Site Selection and Design for Disaster Housing Group Sites

Supporting Technical Data

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SITE SELECTION AND DESIGN FOR DISASTER HOUSING GROUP SITES

Prepared by

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PREFACE

When a disaster strikes, and families are left homeless, local officials must find immediate shelter for them, usually in schools, armories or other public buildings. If the disaster victims are unable to be relocated quickly to either existing or vacant housing requiring minimal repair, the next step is to furnish them temporary housing as rapidly as possible, in a manner acceptable to the locality and satisfying to the prospective occupants.

The preferred location for this temporary housing is at the site of each family's destroyed or damaged home. However, if this is not appropriate or possible, temporary housing units must be provided at group sites. The technical data contained in this volume, together with the step-by-step procedure portrayed in the complementary Guidebook, is designed to assist local officials and professionals in the development of disaster housing group sites. The Guidebook is an easily referenced source of information for the selection, planning, and development of group sites. The data in this report offers background information, documentation, and additional data on the selection and planning process.

The report starts with a review of legislation and regulations: then discusses existing criteria for selecting, designing and developing temporary group sites; and, provides a guide for site management and maintenance. The use of portable utility systems is covered, and recommended standards for site selection and planning are presented in detail.

Users of both the Guidebook and the Supporting Technical Data should recognize that local conditions, the scope of the disaster, or other circumstances may in some cases take precedence over the information and recommendations contained in these sources.

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ABSTRACT

Technical data on site selection for temporary group housing for families displaced by natural disasters, the design of site plans for this housing and the provision of site amenities and utilities are presented in this report. It is complemented by a Guidebook which covers the essential elements of selecting and planning housing sites for temporary use.

Although existing public and private guidelines for group housing sites contain some useful features, the criteria are often contradictory and difficult to balance among competing needs and requirements. Conflicts arise between the immediate and long-range goals of disaster housing and between human and administrative needs. Practical experience gained in previous disasters, especially Tropical Storm Agnes, can be used to formulate improved standards and guidelines for the future.

Good site design involves all those elements that make a site livable. Since time is critical in the aftermath of a disaster, preplanning is highly desirable. Temporary group sites can be obtained quicker and at lower cost if they are selected before a disaster, by maintaining a master list of potential sites. If sites are selected after a disaster, vacant parcels that are immediately available for temporary use should be sought.

Generally, public land, preferably state-owned property, is easier to obtain than private land. The potential site should be further evaluated by consulting the Site Selection Checklist which presents the criteria needed to determine if a site is acceptable.

Potential sites should be located near the original neighborhoods of displaced families and close to concentrations of jobs and community facilities. Good public transportation should be available; sites with inappropriate adjacent land uses should be avoided.

The site should allow the required number of units and permit the temporary unit to be maneuvered to its location. Sites with problems, such as flood plains, swamps and steep slopes should be avoided. Six to eight units per acre is a desirable density; sites of no more than 25 units each are recommended.

Speed and efficiency are essential in designing disaster housing sites. The planner must understand the unit to be used and how it relates to other units and to the spacing of the units. Criteria of density, privacy and cost-effectiveness have been developed for two prototypical lots for mobile homes, the most suitable form of temporary housing.

Units grouped in clusters of 25 will achieve an efficient and economical plan and a sense of community. Larger clusters are harder to develop, require more amenities, and tend to be monotonous. However, regardless of the size of the site, the suggested densities should be respected. A variety of layouts are shown to help the planner apply the recommended prototypes to actual sites.

Availability of utilities is critical. Existing water and sewer lines are essential for economical development; electric lines are less important. If existing systems are not adequate for the anticipated use, water conservation devices or portable systems should be considered. The key determinants in selecting an appropriate cost-effective portable utility system are the number of units to be served, the period of time the site will be used, and the availability and capacity of existing utilities. Site characteristics such as slope and soil type must also be considered.

Three portable water supply systems are evaluated: central treatment to pipeline distribution, truck transport to individual storage tanks, and truck transport to pipeline distribution. Four portable sewage disposal systems are considered: gravity to actuated sludge treatment, pressurized collection to activated sludge treatment, truck collection to an existing collection system, and septic tanks. Two sets of heating and lighting systems are considered: all electric, or partial electric with propane for heating. Electricity may be generated on site or through connection to an existing grid.

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Part I

Introduction and Summary

In analyzing the way temporary housing should be provided for, victims of natural disasters, issues related to the selection, design, and development of group housing sites for mobile homes are critical. These issues are discussed in Parts II, III and IV. The emphasis is on ways to improve site handling so future disaster housing sites can be chosen and developed with the maximum efficiency and humanity. Specific guidelines and directives are provided. Since the provision of utilities is integrally related to site handling, this subject is included in the discussion.

