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ENERGY - EFFICIENT SUBDIVISION REGULATIONS:  
A CASE STUDY IN MISSOULA COUNTY

By

Ronald Fred Brey

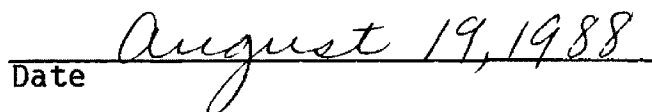
B.A., University of Montana, 1977

Presented in partial fulfillment of the requirements  
for the degree of  
Master of Science in Rural, Town, and Regional Planning  
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1988

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Pat O'Herren of the Missoula Office of Community Development filled in the blanks where unanswered questions remained.

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## CHAPTER 1

### INTRODUCTION

#### Energy and Land Use Planning

The October, 1973 oil embargo awakened American planners to the need for energy-efficient land use planning. Prior to the embargo, land use planning focused primarily on concerns involving function, aesthetics, networks, capability, and marketability. Readily available and reasonably inexpensive energy supplies relegated energy concerns to a position of minor importance in site and neighborhood design. With the shortage of inexpensive energy supplies in the late 1970's and the assumption that energy costs would continue to rise, energy considerations became a matter of greater concern in development decisions.

Once the need for energy conservation became apparent, many planning offices around the country began to address energy concerns in comprehensive plans and conducted a variety of energy-related studies. But the impact of land use planning regulations on energy consumption was recognized more gradually and thus, the adoption of energy-efficient land use regulations did not occur immediately. A 1980 study of 1,400 local, regional, and state planning agencies conducted by the American

Planning Association identified only 13 agencies that had adopted energy-efficient development regulations.<sup>1</sup>

By 1983, many communities had begun to incorporate energy conservation measures into their development regulations. Local governments were discovering that a wide variety of energy concerns could be addressed through development regulations. In Dade County, Florida for example, the primary interest was cooling costs and was addressed with shading and ventilation recommendations. Southbury, Connecticut sought to reduce winter heating costs by insuring solar access and encouraging wind buffering.

Development regulations are a logical starting point for the establishment of community-wide energy conservation measures. For all practical purposes, opportunities for conservation in site design are lost unless seized at the outset of development. For example, climatic factors, which play a major role in energy consumption, can be modified with design techniques. With careful siting, orientation, and integration, development can warm and/or cool the microclimate around building sites and offset some of the effects of climate. Carefully designed development regulations can assure that

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<sup>1</sup>Duncan Erley and David Mosen, Energy-conserving Development Regulations: Current Practice, (Chicago: Planning Advisory Service Report No. 352, 1980), p. 1.

such opportunities are secured to the fullest extent possible. Design decisions made prior to platting lots can permanently determine energy consumption patterns and developments may be guided toward energy efficiency through regulation.

By 1983, the Missoula City County Planning Office (MPO) realized the need for energy-efficient development regulations in Missoula County, Montana. A 1981 study of energy consumption in Missoula County found that Missoula's 1979 energy expenditures totalled \$84.5 million, and only 10-20% of those expenditures remained in the local economy. The effect of this cash drain is magnified because each dollar spent locally changed hands up to 19 times before leaving the local economy.<sup>2</sup> The study also showed that energy costs were rising faster than the rate of inflation except for electrical rates in the residential and commercial sectors.<sup>3</sup> It was clearly in the economic interest of the community to address these increasing energy expenditures which contributed little to the local economy.

Like other communities in the nation, Missoula responded to these new energy concerns with numerous

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<sup>2</sup>Jim McNairy, Energy Use in Missoula, 1981, cited by Community Energy Study, (Missoula, Montana. 1983. An unpublished report for the Missoula Planning Office), p. 1.

<sup>3</sup>McNairy, op. cit. footnote 2, p. 2.

studies. At least thirteen local energy-related studies were conducted between 1979 and 1982. One study proposed ordinance revisions to assure solar access and to better accommodate the development of solar energy systems, but confined its scope to zoning issues.<sup>4</sup>

By mid 1983, the community had taken other steps to address community energy concerns. The Missoula Energy Conservation Board was appointed and the position of City/County Energy Coordinator was established and funded. The Montana Local Government Energy Office, an agency of the Montana League of Cities and Towns and the Montana Association of Counties, was located in Missoula.

Perhaps the clearest indication of new concerns relating to energy efficiency appeared in the unadopted update of the 1975 Missoula Comprehensive Plan. In early 1983, the MPO began an effort to update the 1975 Missoula Comprehensive Plan. Although the 1983 Update was never adopted by local government, it was intended to revise the previous Plan, particularly as it related to energy concerns.

The 1975 Plan referred to energy conservation solely in terms of transportation issues. "Reduction of Energy

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<sup>4</sup>Report to the Missoula Planning Office by Michael N. Weinstein and Associates for the Western SUN Barrier Removal Project, April 20, 1981. (In the files of the Missoula Office of Community Development.)

Consumption" is listed as one of fourteen transportation goals in the plan, followed by five objectives related to that goal. These objectives chiefly addressed alternative modes of transportation including public transit, bikeway systems, and pedestrian travel ways. Congestion and adequate parking were also discussed as energy-related transportation issues.<sup>5</sup>

The 1983 Comprehensive Plan Update placed much more emphasis on energy conservation. The Plan Update contained an Energy Element, and an Energy Task Force was created and began meeting in February, 1983. By August, 1983, the Energy Task Force identified fifteen energy issues to be addressed in the Plan Update. Once again the concerns focused mainly on transportation issues. However, the task force also identified several issues which were closely related to the initiation of energy-efficient development regulations.

Although inadequate pedestrian and bicycle facilities and sparse settlement patterns were again identified as transportation-related energy issues, the need for development regulations to address these concerns was implied. The task force also mentioned the need for

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<sup>5</sup>"Goals and Objectives for Transportation", a report of the Citizens Coordinating Committee, Missoula: A Policy Guide for Urban Growth, (Missoula, Montana: Missoula Planning Board, undated), p.X.

better public education on energy issues. It recommended programs be created which would address not only the types of energy-saving techniques available but also the cost effectiveness of these conservation methods.

The task force mentioned careful landscaping as a method to reduce energy costs by providing shade and windbreaks. They also identified the need for site-specific information to determine optimal retrofit measures.

The task force also recognized "a lack of energy efficient building in Missoula and Missoula County."<sup>6</sup> Blame was attributed to several factors: inappropriate building code requirements for the Missoula climate; the initial cost of energy-efficient buildings seemed to outweigh potential energy savings in the minds of purchasers; and the failure of homebuyers, builders and lenders to take energy costs into consideration.

The Energy Task Force noted that "Montanans often strongly resist regulations."<sup>7</sup> This characteristic of Missoula County's population would prove to be one of several impediments in Missoula's effort to adopt energy-efficient land use regulations.

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<sup>6</sup>Part 1: Issues (Draft): Part of the Comprehensive Plan Update. (Missoula, Montana: Missoula Planning Office, August, 1983) p. 91.

<sup>7</sup>Missoula Planning Office, op. cit. footnote 6, p.90.

