uses to the amount required for EM in the same proportion.

EM+ has important advantages for the DoE. Hanford, Savannah River and the three other major sites would receive relatively stable funding for a fixed period, which would improve their capability of developing a post-nuclear weapons land use image and plan that would link environmental management and the enhancements. These enhancements also will increase interaction between the DoE and interest groups. Local stakeholders surely will have much more valuable information about the kinds of recreation, agriculture and industry that might be viable on a site than they have about a facility that reprocesses nuclear materials, or a new technology that treats mixed nuclear and non-nuclear wastes. Compared to incremental site planning, EM+ will permit careful thinking about where future national security and waste management will be located, where these enhanced activities can be located and where the DoE needs buffers and temporary land use designations that preserve its hegemony. In other words, EM+ is a planning principle most likely to result in a flexible and useful result for the large sites. Regarding image, EM+ represents what the DoE can do to enhance the overall result for health, environmental protection, land use and economic development when it concentrates and co-ordinates its resources. EM+ can demonstrate that bombs, butterflies and other activities can co-exist. In the case of Savannah River, the site is so large that it probably can accommodate more recreation, ecological research, non-nuclear industry, waste cleanup and weapons activities.

Two important weaknesses of EM + are the bases for two other planning principles. EM + absorbs nearly all the funds in activities at five massive sites mostly located in less urbanized regions of the US and essentially ignores the Northeast and Mid-Atlantic regions. This has obvious political disadvantages with respect to securing support from elected officials from the Northeast and major urban centres, who will doubtless view EM + as an unreasonable transfer payment.

An alternative planning principle might assign budgetary priority to cleaning up those sites that have the fastest and most cost-effective turn-around for the agency and regions, that is 'highest value added' investments. This *highest value added principle*, our second planning principle, means disproportionately investing in the short-run in sites located in Kansas City (MO), near Dayton (OH), St Petersburg (FL) and other places where regional infrastructure is abundant and high value uses are more probable than they are in rural and small city environments. The DoE's 40 + Formerly Utilized Sites Remediation Program (FUSRAP) consists of much smaller and less contaminated sites. The cost of cleaning them up and returning them to private business is, wherever environmental risk and market conditions permit, a tiny fraction of the $100 billion likely to be spent at SRS and Hanford. Disproportionately located in the Northeast and urban centres, cleaning up many FUSRAP sites would doubtless improve the DoE's political support. The highest value added principle, in short, would help demonstrate that the agency can complete a task at some intermediate-size and small sites. Our preliminary studies of the 46 FUSRAP sites shows that some are already being reused for industrial and commercial purposes and others can be reused. Moving sites from the stage at which the taxpayers are supporting cleanup to the stage when the sites are paying taxes, doubtless, is appealing to the Department.

A second disadvantage of EM + and a disadvantage of the highest value-added principle is that they ignore interregional differences in economic stress. This leads to our third planning principle, *social justice*. Using US census data, we compared unemployment, job growth, income, and other social and economic indicators of 65 counties within 10 miles of the 18 major weapons sites. We found that the areas near the Hanford, Savannah River, Portsmouth and Paducah sites have populations that are poorer, more likely to be unemployed, and economies that are creating jobs at a slower rate than the other 14 major sites and the US as a whole (Greenberg & Simon, 1995a, 1995b). In addition, these four sites tended to have the largest intraregional differences in economic stress. For example, Aiken County, which lies directly north of the Savannah River site, has a per capita income that was more than 75% higher than Allendale County which lies just to the south of the site. Judged by the clustering of the residents of SRS employees and location of related off-site economic activities, Aiken and the northern tier of counties have realized most of the benefits from SRS (Figure 2). Also unemployment rates are much higher and job creation much slower in Allendale and the southern tier of counties (Greenberg & Mayer, 1996).