Part II analyses factors related to selection and design of temporary housing sites, beginning with a review of pertinent legislation.

The federal government's role in relief assistance has increased in recent years, focusing on prompt and effective delivery of relief services and disaster preparedness.

The first comprehensive federal disaster act was enacted in 1950: the federal responsibility for temporary housing assistance began a year later. Two key pieces of legislation were enacted in the 1970s. The intent of the Flood Disaster Protection Act of 1973 was ultimately to eliminate all non-floodproof construction in flood-prone areas; the Disaster Relief Act of 1974 encouraged expanded state and local disaster preparedness planning. But no federal legislation specifically defines temporary group housing, and the lack of guidance on site handling reduces the promptness and quality of disaster relief.

State governments are natural units for directing and coordinating aid. By clarifying and organizing responsibilities for temporary housing, the state can better deliver relief services.

But existing state plans reflect a wide variety of preparedness; the plans reveal almost no appreciation of the potential value of temporary housing for disaster relief. Since such housing is the only effective way to cope with the aftermath of major disasters, state disaster plans must recognize its importance.

Despite the absence of legislative directives, some standards have been developed for the handling of group housing sites. The various public and private guidelines that do exist contain some useful elements, but criteria are often contradictory, and it is difficult to balance conflicting needs and requirements. Conflicts arise between immediate and long-range functions of disaster housing and between human and administrative needs. In the past, existing standards for disaster housing have emphasized the more easily quantifiable aspects of site handling. To compensate, less quantifiable but equally important aspects should be stressed in the future.

Practical experience gained in past disasters can be used to formulate improved standards and guidelines for the future. The most valuable experience is that gained in Tropical Storm Agnes.

The two states affected -- New York and Pennsylvania -- handled the housing mission in markedly different fashion. The consensus is that the New York mission was conducted efficiently, but there was criticism of the mission in Pennsylvania, where problems arose related to the division of responsibility among various agencies and the lack of a single agency to handle all aspects of site development.

Some site selection criteria developed naturally. Availability of utilities and public transportation and proximity to a population center and the victims' former neighborhood were among important criteria in the category of location; site size was the most important physical feature. Group sites should have less than 125 units, and HUD recommends an optimal maximum of 25 units each.

The need for pre-planning is obvious. Without time constraints, conflicting criteria could be better resolved.

Good site design entails planning all those elements that make a site livable. Here again, pre-planning is the best alternative, since time is an essential ingredient.

Designers of Agnes sites received little guidance, and the design process focused mainly on utility layouts. Ideally, the design process would stress a reasonable density and the provision of such amenities as landscaping, recreation areas, buffer spaces, and common facilities. A review of selected disaster sites shows that many of these features have been ignored in the past. This is unfortunate, because good design is needed to produce an efficient, livable site. Its costs are more than justified, especially for long-term sites. It should not be ignored in an effort to induce disaster victims to leave the sites: often victims have no place to go.

Site development is a complicated process, and, in Pennsylvania, was criticized because of the great amount of time involved. Problems with contractors, limitations of the mobile home, and difficulties in determining the number of occupants contributed to the delay.

The standards and experience of commercial mobile home park developers also have some relevance to the requirements of disaster housing. In general, however, the commercial developer is mainly concerned with marketability and profits.

The lack of guidance on tenant services and community facilities for group sites has resulted in wide ranges of quality in temporary housing environments. In determining what services and facilities should be provided, existing standards and past experience should be analyzed as a guide to future decisions.

While several existing studies emphasize making sites as livable as possible through the provision of a wide range of services, such as community centers and garbage collection, the approach in Pennsylvania after Agnes reflected an opposite approach. Since the primary concern was restoring the community to pre-flood conditions, services and amenities were kept to a minimum to discourage feelings of permanency towards mobile home living. Ultimately, services even were curtailed.

HUD's temporary housing program must recognize the need for flexibility in delivering community facilities and services, which should be tailored to the needs of the victim population. Group sites should be located and developed so residents can make maximum use of existing facilities and services. But, although community restoration should be the ultimate goal, residents should not suffer from a lack of services.

Once residents move onto a site, such issues as their response to mobile home living and the management and maintenance of the site become important. An understanding of the makeup of the site population is essential in determining what community facilities should be provided. The poor and the old require particular consideration in the preparation of group sites, and facilities tailored to their specific needs should be made available.

The reactions of occupants to temporary group housing can be useful in identifying the limitations and problems of this type of relief and can help improve the design and development of future sites. One study shows that more site residents were pleased with mobile home living than displeased with it: while the lack of interior space was criticized, occupants praised the unit's convenience. Occupants did, however, suggest changes to make the unit sturdier and roomier.