Department of Natural Resources and Conservation Grant  
for Energy-Efficient Development Regulations

In 1983, the Montana Department of Natural Resources and Conservation (DNRC) established a program to assist in the development of energy-efficient land use regulations. A Request for Proposal (RFP) was distributed to local government planning offices statewide, offering U. S. Department of Energy funds totalling \$10,000 for the purpose of developing either an energy-efficient subdivision or zoning ordinance in Montana. The stated goal of the program follows:

DNRC's primary goal in offering this grant is to foster the development and eventual adoption of an energy-efficient subdivision or zoning ordinance, in order to demonstrate by example, that such regulations can be adopted in this state, and can be used effectively to review and regulate land use and development. This goal will be achieved if the regulations developed under this grant are adopted by the local elected officials.<sup>8</sup>

The RFP also emphasized that incentives were preferable to a regulatory approach. Despite the goal of achieving an adopted final product, the DNRC acknowledged that adoption could not be guaranteed and merely required that an ordinance be developed to the point of adoption.

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<sup>8</sup>"Request for Proposal", from communities in Montana to develop an energy efficient subdivision or zoning ordinance, (Montana Department of Natural Resources and Conservation, 1983) p. 2. (In the files of the Missoula Office of Community Development).

Grant proposals were to include the following items:

1. Background on Planning Office -- to include the jurisdiction of the proposed ordinance.
2. Energy Related Planning Activities to Date -- to include such energy-related items as studies, task forces, and Comprehensive Plans.
3. Proposed Ordinances -- to include an explanation of approach, process, and conflict resolution.
4. Public Participation -- to describe the process used to assure public input.
5. Documenting the Process -- to include a final report which documents the process adequately for use by other communities; DNRC indicated that a "how to" handbook might be drafted from the report.
6. Budget and Implementation Schedule -- to include a description of in-kind contributions and a work schedule not to exceed a 10 month time period.

The final section of the RFP described the criteria for selection. Seven criteria were considered, with the greatest emphasis placed on previous energy-related planning activities, clarity of the proposal, public and private sector involvement, and of course, budget.

The deadline for applications was August 31, 1983.



## The Missoula Proposal

The thirteen energy-related studies prepared by Missoula between 1979 and 1982, and the emphasis on energy conservation in the Comprehensive Plan Update provided the MPO with considerable ammunition to respond to the RFP. Their proposal emphasized the role of the MPO in the creation of the Missoula Valley Energy Conservation Board, the organization of the Missoula Energy Futures Conference, and the formation of the City-County Energy Office.

The proposal listed the following recommendations from the partially completed energy element of the Comprehensive Plan Update which would serve as the starting point for the development of the proposed regulations:

1. removing regulatory barriers to solar access;
2. encouraging planned unit developments to reduce the numbers and lengths of car trips;
3. requiring shadow and wind overlays in subdivision submittals to encourage landscaping that responds to solar access and windbreak opportunities;
4. examining street widths and layouts in subdivision plats to determine how necessary the oil products to be used in construction would be;
5. examining building orientations to encourage solar access and wind barriers; and

6. developing a system of incentives to implement the other recommendations through density bonuses, public infrastructure support and preferential approvals.<sup>9</sup>

In addition, the Missoula proposal outlined a methodology which contained six milestones:

Milestone 1 -- summarize existing regulations and recommendations that relate to energy conservation;

Milestone 2 -- collect and review information from federal and state agencies and from areas with similar climatic conditions that have adopted energy efficient regulations;

Milestone 3 -- compile a detailed list of proposals to change the subdivision regulations;

Milestone 4 -- evaluate the proposals and review them for compliance with existing state and local laws, regulations and ordinances;

Milestone 5 -- notify the public that an energy proposal for subdivision regulations will be proposed and solicit citizen comment;

Milestone 6 -- use formal public hearings and staff reports to develop a final proposal for presentation to the Planning Board and local governing bodies.<sup>10</sup>

The proposal was well conceived and documented, and in November, 1983 the MPO was awarded the single Montana grant.

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<sup>9</sup>Grant proposal to the Montana Department of Natural Resources and Conservation by the Missoula Planning Office, 1983, pp. 4-5 (in the files of the Missoula Office of Community Development).

<sup>10</sup>Missoula Planning Office, op. cit. footnote 9, p. 11.

The second chapter of this paper identifies and discusses those items described in milestones 1, 2, and 3. The development of an inventory of existing energy-efficient development regulations and related articles was one of my responsibilities during an internship with the MPO from June through December, 1983. A thorough literature review was conducted at that time and numerous local government planning offices were contacted to determine whether cited regulations did, in fact, function as described and if so, whether such regulations would effectively promote energy conservation in Missoula's climate.

Chapter 3 of this paper summarizes the process for adopting the energy-efficient regulations proposed for Missoula County. Reactions and suggestions are discussed.

Finally, Chapter 4 evaluates reasons why the proposed regulations were never adopted, and considers the implications of this refusal for efforts to establish other innovative regulations.

## CHAPTER 2

### ENERGY EFFICIENT LAND DEVELOPMENT TECHNIQUES

#### Organization of Research

The techniques for site design and development regulation presented in this chapter were taken from material collected in 1983 from planning publications, city and county ordinances, regulations, policy statements, energy planning programs, and other energy-related documents. The MPO used these sources and others to formulate the proposed regulations. The discussion in this chapter focuses on the various types of energy-saving development techniques categorized by the type of energy consumption addressed.

The initial screening of techniques was accomplished with an eye toward the likelihood of implementation in Missoula County. Several communities have developed sophisticated development permit systems which award points for energy-efficient development techniques in design, then award development permits on a competitive basis. Implementation of such a program in Missoula County, however, would have been extremely unlikely at the time of the grant. The techniques identified here deal with design methods that could have been encouraged or required in the county immediately.

The site design and development techniques which follow have been grouped according to a classification system recommended by N. F. Kron, Jr. in the 1982 Zoning and Planning Law Handbook. According to Kron, energy-conserving development regulations should be evaluated in terms of the basic services which consume energy. Focusing on services clarifies the conservation issues, which may then be addressed through revised regulations.<sup>11</sup>

Kron cited five energy-demanding services which will serve to categorize energy-efficient development regulations: 1) Space Heating, 2) Space Cooling, 3) Domestic Water Heating, 4) Electricity, and 5) Transportation. A separate category, General Energy-Saving Actions, includes community-wide actions to reduce embodied energy consumption.<sup>12</sup>

The previously mentioned inventory of existing energy-efficient development regulations and related articles identified numerous techniques to address each energy demand. The techniques discussed in this chapter are found in a host of ordinances, publications, plans, and studies. As no technique is uniquely attributable to a single source, no specific citations are made. The

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<sup>11</sup>Strom, Frederic A., ed. 1982 Zoning and Planning Law Handbook, New York: Clark Boardman Company, Ltd. 1982. p. 412.

<sup>12</sup>Strom, op. cit. footnote 11, pp. 412-413.

bibliography contains a list of uncited materials which were used to identify feasible regulatory techniques.

## Techniques Appropriate for Subdivision Regulations in Missoula County

### Space Heating

Space Heating considerations primarily fall into topographic, orientation, wind buffering, and solar access concerns.

### Topography

The varied topography of Missoula County offers both opportunities and constraints for energy-efficient site development. Techniques which take advantage of topographic opportunities include:

1. Encourage development on south-facing slopes. Such encouragement would take place at the site plan review stage of the subdivision review process. A perpendicular angle of solar exposure maximizes the amount of solar radiation reaching a parcel of land. Shadows are shorter on south facing slopes, allowing buildings to be located closer to each other without obstructing solar access.
2. At the site plan review stage, encourage the use of topographic features to buffer sites from the prevailing winter winds.
3. Encourage development on hillsides rather than at the top or bottom of a hill where the site may be subject to excessive winds or cold air pockets. South and southeast facing slopes will provide the greatest solar exposure and the greatest protection from prevailing winter winds.