Does the DoE have a moral imperative to provide more funding to the Savannah River because of a social justice principle? And does Savannah River have an imperative to use such funds to benefit more stressed populations and areas? Redressing social inequities as a guiding principle has not been part of the DoE's mandate. Indeed, it is likely that conservative elements of the US Congress would continue to attempt to stop the DoE from using any funds to

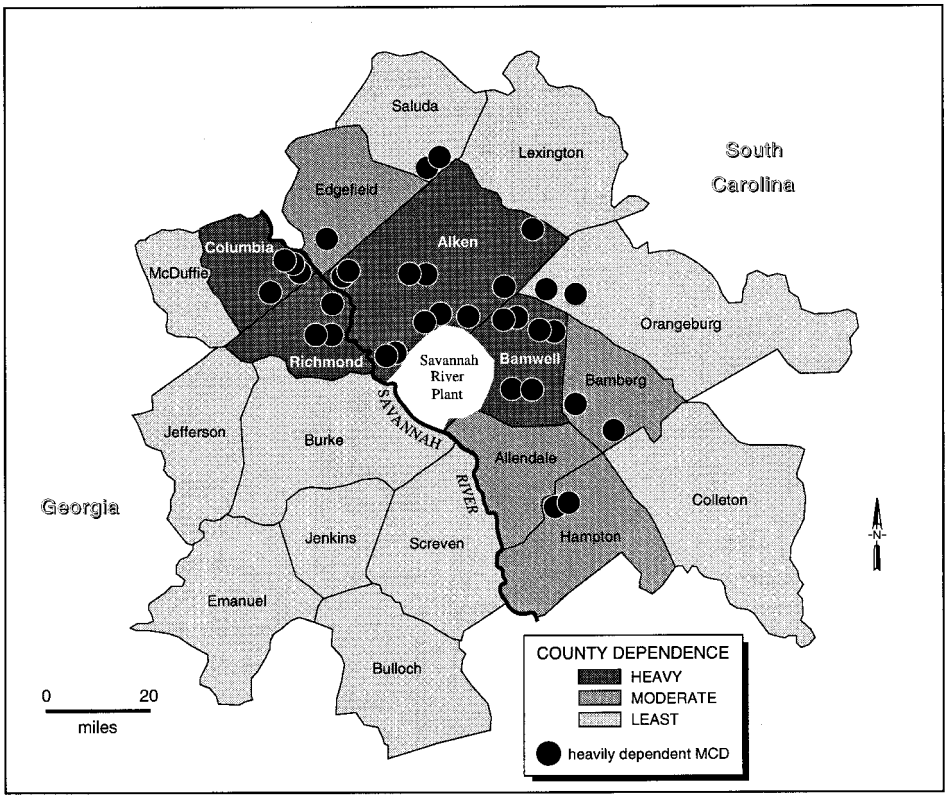

Figure 2. Savannah River plant study area.

address social justice issues in a meaningful way. However, other federal agencies, most recently the US Environmental Protection Agency, have embraced environmental justice as a policy issue (US Environmental Protection Agency, 1992). It would not be unreasonable for the DoE to consider social justice, which includes environmental justice, in its decision making. For example, priority could be assigned to developing recreational facilities and expanding ecological research at the Savannah River site border with specific places. This planning option is particularly important at weapons sites where open and consensual land use planning did not formally exist, and where representatives of some groups perceive that they bear a disproportionate amount of the risk and have not received many benefits.

Allendale County (SC) is a good illustration of how a social justice mechanism could potentially decrease the Department's trust problem and allow it to move forward with co-operative planning efforts. Our initial interviews in the Savannah River area found less participation in land use planning than we had anticipated (Lowrie & Greenberg, 1996a, 1996b). In Allendale, we asked the head of the county Chamber of Commerce to invite five to 15 distinguished business representatives to discuss why there appeared to be so little involvement, what could be done to increase involvement and time permitting, what their views were of future on-site land uses (Simon & Greenberg, 1996). Fifteen prominent local business and political leaders attended the meeting. They never addressed

their land use preferences. Rather they explained that they collectively considered it a waste of their time to engage the DoE in a discussion of land use. The DoE, they argued, had ignored Allendale for years, and instead had focused on areas north of the site. Furthermore, they suspected that the Department had already made future land use decisions. If the DoE wanted their participation, a senior DoE representative would have to convince them that their cynicism is not warranted.

We feel that the participants at this meeting are highly motivated to participate in future land use decisions. However, they collectively represent decades (in one case >40 years) of pent-up frustration, suspicion and cynicism. What is so troubling about this case is that Allendale is the poorest county near the Savannah River site, more than two-thirds of the county population is African-American, and if the SRS becomes the place in the US where nuclear materials are shipped for reprocessing, much, if not all, of it will pass through Fairfax, a town in Allendale County, within a few feet of the office of the President of the county Chamber of Commerce.

This example is not meant to be critical of the current DoE SRS staff. This legacy was created before they arrived, when some people were evicted from their land to create the SRS, and continued when secrecy was deemed essential. Even though the current managers did not create mistrust, they must address it in order to facilitate an open dialogue and land use planning process. The Department's credibility will increase if it has the flexibility to use some of its resources to address at least the most obvious social justice issues.