An understanding of management and maintenance problems associated with disaster housing can be useful in evaluating the handling of future sites. An efficient, centralized management system is essential, and, after a large disaster especially, a sophisticated maintenance system is needed.

It is sometimes impossible to locate disaster sites near existing utilities. Therefore, alternative or portable systems must be used. Part III analyzes the effectiveness of various systems and indicates which systems are appropriate under what conditions.

To select an appropriate system, it is necessary to know the number of units to be served, the period of time the site will be in operation, and the availability and capacity of existing utilities. Site characteristics such as slope and soil type also must be investigated. A system should be chosen on the basis of its cost-effectiveness, which is calculated in terms of dollars per household or dollars per thousand gallons of water.

Three portable water supply systems are evaluated.

- Central treatment to pipeline distribution. This system makes use of an on-site or nearby raw water source. Water is processed in a central treatment plant, stored in an on-site tank, and distributed to individual units through a pressurized pipeline. It is cost-effective for all sites, except short-term ones in which water conservation devices are used.

- Truck transport to individual storage tanks. In this system portable water is trucked to storage tanks at individual units. This system is cost-effective only for short-term sites of less than 50 units, short-term sites of more than 50 units with water consumption devices, or under special conditions.

- Truck transport to pipeline distribution. In this system, potable water is trucked to an on-site storage tank, then distributed to individual units through a pressurized pipeline. It is never cost-effective and should be used only as a temporary measure until an on-site treatment plant can be installed.

Four portable sewage disposal systems are evaluated.

- Gravity collection to activated sludge treatment. In this system sewage is collected through an underground pipeline network by gravity flow, then deposited at an on-site or nearby activated sludge treatment plant. This system is recommended for large or long-term sites with sufficient slope and no sub-surface impediments.

- Pressurized collection to activated sludge treatment. In this system underground pressurized pipes collect sewage and carry it to an activated sludge treatment plant. Its per-unit cost is lower than that of the gravity system, but it is less reliable.

- Truck collection to an existing sewer collection system. In this system, sewage storage tanks are located at each unit, and sewage is trucked to an existing sewage collection system. This system is appropriate only for sites of 100 units or less, for short periods, and under highly unusual conditions.

- Septic tanks. This system is cost-effective only for long-term sites. It is recommended for all site sizes if water conservation devices are used.

In the evaluation of gas and electric systems, two sets of alternatives are considered: all-electric versus partial-electric systems, and on-site electrical generators versus connection to an existing grid.

In the all-electric system, electricity supplies energy for all uses. In the partial-electric system, electricity supplies energy for all uses except heating, for which propane is recommended. For a short-term site, the two systems are nearly identical in cost. Since the all-electric system is much simpler, it is preferable. For a long-term site, the all-electric system costs about 20% more than the partial-electric system.

The alternatives of on-site generation versus purchased power are discussed because power may not be available near the site. The convenience and reliability involved in purchasing power should be considered in making a selection. Small, short-term sites should be close to an existing power grid to make this alternative economical.

Part IV offers guidelines to help officials select, design, and develop sites quickly and efficiently. Currently, there are no guidelines to assist officials with these tasks. Poor planning can cause serious delays. Use of these guidelines will expedite the evaluation and selection process.

It is much easier to obtain sites rapidly and cheaply if they are selected before a disaster, by maintaining a master list of potential sites.

If sites are selected after a disaster, the planner should compile a list of vacant parcels and determine whether their temporary use can be negotiated. Public land generally can be obtained more easily than private land; and, of public land, state-owned parcels are preferable to federal or municipal property.

The list of potential sites should be further refined by consulting the Site Selection Checklist. The checklist should be followed as closely as possible, for it contains all criteria needed to determine if a site is acceptable.

Potential sites should be located near the victims' original neighborhood and close to concentrations of jobs and community facilities. Good public transportation should be available, and inappropriate adjacent land uses should be avoided.

The site should allow the required number of units and the maneuvering of mobile homes. Such site problems as flood plains, swamps, and steep slopes should be avoided. Six to eight units per acre is a desirable density, and sites of 25 units each are recommended.

Availability of utilities is critical. Existing water and sewer lines are essential for economic development; electric lines are less important. If existing systems aren't adequate for the anticipated use, water conservation devices or portable systems should be considered.

Speed and efficiency are essential in designing disaster housing sites. The planner must understand the unit to be used and how it relates to other units and to spaces between units. Two prototypical lots have been developed which meet the criteria of density, privacy, and cost-effectiveness.