This and other areas of "encouragement" will require that staff members become sufficiently knowledgeable of

energy-efficient design techniques to assist developers in uncovering potential opportunities on the site in question.

### Orientation

Orientation considerations include the following:

1. Require east-west street orientation wherever possible. With such street orientations, most zoning ordinances would then require lot and building alignment which would provide correct building orientation for solar access. Encouragement of north-south lot lines on diagonal streets is another possible solution to lot and street layout which results in southern exposure opportunities for buildings.
2. Require a minimum percentage of lots in each subdivision be oriented to provide proper solar access.

### Wind Buffering

Wind buffering may be encouraged or required through several different techniques.

1. Require the preservation, replacement, or initial planting of trees and other vegetation for shelter and buffering from the prevailing winter winds.
2. Review building layout for mutual wind buffering.
3. Require wind information and information on the location of specific existing vegetation as part of the data to be included with the subdivision application. On many sites it will be necessary to include the direction and intensity of prevailing winds for each season, the direction and intensity of thermal winds on the site, and the effect of different landforms on the prevailing winds at the site.

### Solar Access

In order for proper building orientation to be a meaningful energy efficiency measure, solar access must be

provided and maintained for the lots created. The following methods assure solar access for lots in new developments.

1. Require the provision of solar access to all or to a minimum percentage of new lots.
2. Require shadow diagrams for all existing and proposed trees, buildings and topographic features at a critical time, for example, at twelve noon on December 21.
3. Review sites for maximization of solar access.
4. Require a minimum square footage of each lot to have unobstructed solar access.
5. Review the site plan to assure that open space is located in such a manner that solar access is maximized for building lots.
6. Require solar access easements for all new lots.
7. Evaluate the potential for unconventional lot shapes, for example flag lots, to increase solar access.

In addition to the above, significant space heating savings can be realized when common wall clustered housing is encouraged. Requirements or incentives for a certain number of multiunit structures in a Planned Unit Development is one way to promote this concept.

#### Space Cooling

Space Cooling techniques can be used to reduce the costs of air conditioner operation, electric fans, swamp coolers, and refrigerators and freezers. Although the 188 cooling degree days annually occurring in Missoula are



insignificant in comparison to the total of 7,931 annual heating degree days, there is an opportunity to significantly reduce the costs of such cooling, as illustrated by the following:<sup>13</sup>

1. Orient buildings to take advantage of summer breezes.
2. Preserve, replace, or plant new vegetation to provide summer shading on building sites. The intent should be to provide as much summer shade as possible without interfering with solar access in the winter.
3. Encourage minimal paving and narrow streets with vegetative canopies in residential areas to reduce daytime heat around homes.
4. Use topographic characteristics of building sites to maximize summer breezes.
5. Encourage landscaping to channel summer breezes through building sites. Topography and vegetation can be combined to screen a site from north and northwest winter winds while channeling west and southwest breezes through the site in the summer.
6. Use shadow diagrams in making location and orientation decisions concerning lots and structures.

Beneficial side effects result from some of these energy-conserving measures. Shaded streets, for example, hold appeal for pedestrians and cyclists, encouraging energy conservation in the transportation sector.

#### Domestic Water Heating

Minimizing energy costs related to domestic water heating can partially be addressed through the previously

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<sup>13</sup>Community Energy Study. Unpublished study for the Missoula Planning Office. May, 1983. p. 6.

mentioned techniques for assuring solar access. The major concern in addressing water heating through development regulations is to avoid restricting water heating devices in covenants which deal with aesthetic concerns or restrict accessory structures. A reasonable goal given Missoula's climate would be to encourage at least partial solar heating of hot water for swimming pools. Residential solar water heaters can also be encouraged, particularly in Planned Unit Developments.

### Electricity

Most of the previously mentioned techniques result in reductions of electricity consumption. The following methods, however, are specifically designed to reduce the consumption of electricity:

1. Use sodium vapor street lighting which is properly spaced and efficiently located.
2. Require heating systems which use the most abundant and accessible fuel available at a given time.
3. Use proper building orientation along with assured solar access to provide a maximum amount of natural lighting.
4. Use a topographic evaluation to minimize the requirements for pumping either waste water or fresh water.

### Transportation

Subdivision design can also reduce transportation-related energy consumption. Savings can be realized through the adoption of land use patterns which either

reduce the reliance on the automobile or create opportunities for efficient mass transit and alternative transportation methods. For example:

1. Promote walking and cycling -- a 100% energy savings. Planned unit developments with mixed land use can provide closer home-to-work proximity and reduce the length of routine trips, resulting in both the encouragement of alternative transportation methods and in reduced trip lengths when using more conventional methods.
2. Require bike and foot paths as a design aspect.
3. Create and maintain neighborhood parks -- resist cash payments in lieu of parks and obtain useable parkland in each subdivision.
4. Establish density bonuses to encourage contiguous or infill development which minimizes transportation needs.
5. Require participation in a public transportation district if a proposed development is contiguous to district boundaries. Any development with bus service should be required to provide adequate bus pull outs.
6. Evaluate street design for efficiency in circulation patterns.
7. Require the provision of facilities which encourage the use of mass transit or alternative transportation methods. Bicycle racks at bus stops, shelters, and maintained bicycle and pedestrian paths encourage the use of alternative transportation.
8. Cluster commercial development so that fewer and shorter trips are needed.

#### General Energy-Saving Actions

Community-wide practices to save energy involve a broad range of considerations, as illustrated by the following:

1. Identify energy conservation as a community-wide objective in all development decisions. Education programs for buyers, builders, and elected officials can generate support for energy-oriented development decisions. An education program should contain explanations of the life cycle savings realized from energy-efficient construction. Without such information at hand, people are reluctant to take on the initial costs associated with energy-efficient development.
2. Encourage higher density, clustered development.
3. Remove covenant language or other regulations which discourage the use of on-site energy generation systems.
4. Avoid excessive grading and unnecessarily wide streets.
5. Allow long narrow lots when the reduced frontage will allow the concentration of utility accesses, thereby reducing installation costs.
6. Link efficient layout of streets with the extension of utilities. The most energy-efficient method of providing utility services is to locate them in trenches beneath road surfaces as the roads are constructed. Superblocks and cul-de-sacs can minimize the total length of both street and utility systems.
7. Restrict the provision of services for strip and leapfrog developments.
8. Develop an energy impact analysis method for new developments.
9. Require a thorough microclimate study as part of the environmental information to be provided in a subdivision application.
10. In general, use the site plan review process to assure that natural energy-saving features of the site are maximized and to assure that situations resulting in temperature extremes are minimized.
11. Provide an energy information service to developers so informed development decisions can be made.

### Suitability of Subdivision Techniques

In general, there are three approaches that may incorporate energy-efficient options into subdivision regulations. These regulatory methods are described by Duncan Erley and David Mosena as: 1) Revising regulations that stand in the way of energy conservation; 2) using development regulations which encourage energy conservation through incentives; and 3) revising regulations to require energy efficiency in new development.<sup>14</sup>

These approaches are listed in increasing levels of stringency. One of the key considerations when evaluating techniques for application in Missoula County was to determine the appropriate degree of stringency.