The economic implications of applying these three planning principles needs evaluation. We have a macroeconomic model developed by Regional Economic Models Inc of Amherst (MA). The REMI model includes nine regions. The counties that surround the SRS, Hanford, Oak Ridge, Rocky Flats, INEEL, Los Alamos and Sandia sites are each separate multi-county regions. Other counties that are adjacent to one of the 18 major sites are aggregated into a 'residual major site' group. The remainder of the United States is the ninth region. We will use the REMI model to examine the economic implications on the regions of applying the three planning principles.

Two caveats are in order about our use of the model. First, readers of this journal are doubtless aware of the reality that even the best socio-economic simulation models can only point in the direction of impact. We are not going to use the REMI model to tell the DoE and the local stakeholders precisely what is going to happen. Rather we hope to calculate a realistic set of demographic and economic impacts that follow from principles that we develop and that the federal and local stakeholders would like to see assessed. Second, legal requirements for cleanup have been mandated at the sites. These and political considerations may make one or more of these three principles difficult to apply, if not moot, irrespective of their logic and what the model results show.

Conclusion: Planning the Feasible

We have said nothing about the scientific challenges at nuclear weapons sites. These are daunting. Some of the sites contain tanks with combined radioactive and chemical wastes. There are no standard methods for separating these wastes. There are soils contaminated with more than two-dozen radioactive elements. There are contaminated aquifers that must be monitored, modelled

and remediated, if possible. These and other complex scientific problems will make sure that no one underestimates the scientific challenges. Yet the reality is that, as noted above, the vast majority of the land on the large sites is not contaminated, and many smaller sites can be remediated to levels acceptable for use by private interests. Some of this land should be able to enter the mainstream of American land use.

We would be remiss not to acknowledge that federal, state and local politics is another challenge. Powerful political forces are at work at these weapons sites and in Congress and in state houses. No one is going to allow decisions that involve tens of billions of dollars and tens of thousands of jobs to be based solely on what environmental planners and managers recommend. We stipulate that good environmental planning alone will not resolve the key scientific and political issues about former US weapons sites. Scientific uncertainty and political decisions may mean that some of these sites will not enter the mainstream of American land use during the next two decades. Some are unlikely to be open to public use during our life times and beyond for reasons that have little to do with environmental planning and management.

Nevertheless, good planning can offer a rational framework and analyses that will assist the agency and local residents to focus on the difference between what they want and what they can reasonably expect to get. For environmental planners and managers, the DoE's nuclear weapons sites represent, above all, a test of our ability to elicit sufficient trust from those who have spent their careers secretly designing weapons of incredible destructive capacity and elected officials to allow us to provide them with as broad a range of land use options as possible, including the continuation of some nuclear weapons missions and enjoying the flight of butterflies.

Acknowledgements

Our research has been supported by a co-operative grant to the Consortium for Risk Evaluation with Stakeholder Participation from the US Department of Energy, Instrument DE-FC01-95EW 55084. The viewpoints expressed in this essay are solely the responsibility of the authors and do not necessarily reflect the views of the US Department of Energy or its contractors. We would like to thank Charles Powers, Frank Popper and Dona Schneider for the helpful comments.

References

Bebbington, W. (1990) *History of DuPont at the Savannah River Plant* (Wilmington, DE, E.I. DuPont De Nemours and Co.).

Biel, A. & Dahlstrand, U. (1995) Risk perception and the location of a repository for spent nuclear fuel, *Scandinavian Journal of Psychology*, 36, pp. 25–36.

Binney, S., Mason, R., Martsolf, S. & Detweiler, J. (1996) Credibility, public trust, and the transport of radioactive waste through local communities, *Environment & Behavior*, 28, pp. 283–301.

Blowers, A. (1990) Public interest and local authorities—the case of radioactive waste. A look back at the conflict over shallow disposal of radioactive waste, *Town & County*, 59, pp. 57–60.

Ehrlich, A. & Birks, J. (Eds) (1990) *Hidden Dangers: Environmental Consequences of Preparing for War* (San Francisco, Sierra Book Club).

Fenske, R. & Mercer, D. (1997). Visions of Hanford: competing values in future land use planning and risk evaluation, Report to CRESP (Seattle).

Goin, P. (1991) *Nuclear Landscapes* (Baltimore, The Johns Hopkins University Press).