Some techniques included in the above listings may contradict others. For example, the most efficient street layout may not maximize opportunities for wind buffering or solar orientation. Therefore, all energy-related considerations must be evaluated comprehensively to determine the optimum design for a given development.

Other techniques could encourage poor design if misapplied. Long, narrow lots and flag lots may create problems for vehicular access if they are not carefully designed with such concerns in mind.

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<sup>14</sup>Erley and Mosena, op.cit. footnote 1, p. 6.

It is important, therefore, that proposed regulations are sufficiently flexible to avoid application where they may be inappropriate. A series of inflexible requirements will not assure maximum energy efficiency.

Addressing energy-efficient development concerns solely through subdivision regulations does not constitute a comprehensive approach to energy-efficient development. The majority of techniques encountered during the research that resulted in these lists included zoning and building code considerations as well. Building setbacks, height, location, orientation, and shape; alternative energy devices; parking lots; and landscaping are just a few of the energy-related issues that are typically addressed in zoning ordinances rather than subdivision regulations. Construction, glazing and mechanical requirements appear in building codes, and are crucial to energy-efficient development practices. Because zoning and building requirements are separate from subdivision controls, many of the listed subdivision techniques will not, by themselves, assure energy efficiency.

Although the techniques described above seem reasonable and feasible, it must be remembered that factors other than energy conservation will influence many design and siting decisions. Amenities play a major role in location and orientation decisions and may conflict with energy

concerns. The "South Hills" of Missoula, for example, are developed for residential use and provide wonderful views of the Missoula valley and the Rattlesnake area to the north. Predictably, most residences on the "South Hills" have picture windows on the north side of the structure.

Energy-efficient guidelines may also conflict with certain community-wide development objectives. The encouragement of development on south-facing slopes in Missoula could impact Waterworks Hill and the Mount Sentinel area, which have been designated for open space. Any requirements or suggestions in regulations proposed for Missoula would require careful tailoring to address Missoula's specific concerns.

## CHAPTER 3

### ENERGY EFFICIENT LAND USE REGULATIONS FOR MISSOULA CITY AND COUNTY

#### Public and Agency Input

The Missoula Planning Office staff anticipated that any efforts to create new regulations would meet with resistance from the general public. The grant proposal summarized the situation as follows:

As the energy element task force has noted there is a general reluctance to further regulate private property. Any regulations proposed which will consider energy efficiency in the design of subdivisions will no doubt be seen as government interference unless people in the community are actively involved in the development of these regulations.<sup>15</sup>

On February 15, 1984, the MPO staff sent to 96 individuals and groups a memorandum which outlined the scope of the project, described items likely to be considered in the development of regulations, and solicited comments and suggestions. Recipients were invited to contact the office if they wished to review the information which the staff had collected.<sup>16</sup>

Three responses were received by the requested deadline; one additional response was submitted shortly thereafter.

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<sup>15</sup>Missoula Planning Office, op. cit. footnote 9, pp. 7-8.

<sup>16</sup>Memorandum from Patrick O'Herren and Barbara Martens, MPO Staff, February 15, 1984.



The Missoula County Surveyor voiced a concern that revisions based on a single consideration (energy) could have unintended consequences. He urged the MPO staff to revise existing subdivision regulations in a comprehensive manner.<sup>17</sup>

A former Missoula County Commissioner responded with concerns relating to street widths, street development standards, and the developer's responsibility for improvements.<sup>18</sup>

The Chairman of the Board of Mountain Line, Missoula's mass transit provider, submitted a specific request which was incorporated into the proposed regulations. He stated:

I am requesting that the Missoula Planning Office include a provision to revised subdivision regulations requiring a developer to petition the District Board for annexation into the urban transportation district when the subdivision will lie in close proximity to the existing district boundaries.<sup>19</sup>

The fourth response, from a Missoula consulting firm, contained three concise suggestions for the proposed regulations:

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<sup>17</sup>Letter from Richard H. Colvill, Missoula County Surveyor, February 16, 1984.

<sup>18</sup>Memorandum from Ludvig G. Browman, February 29, 1984.

<sup>19</sup>Letter from Marvin Enderlin, Chair of Board, Mountain Line, Missoula Urban Transportation District, February 24, 1984.

- a. Keep them simple.
- b. Solar access should be an absolute in terms of protection from encroachment of future buildings and trees.
- c. Lot orientation and aspect to promote better solar access should be encouraged.<sup>20</sup>

The letter further stated:

...somewhere between occasional sales and the perfect subdivision is a medium which incorporates good planning, economical services, energy efficiency and affordable housing. I wish you luck in your quest.<sup>21</sup>

A second mailing, two interviews on radio stations, a lengthy article in the Missoulian and several television interviews resulted in no additional response.

By March, 1984, the staff had prepared a draft of the regulations for review by various individuals and agencies (Appendix A). The staff acknowledged that many energy-efficient requirements are not well suited for application in Missoula County. Area topography would generate many requests for variances if certain controls were imposed. Other provisions originated in either warmer climates or areas with a higher percentage of solar exposure in the winter months. The staff proposed that such provisions warranted consideration on a case by case basis, and should not be mandated as a requirement.

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<sup>20</sup>Letter from Nicholas P. Kaufman, Sorenson & Company, March 9, 1984.

<sup>21</sup>Kaufman, op. cit., footnote 20.

Regulation proposals were subsequently divided into two categories: "Policy Considerations" and "Standards". The staff described the rationale for "Policy Considerations" in the following statement:

Policy considerations can be ignored by developers, since they are not law. However, by presenting policy considerations as criteria in reviewing a development proposal, the governing agency can suggest adherence to energy-related conditions...

OCD [The Missoula Planning Office had changed its name to the Office of Community Development] believes the policy considerations will generally promote energy savings, without burdening developers and landowners with policies that are neither cost nor energy efficient on a particular site.<sup>22</sup>

By contrast, "Standards" were proposed as mandatory regulations which would apply to all sites.

The draft regulations were presented to the Energy Conservation Board for review and to agencies and individuals who had an expressed interest in the project. Five additional responses were received containing specific suggestions.

The Missoula Valley Energy Conservation Board noted that a rewrite of the entire subdivision regulations would not be necessary to accomplish the creation of energy-

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<sup>22</sup>Missoula Office of Community Development, Proposals for Energy-Efficient Subdivision Regulations (Helena: Montana Department of Natural Resources and Conservation, 1985), p. 7.

efficient regulations. The Board also expressed a desire for full public participation in the process.<sup>23</sup>

Ludvig G. Browman, the retired County Commissioner who had responded to the initial request for input, again emphasized the need to maintain adequate roadway width. He stated:

My recommendation is to eliminate all reference to roadways, streets and cul-de-sacs since the recommendations indicate a return to the standards of the 1920s and earlier.<sup>24</sup>

The Missoula County Surveyor again expressed strong opposition to the proposal. He found several provisions unnecessary and felt that engineering considerations should outweigh planning dictates in other instances. The following are selected statements from his response and indicate the fundamental reservation he had about the entire proposal.

It seems to be a very shallow, ill-defined document that I surmise was written to use grant money and keep the Planning Staff occupied between more important tasks. ...This document was written with the usual planning philosophy that passing a regulation will cause something to happen even if the regulation has no relation to reality. ...Some of these regulations are apparently regulations just for the sake of regulating something.<sup>25</sup>

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<sup>23</sup>Letter from Nicholas P. Kaufman on behalf of the Missoula Valley Energy Conservation Board, May 22, 1984.

<sup>24</sup>Letter from Ludvig G. Browman, July 13, 1984.

<sup>25</sup>Letter from Richard H. Colvill, Missoula County Surveyor, July 13, 1984.

These remarks suggest that the County Surveyor objected not only to the specifics of the proposal, but also to the rationale of using planning regulations to address energy concerns.

The Missoula City-County Health Department responded in detail, suggesting four changes in the proposed regulations. Language was added which suggested that developers identify energy-efficient sites on each parcel on the plat. The Health Department also recommended that a proposed standard for locating drainfields south of structures be deleted. The Department was concerned that optimal sewage disposal should be the sole criterion for drainfield location decisions.

A suggestion for requiring assessment of prevailing wind directions on a site at 6:00 a.m. and 6:00 p.m. during the heating season was modified to require only prevailing wind directions for wind speeds greater than 5 m.p.h.

The Health Department's response also proposed the addition of the following requirement:

Supply of Utility Energy. Where economically feasible, the developer should provide for access to electricity and natural gas on each lot.

The purpose of this amendment is to insure that consumers have access to the cheapest form of utility energy. The lack of available natural gas in a subdivision in Grant Creek has caused

excessively high energy costs for consumers, and has forced many to use wood heat as an economy measure, which in turn degrades the air quality.<sup>26</sup>

### Public Meetings

The proposed regulations, with comments and suggested amendments, were scheduled for presentation at a series of public meetings prior to final adoption by the City Council and County Commission. Initially, they were presented to the Missoula Valley Energy Conservation Board on May 17, 1984.

They were then presented at a public hearing before the Missoula Planning Board on July 17, 1984. The only speakers at the public hearing were Planning Staff, the City/County Energy Coordinator, a staff member of the Montana Local Government Energy Committee, and the Montana Department of Natural Resources and Conservation staff administering the grant.

Faced with no publicly expressed concerns, the Planning Board's discussion focused on the issues addressed in the written responses described previously. Other questions related to the impacts of narrow streets on cyclists and to review of the proposed regulations by

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<sup>26</sup>Submittal by Missoula City-County Health Department, undated.

legal counsel. After a brief discussion, a motion was passed to recommend adoption of the regulations.<sup>27</sup>

The Missoula City Council heard the matter on August 6, 1984. The proposal was modified to reflect the County Surveyor's concerns about roadway widths. The modifications proposed by the City-County Health Department were also incorporated into the proposal and these modifications were explained to the City Council by the Planning Staff. The Health Department then indicated support for the regulations as amended. Again, no public support or opposition was expressed.<sup>28</sup>

The public hearing on the proposed energy-efficient subdivision regulations was held before the Missoula County Commissioners on August 8, 1984. Two individuals other than staff offered testimony. A local real estate broker supported the regulations but requested clarification of language in the proposal. He also suggested that requirements for shadow patterns and prevailing wind studies be deleted because of their difficulty.

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<sup>27</sup>Minutes of the July 17, 1984 meeting of the Missoula Planning Board. (In the files of the Missoula Office of Community Development.)

<sup>28</sup>Journal of Proceedings, Missoula City Council, August 6, 1984.

The second individual represented the Missoula Rural Fire District and withdrew prepared questions when informed that street width provisions had been deleted from the proposal.

Commissioner Barbara Evans criticized the proposal on the following points:

1. She supported the provision of a pamphlet with suggestions, but opposed standards.
2. She opposed including items which already were regulated, such as the transit issues.
3. She expressed an interest in better communication between departments to avoid the extensive amendment of proposals.

The Commission concluded the hearing by postponing formal action indefinitely.<sup>29</sup>

The City Council referred the matter to its Plat, Annexation, and Zoning (PAZ) Committee for review and recommendation. After requesting and receiving a demonstration of shadow pattern analysis, PAZ made the following recommendation to City Council:

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<sup>29</sup>Minutes (draft) of the Public Meeting, August 8, 1984, Missoula County Commission.



The Committee recommends that the Council adopt the attached energy conservation proposals as energy saving suggestions. They will not have the force of law and will be included with the subdivision regulations as suggestions only.<sup>30</sup>

On October 15, 1984, the City Council accepted PAZ's recommendation and approved the proposal. The County Commissioners took no further action on the proposal. The final proposal, drafted as suggestions, is included in the information packet provided by the City of Missoula to prospective subdividers (Appendix B). Thus, a subdivision proposal inside the City may be evaluated in terms of energy efficiency but may not be denied based on energy concerns.

With no expressed public opposition to the proposal, it is difficult to evaluate the reluctance of the County Commission and City Council to take substantive action. The MPO staff incorporated expressed concerns into the proposal in a manner that addressed the majority of the concerns. The goal of community-wide energy savings certainly met with no opposition, so the "problem" with the proposal must have been related to either adoption procedures, specific details of the proposal, or the attitude of the community regarding further regulation.

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<sup>30</sup>Plat, Annexation, and Zoning Committee Report, September 26, 1984.

The following chapter considers possible problems with the MPO proposal which may have precluded the elected officials from taking substantive action.

## CHAPTER 4

### EVALUATION

Since the proposed energy-efficient development regulations faced little public opposition, what then caused the Missoula City Council to adopt the provisions as suggestions rather than law? The County Commissioners were even less enthusiastic, taking no action at all. The possible explanations for these positions fall into two general categories: 1) the proposal or the process by which it was developed contained deficiencies and constituted bad public policy; and 2) the political climate in Missoula at that time was not conducive to the adoption of additional development regulations.

#### Deficiencies in Missoula's Proposal

The ability of developers, staff, and elected officials to accurately evaluate development proposals for energy efficiency was questioned at several points. If the provisions had been readily understandable and clearly enforceable, this perceived deficiency in the proposal might have been avoided.

Enforceability, however, was a question of real merit. Davis, California was one of the most frequently cited examples of a community with energy-efficient development standards, yet a conversation with the Davis Planning

Director revealed that some provisions are only implemented when "politically expedient".<sup>31</sup> Apparently Missoula policymakers were not satisfied that the proposal was clear and enforceable.

The proposal contained apparent deficiencies in those areas where traditional standards and procedures of other agencies were modified for purposes of energy efficiency. This problem was most evident regarding reduced roadway widths and the location of septic drainfields. Careful coordination with other affected agencies during the drafting of the regulations would have precluded the eleventh hour difficulties encountered when those agencies voiced their complaints or amended the proposal. One County Commissioner expressed a desire to have departments "conduct their business with other departments personally rather than via memo in order to receive input early enough to avoid extensive amendments."<sup>32</sup>

The County Commissioners also objected to the initial development of the proposal by the planning staff, on the grounds that new regulations should be proposed by the citizenry or by elected officials. The problem arose when

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<sup>31</sup>Letter from Patrick O'Herren, Staff Planner, Missoula Planning Office, Missoula, MT, undated, 1984.

<sup>32</sup>Missoula County Commission, op. cit., footnote 29.

DNRC distributed the RFP to planning offices rather than elected officials. The MPO responded and was awarded the grant without formally seeking the support of the City Council or the County Commissioners. From the County Commissioner's point of view, this action by the MPO resulted in an unacceptable proposal.