Greenberg, M. & Simon, D. (1995a) Demographic characteristics of counties adjacent to the Savannah River, Hanford, and other major US Department of Energy sites, *Report 1* to CRESP (New Brunswick, NJ).

Greenberg, M. & Simon, D. (1995b) Economic characteristics of counties adjacent to the Savannah River, Hanford, and other major US Department of Energy sites, *Report 2* to CRESP (New Brunswick, NJ).

Greenberg, M. & Mayer, H. (1996) Demographic characteristics and residential locations of employees of the US Department of Energy Savannah River site, 1940–1990, *Report 3* to CRESP (New Brunswick, NJ).

Greenberg, M., Isserman, A., Krueckeberg, D., Lowrie, K., Mayer, H., Simon, D. & Sorenson, D. (1996) Socioeconomic impacts of nuclear weapons facilities, 1950 to 1993: the case of Savannah River, *Report 4* to CRESP (New Brunswick, NJ).

Hinman, G., Rosa, E., Kleinhesselink, R. & Lowinger, T. (1993) Perceptions of nuclear and other risks in Japan and the United States, *Risk Analysis*, 13, pp. 449–456.

Kraft, M. & Clary, B. (1993) Public testimony in nuclear waste repository hearings: a content analysis, in: R. Dunlap, M. Kraft & E. Rosa (Eds) *Public Reactions to Nuclear Waste*, pp. 89–114 (Durham, NC, Duke University Press).

Kunreuther, H., Easterling, D., Desvousges, W. & Slovic, P. (1990) Public attitudes toward siting a high-level nuclear waste repository in Nevada, *Risk Analysis*, 10, pp. 469–484.

Lowrie, K. & Greenberg, M. (1996a) Local interviews in the SRS region: a perspective on socioeconomic and land use impacts of future use options, *Report 5* to CRESP (New Brunswick, NJ).

Lowrie, K. & Greenberg, M. (1996b) An analysis of plans for SRS and the SRS region, *Report 6* to CRESP (New Brunswick, NJ).

Mehta, M. & Simpson-Housley, P. (1994) Trait anxiety and perception of a potential nuclear power plant disaster, *Psychological Reports*, 74, pp. 291–295.

Office of Environmental Management, US Department of Energy (1994) *Environmental Management, 1994*, DOE/EM-0119 (Washington, DC, US DoE).

Office of Environmental Management, US Department of Energy (1995a) *Closing the Circle on the Splitting of the Atom* (Washington, DC, US DoE).

Office of Environmental Management, US Department of Energy (1995b) *Estimating the Cold War Mortgage*, 2 vols, DoE/EM-0230 (Springfield, VA, NTIS).

Office of Environmental Management, US Department of Energy (1996) *Charting the Course: The Future Use Report*, DoE/EM-0283 (Washington, DC, USDoE).

Openshaw, S., Carver, S,. & Fernie, J. (1989) *Britain's Nuclear Waste: Safety and Siting* (London, Belhaven).

O'Riordan, T. (1988) The prodigal technology: nuclear power and political controversy, *The Political Quarterly*, 59, pp. 161–177.

Pasqualetti, M. (Ed.) (1990) *Nuclear Decommissioning and Society: Public Links to a New Technology* (London, Routledge).

Schill, K. (1995a) Cleaning up SRS a long costly job, *The Augusta Chronicle*, 27 August, pp. 17A–19A.

Schill, K. (1995b) Jobs and transformation came with nuclear plant, *The Augusta Chronicle*, 6 November, p. 1B.

Schill, K. (1996) SRS losses mount, *The Augusta Chronicle*, 20 March, p. 1.

Simon, D. & Greenberg, M. (1996) Group meetings as fora for understanding public participation in future land use decisions, *Report 8* to CRESP (New Brunswick, NJ).

Slovic P., Layman, M. & Flynn, J. (1991) Risk perception, trust, and nuclear waste: lessons from Yucca Mountain, *Environment*, 33, pp. 6–11.

US Environmental Protection Agency (1992) *Environmental Equity: Reducing Risk for All Communities* (Washington, DC, US EPA).

Weart, S. (1992) Fears, fantasies and fallout, *New Scientist*, 136, pp. 34–37.

Wiegman, O., Gutteling, J. & Cadet, B. (1995) Perceptions of nuclear energy and coal in France and the Netherlands, *Risk Analysis*, 15, pp. 513–522.