From the viewpoint of staff, elected officials vary in the amount of responsibility they delegate, depending on individual personalities, commissioner-staff relationships, and the timing of various proposals. In this instance, the MPO staff misread the willingness of elected officials to support the proposal.

Another deficiency of the proposal lay in the staff's inability to offer incentives for energy efficiency. Incentives clearly establish the municipality's interest and willingness to participate in the process by offering benefits to developers in exchange for compliance. The staff intended to offer incentives, but found that all customary incentives, such as density bonuses, fell under the jurisdiction of the Zoning Ordinance.

A further deficiency in the proposal was the difficulty in coordinating different types of regulations. The effort to develop energy-efficient subdivision regulations was intended to identify regulatory barriers to energy efficiency and remove or modify them. But the

major identified barriers fell outside the scope of subdivision regulations. Barriers to energy efficiency were discovered in both zoning regulations and in the building code. The Western SUN Barrier Removal Project, in an analysis of the Missoula Zoning Ordinance, found numerous "barriers" to solar access provision and to solar retrofits to existing structures.<sup>33</sup> This study made no attempt, however, to weigh energy saving opportunities in relation to the public health, safety, and welfare concerns addressed by the provisions which were identified as "barriers" and the Missoula Zoning Ordinance was therefore not revised.

The MPO was concurrently seeking the means to coordinate zoning and building requirements. A second grant was obtained, this one from the Bonneville Power Administration to research energy conserving zoning regulations.

State statute (50-60-301, 302, and 303, Montana Code Annotated) did not allow local government adoption of building code provisions more stringent than those adopted by the state. While the MPO was evaluating subdivision and zoning regulations, the Missoula City-County Energy Coordinator was working with the Northwest Power Planning

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<sup>33</sup>Weinstein, op. cit. footnote 4.

Council and the state legislature to allow local revision of building codes.

Even if subdivision regulations, zoning requirements, and building codes are revised to allow consideration of energy conservation, the separate procedural requirements currently in place prevent effective implementation. The conservation tools available in one regulatory arena work most effectively when applied in conjunction with the regulations found in the other two. A comprehensive approach is needed to allow simultaneous design of subdivisions, sites, and buildings.

The most serious deficiency of the Missoula proposal was its failure to provide a quantitative analysis of the proposed conservation measures. By 1983, consumers had grown accustomed to seeing projected energy costs on automobiles, water heaters, and appliances; and projected savings for insulation products and windows. However, land use approaches to energy conservation had not been in place in other communities for a sufficient time to provide meaningful data. Erley and Mosena found that regulatory actions which resulted in little cost to developers would be accepted with little technical support.<sup>34</sup> Policies which significantly increased development costs, however,

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<sup>34</sup>Duncan Erley and David Mosena, op. cit., footnote 1, p. 2.

needed to be documented. As a result, the recently adopted policies studied by Erley and Mosena were typically low-risk efforts, using incentives and voluntary approaches to minimize community opposition and thus to minimize the need for technical documentation.<sup>35</sup> This approach resulted in little data analysis for use by communities looking to substantiate energy-efficient regulations.

Experience alone will not make energy savings easy to quantify. As David B. Crandall noted:

It is difficult to model and quantify the impacts of energy options once one goes outside the building shell, due to the scale of spaces, the variation in natural land forms from site to site, and the difficulty of dealing with the complexities of our country's diversified climates.<sup>36</sup>

For most communities in the Erley and Mosena study, the question was not "how much energy could be saved, but rather if energy could be saved."<sup>37</sup> The Missoula proposal was based on the same question.

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<sup>35</sup> Duncan Erley and David Mosena, op. cit., footnote 1, p. 33.

<sup>36</sup> David B. Crandall, "Maximizing Energy Conservation Through Site Planning and Design", in Robert W. Burchell and David Listakin (Eds.), Energy and Land Use (Piscataway, New Jersey: Center for Urban Policy Research, Rutgers, the State University of New Jersey, 1982), p. 271.

<sup>37</sup> Duncan Erley and David Mosena, op. cit., footnote 1, p. 29.



### Missoula's Political Climate

The mid 1980's marked a change in the political enthusiasm for planning in the city of Missoula and in Missoula County. The interlocal agreement establishing the MPO was executed in 1973. The Planning Office was to coordinate "all City and County land use planning, subdivision, zoning, and building inspection regulations and community development efforts."<sup>38</sup> In 1975, county-wide and urban comprehensive plans were adopted. The Planning Office and Planning Board were involved in the adoption of regulations pertaining to signs and the movement of hazardous wastes through the community. The MPO actively supported these progressive policies and continued this overall direction through the staff's participation in the DNRC grant.

Meanwhile, anti-planning sentiment in the community was becoming more organized and vocal. The Missoula County Freeholders, an organization dedicated to maintaining private property rights, was quite vocal. Freeholders frequently expressed opposition to land use regulations at public hearings and in letters to the editor of the Missoulian. The focus of the assault was often the MPO and the Missoula Planning Board.

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<sup>38</sup> Missoula Planning Office, op. cit., footnote 9, p. 1.

This pressure was coupled with changes in the memberships of the City Council and County Commission. The cumulative effect was a greater reluctance on the part of elected officials to encourage additional land use regulations.

It is not possible to provide documentation of lobbying efforts against the proposal, but it was apparent to observers that extensive lobbying took place. Developers, builders, and their associations approached individual elected officials to express opposition to the proposed regulations. Arguments about excessive "up front" costs were intimidating. The "little guy" could not handle these costs, according to opponents of the proposal. Additional delays resulting from unnecessary review would prove fatal to many good development proposals. Without quantitative data to refute these claims, or staff present to clarify issues, the arguments were presumably influential.

Perhaps most important, the energy crisis of 1973 was a decade behind us. The community, and the country, learned to live with higher energy prices. Nothing like the immediate impact of the oil embargo was present to create massive public concern about the issue at hand. The federal funds provided to address energy-efficient development concerns were arriving at precisely the time

that the community's concern about energy was beginning to wane.

The statements of the various Plan Update task forces indicated continued concern. However, this concern was principally addressed through consumers' selections of more efficient cars and other energy-saving commodities. These actions represented a more evolutionary approach to community wide energy conservation than did the adoption of development regulations. Energy-efficient regulations seemed extreme without an immediate energy crisis.

#### Project Accomplishments

Although Missoula County benefitted little from this project, nearly all of DNRC's objectives were met. Not only did the MPO accomplish all the milestones contained in the grant proposal, they accomplished them in a thorough manner that satisfied the grantor. The MPO demonstrated how this type of regulatory approach should be researched and prepared for application in a Montana community.

DNRC subsequently published a document entitled Proposed Energy-Efficient Land Use Regulations for Missoula City and County. The publication contains documentation useful to other communities intending to embark on a similar endeavor.

DNRC cosponsored with the Bonneville Power Administration and the U. S. Department of Energy the "Montana Local Governments Peer Matching Program: Local Governments Sharing Energy Information". The program was designed to get local officials together to exchange information on energy. DNRC would reimburse program participants for travel, meals, and lodging expenses when expertise was exchanged through the program. Conferences with MPO staff regarding energy-efficient planning and zoning techniques were among the items eligible for reimbursement. Perhaps indicative of the waning concern about energy, the MPO received no requests for information through the program by February, 1988.

The MPO's proposal made apparent the obvious ties of energy concerns to traditional planning objectives. Minimizing infrastructure costs associated with development is always an objective of planning. The inability of separate subdivision, zoning, and building review procedures to provide a comprehensive means of development review has long been evident. Bringing energy concerns into the public eye in a manner that corresponded closely with other accepted planning objectives should identify energy-efficient regulations as an aspect of sound comprehensive planning.

## Implications of the Missoula Experience for Other Regulatory Proposals

Several of the lessons learned from Missoula's attempt to adopt energy-efficient development regulations are likely unique to Missoula or are specific to energy concerns. The experience in Missoula still provides some important considerations for those who are creating or revising development regulations.

Proposed regulations should be citizen or commission initiated -- The staff may develop and support proposals, but it is essential that the proposal be initiated and endorsed by private individuals or elected officials. In instances where the matter first comes to the attention of staff, endorsement of the effort or, preferably, sponsorship should be obtained from the appropriate councils or commissions. Such action not only legitimizes the effort, it also provides the staff with an early indication of the ultimate success of the project.

Co-opt the opposition -- The staff should make an effort to identify potential opponents to the proposal and assimilate them into the process. Staff-guided citizen task forces provide an opportunity for participation. Although the final product of such a process may not resemble what the staff had intended, it is better to lose battles than wars.

Quantify arguments whenever possible -- The Missoula proposal was accused of regulation for regulation's sake. Hard data would offset many of the objections raised by the proposal. Data supporting the proposal can also define the scope of the debate, keeping philosophical battles in perspective.

Regulations should be coordinated and comprehensive -- Proposals must be carefully coordinated to avoid conflict or overlap with other agencies and the resultant "turf wars". Regulations affecting a single element of an overall process should be examined to determine whether aspects of other procedural arenas may require modification.

Identify possibilities for incentives -- This approach would allow local government to be viewed as doing it "with us" instead of "to us". Positive local government participation is important in defusing hostile reactions to proposals.

Establish a feasible scope of work and time frame -- Although the proposed regulations were not adopted, the MPO accomplished each of the six milestones in the grant proposal and completed the hearings process within a year of obtaining the grant. It is critical that projects be technically feasible and completed on time.

## Summary

Missoula's participation in the DNRC grant was a worthwhile endeavor. Energy-efficient development techniques from around the country were reviewed for potential application in Missoula County. Project findings are available to developers interested in energy-conserving design techniques.

The effort to compile appropriate techniques resulted in close examination of existing regulations. Long-held assumptions were called into question from a new perspective. Whether assumptions were confirmed, modified or discarded, such examination was a healthy process that otherwise would not have occurred.

The project also revealed the need for a comprehensive approach to land use planning. The fragmentation of subdivision, zoning and building reviews does not encourage, and may even preclude, coordinated development design.

Changes are contemplated. With energy efficiency as the rationale, the Montana Legislature is beginning to provide some building code flexibility in accord with Northwest Power Planning Council objectives. The Environmental Quality Council is conducting an interim study of the subdivision regulation process. Several Montana communities are investigating performance zoning

approaches which would relate zoning requirements to subdivision and building design. Missoula's investigation of energy-efficient development regulations clearly demonstrated the shortcomings of existing procedures by testing them against a specific objective.

Missoula's future attempts at adopting progressive policies will likely achieve a greater degree of coordination as a result of the lessons learned from this project. A greater effort will likely be made to involve all interested agencies and individuals in developing new programs or policies.

In the final analysis, drafting energy-efficient subdivision regulations reminded planners, elected officials and the general public of the need for well-researched, evaluative, comprehensive and coordinated policies to achieve desired objectives. Despite the innovative nature of the proposal, the key issues identified during the Missoula effort are nothing more than fundamental land use planning principles.



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Aspen, Colorado  
Boulder, Colorado  
Dade County, Florida  
Davis, California  
Madison, Wisconsin  
Middlebury, Connecticut  
Port Arthur, Texas  
Sacramento, California  
Schaumburg, Illinois  
Southbury, Connecticut  
Waterbury, Connecticut

## APPENDIX A

### Draft Energy-Efficient Subdivision Regulations

\* \* POLICY CONSIDERATIONS \* \*

These policies are intended only as recommendations or suggestions. Developers, land owners and others are encouraged to review these policies in an attempt to utilize land in the most efficient manner possible. By designing new subdivisions so as to save energy for future residents, all residents of the community should benefit from the money which will then remain in the local economy. These policies are not mandatory and shall not be used alone to deny a potential subdivision. However, when combined with other mandatory standards found in city and/or county subdivision regulations, these policies should be given considerable weight when reviewing new subdivision proposals.

1. Solar Access and Topographic Considerations. When possible, solar access should be maximized by developing generally south and southeast facing slopes. North facing slopes which shade habitable structures and public roadways should be avoided.

2. Solar Access Performance Consideration. Solar access to each potential new structure should be maximized on each lot in every new subdivision. The lot lines of each lot should be oriented to provide solar access at ground level at the southern building line two hours before and after the solar zenith from September 22 to March 21. If

solar access to the southern building line is not feasible, solar access should be provided at ten feet above ground level at the southern building line two hours before and after the solar zenith from September 22 to March 21.

This solar access should be protected by solar height restrictions for the benefit of the lots receiving the solar access and should be filed as part of the subdivision's restrictive covenants.

3. Solar Access Disturbance. Solar access to each potential and existing lot adjacent to the proposed subdivision should be protected through lot orientation and/ or protective covenants.

4. Site Design for Solar Access. All subdivisions should be reviewed by the Planning Office in concert with the Energy Coordinator to insure energy efficient site design and building location. Special care should be taken by the developer to avoid placement of structures in cold air drainages, cold air sinks, and on portions of the subdivision which receive maximum shading on December 20. The subdivision should be designed to promote usable open space which also protects solar access to lots within the subdivision. Covenants for the maintenance of open areas should be included to guarantee that these areas do not become areas of little use due to weeds, garbage, etc.



5. Conservation through the Clustering of Buildings.

Whenever possible, to promote conservation of heating and cooling resources, lots should be designed to encourage clustering of structures. This clustering is intended to maximize the efficient use of heating and cooling sources and to minimize energy losses through exterior surfaces.

6. Solar Access and Street Orientation. Streets should be designed so that 80% or more of the buildings or potential buildings within the subdivision can be oriented with their long axes parallel to 12 degrees south of west.

7. Cost Reductions Regarding the Cutting and Filling of Roadways. Whenever possible, cutting and filling of slopes should be engineered so as to reduce road construction, road width and road maintenance while preserving automobile, bicycle and pedestrian safety.

8. Heating/Cooling Losses and Prevailing Wind Direction. The topographic data required in Section II-A-6 of the Missoula County Subdivision Regulations (Resolution No. 78-68) and in Section II-A-6 of the City of Missoula Subdivision Regulations (Resolution No. 3353) should include prevailing wind directions at 6:00 a.m. and 6:00 p.m. during the heating season. The type and size of existing and proposed non-deciduous vegetation which shades or may shade buildable lots should also be shown.

9. Heat Conservation and Wind Breaks. Vegetative wind breaks should be proposed which minimize energy loss through infiltration. Wind buffers can be supplemented by designing lots that are "off-set" (that do not create corridors which channel wind) or by designing "curvilinear" streets (streets that include curves which help break-up wind corridors).

10. Solar Access and Shadow Patterns for Rural and Non-Conventional Subdivisions. Shadow patterns for all existing and proposed non-deciduous vegetation over ten (10) feet in height and all existing and proposed structures over ten (10) feet in height which shade buildable lots should be drawn as calculated for 10:00 a.m. and 3:00 p.m. on December 20th. Where clusters of vegetation exist, shadow patterns for the clusters should be shown where the shadow falls outside of the cluster.

\* \* STANDARDS \* \*

These standards are mandatory and shall be met by all subdivisions.

A. Solar Access and Septic Drainfields. Whenever possible, drainfields shall be located to the south of structures in order to promote solar access to the structure.

B. Solar Access and Shadow Patterns for Urban Subdivisions. Shadow patterns for all existing and proposed non-deciduous vegetation over ten (10) feet in height and all existing and proposed structures over ten (10) feet in height which shade buildable lots shall be provided with the submittal application. Shadow patterns shall be drawn as calculated for 10:00 a.m. and 3:00 p.m. on December 20th. Where clusters of vegetation exist, shadow patterns for the cluster shall be shown where the shadow falls outside of the cluster.

C. Electrical Savings in Street Lighting. All street lighting required as a condition of approval of the subdivision shall be sodium vapor lighting, or the best available technology, spaced so as to provide maximum coverage with a minimum number of lights.

D. Cost Reductions Through Reduced Roadway Widths. The following roadway widths shall be the maximum permitted for developments intended only for residential purposes:

For cul-de sacs without parking on either side of the street: 20 feet.

For one-way loop streets without parking on either side of the street: 12 feet.

For other standard driving widths, see Section III-A-6 of the Missoula County Subdivision Regulations (Resolution No. 78-68) and Section III-A-6 of the City of Missoula subdivision regulations (Resolution No. 3353).

E. Mass Transit Energy Savings. Any subdivision within one-half mile of the Missoula Urban Transportation District shall petition said district for annexation and all major subdivisions within one-half mile of the District shall provide a bus pull-out as approved by the District.

F. Energy Savings Through the Use of Bicycles. All subdivisions shall be reviewed by the Planning Office and the Missoula Bicycle Coordinator to insure that proper and efficient bicycle transportation is enhanced or promoted. The intent of this review is to insure that potential community-wide bicycle paths are not permanently obstructed, that bicycle safety is not compromised and that long-range planning of bicycle transportation is promoted. It is not the intent of this section to require bicycle paths for every subdivision submitted to the governing agencies for approval.

## APPENDIX B

### City of Missoula Energy-Efficient Subdivision Suggestions

Developers, landowners, and others should review these suggestions on using land as efficiently as possible. Designing subdivisions to save energy should benefit all residents of the community because the result could be more money remaining in the local economy.

These guidelines are not mandatory and will not be used alone to deny a subdivision. However, they will be considered in combination with mandatory standards in city and county subdivision regulations, and may be given considerable weight in reviewing subdivision proposals. The suggestions are reprinted below.

#### CITY OF MISSOULA ENERGY-EFFICIENT SUBDIVISION SUGGESTIONS

1. Solar Access and Topographic Considerations. When possible, solar access should be maximized by developing generally south and southeast facing slopes. North facing slopes which shade habitable structures and public roadways should be avoided.

2. Solar Access Performance Consideration. Solar access to each potential new structure should be maximized on each lot in every new subdivision. The lot lines of each lot should be oriented to provide solar access at ground level at the southern building line two hours before and after the solar zenith from September 22 to March 21. If solar access to the southern building line is not feasible, solar access should be provided at ten feet above ground level at the southern building line two hours

before and after the solar zenith from September 22 to March 21.

This solar access should be protected by solar height restrictions for the benefit of the lots receiving the solar access and should be filed as part of the subdivision's restrictive covenants.

3. Solar Access Disturbance. Solar access to each potential and existing lot adjacent to the proposed subdivision should be protected through lot orientation and/ or protective covenants.

4. Site Design for Solar Access. All subdivisions should be reviewed by the Planning Office in concert with the Energy Coordinator to ensure energy-efficient site design and building location. The developer should identify preferred energy-efficient building sites on each parcel within a subdivision. These sites should maximize protected solar access for each lot, taking into consideration topography, and the location of roads, sewer systems or drainfields, mature vegetation, water supplies, and local meteorology.

Special care should be taken by the developer to avoid placement of structures in cold air drainages, cold air sinks, and on portions of the subdivision which receive maximum shading on December 20. The subdivision should be designed to promote usable open space which also

protects solar access to lots within the subdivision. Covenants for the maintenance of open areas should be included to guarantee that these areas do not become areas of little use due to weeds, garbage, etc.

5. Conservation through the Clustering of Buildings.

Whenever possible, to promote conservation of heating and cooling resources, lots should be designed to encourage clustering of structures. This clustering is intended to maximize the efficient use of heating and cooling sources and to minimize energy losses through exterior surfaces.

6. Solar Access and Street Orientation. Streets should be designed so that 80% or more of the buildings or potential buildings within the subdivision can be oriented with their long axes parallel to 12 degrees south of west.

7. Cost Reductions Regarding the Cutting and Filling of Roadways. Whenever possible, cutting and filling of slopes should be engineered so as to reduce road construction, road width and road maintenance while preserving automobile, bicycle and pedestrian safety.

8. Heating/Cooling Losses and Prevailing Wind Direction.

The topographic data required in Section II-A-6 of the Missoula County Subdivision Regulations (Resolution No. 78-68) and in Section II-A-6 of the City of Missoula Subdivision Regulations (Resolution No. 3353) should include prevailing wind directions for wind speeds greater



than 5 miles per hour during the heating season. The type and size of existing and proposed non-deciduous vegetation which shades or may shade buildable lots should also be shown.

9. Heat Conservation and Wind Breaks. Vegetative wind breaks should be proposed which minimize energy loss through infiltration. Wind buffers can be supplemented by designing lots that are "off-set" (that do not create corridors which channel wind) or by designing "curvilinear" streets (streets that include curves which help break-up wind corridors).

10. Solar Access and Shadow Patterns for Rural and Non-Conventional Subdivisions. Shadow patterns for all existing and proposed non-deciduous vegetation over ten (10) feet in height and all existing and proposed structures over ten (10) feet in height which shade buildable lots should be provided with the submittal application. Shadow patterns should be drawn as calculated for 10:00 a.m. and 3:00 p.m. on December 20th. Where clusters of vegetation exist, shadow patterns for the clusters should be shown where the shadow falls outside of the cluster.

11. Supply of Utility Energy. Where economically feasible, the developer should provide for access to electricity and natural gas on each lot.

12. Electrical Savings in Street Lighting. All street lighting required as a condition of approval of the subdivision shall be sodium vapor lighting, or the best available technology, spaced so as to provide maximum coverage with a minimum number of lights.

13. Mass Transit Energy Savings. Any subdivision within one-half mile of the Missoula Urban Transportation District shall petition said district for annexation and all major subdivisions within one-half mile of the District shall provide a bus pull-out as approved by the District.

14. Energy Savings Through the Use of Bicycles. All subdivisions should be reviewed by the Planning Office and the Missoula Bicycle Coordinator to ensure that proper and efficient bicycle transportation is enhanced or promoted. The intent of this review is to ensure that potential community-wide bicycle paths are not permanently obstructed, that bicycle safety is not compromised and that long-range planning of bicycle transportation is promoted. It is not the intent of this section to require bicycle paths for every subdivision submitted to the governing agencies for approval.