In each of the two prototype layouts, units are placed two abreast, 30 feet apart, and are provided with a double-loaded utility line and a perimeter access road. In prototype A, units are placed parallel to the contours of the site; in prototype B they are placed at a 45 degree angle to the contours, thus allowing greater flexibility in designing layouts.

Units grouped in clusters of 25 will achieve an efficient and economical plan and a sense of community. Larger clusters are harder to develop, require more amenities, and tend to be monotonous. However, regardless of the site size, the suggested density levels should not be altered; undeveloped areas can be used for open space.

A variety of layouts are shown to help the planner apply the recommended prototypes to an actual site. Plans are evaluated in terms of their relative advantages and cost-effectiveness.

Once a site is chosen, the following steps should be followed for overall site design: all physical features should be identified; the required number of lots should be laid out and the placement of mobile homes on them shown, using the suggested lot prototypes; utility lines and on-site roads should be plotted; community space should be designated; and certain amenities should be provided, such as parking areas, walkways, outdoor play areas, and storage space. Portable life support systems should be provided if existing systems are unavailable; exterior lighting and a storm drainage system should be provided.

Part II

Analysis of Factors Related to Site Selection and Design of Temporary Emergency Housing

A. FEDERAL AND STATE LEGISLATION, REGULATIONS AND GUIDELINES FOR TEMPORARY HOUSING SITES

1. FEDERAL DISASTER ASSISTANCE LEGISLATION AND ITS IMPLICATIONS FOR TEMPORARY GROUP SITE HOUSING

a. The Role of the Federal Government

The federal government's attitude toward disaster relief and preparedness is reflected in the legislative history of federal disaster assistance. The increasing damage caused by natural disasters and the inability of state and local governments to respond to these disasters led the federal government to become more involved in relief assistance. During the last two decades, federal assistance has focused on ensuring prompt, effective delivery of relief services in federally declared disasters. More recently, federal policy has broadened to include mitigating the effects of disasters. Federal legislation is the basic source of relief assistance and incentives for relief operations available to state and local government.

The federal government has the authority and resources to encourage and enhance delivery of disaster relief services. The varying capabilities of the states and their localities, combined with the widespread nature of many disasters, require federal intervention to equalize the distribution of benefits. National legislation can also enforce minimum standards for relief and disaster preparedness.

b. Pre-1950 Federal Disaster Legislation

As early as 1803, the federal government provided disaster relief assistance. From 1803 to 1947 Congress passed more than 100 separate disaster assistance acts providing supplemental aid to localities. But none of these acts represented a continuous source of federal assistance. Instead, they provided short-term relief to single locales in response to specific situations.

In 1947 Congress recognized the need for a national disaster assistance law. Public Law 80-233 made surplus federal property available to state and local governments for post-disaster relief needs, but the law did not provide general appropriations for relief activities.

c. Disaster Act of 1950 (PL 81-875) and Amendments

The declining stock of surplus federal property, the lack of funds under PL 80-233, and the increasing need for federal assistance led to enactment of the first comprehensive federal disaster act in 1950. Public Law 81-875 empowered the President to aid local governments affected by a major disaster. Relief efforts emphasized restoration and repair of public facilities.

A year later the Congress amended the Disaster Act of 1950, easing credit restrictions under the National Housing Act and authorizing delivery of emergency housing services to displaced persons. This law, PL 82-107, began the federal responsibility for temporary housing assistance. The federal government was authorized to provide

> temporary housing or other emergency shelter for families, who as a result of such major disaster, require temporary housing or other emergency shelter.

The Act did not define the type of housing to be provided, state how long it would be provided, or offer formulas for sharing its costs.

Executive Order 10427 of 1953 transferred the administration of PL 81-875 to the Federal Civil Defense Administration (FCDA). The FCDA would direct and coordinate federal disaster relief efforts, foster state and local disaster planning, and evaluate relief activities.

In 1953, Public Law 83-134 further amended PL 81-875, making surplus federal property available to states and localities for repairing damaged public facilities. In addition, federal resources could be used to rehabilitate individual properties.

Executive Order 10737 of 1957 established qualifications for states applying for federal assistance. The order clarified the type of assistance provided under PL 81-875 and set forth guidelines for granting aid. In 1958 Executive Order 10773 transferred the disaster relief activities of the FCDA to the new office of Defense and Civilian Mobilization (later named the Office of Civil and Defense Mobilization [OCDM] and ultimately designated the Office of Emergency Planning [OEP]).

Public Law 87-502, passed in 1962, enlarged the coverage of PL 81-875 to the entire United States and its possessions and extended provisions covering the repair and replacement of public facilities to state-owned facilities.

Public Law 89-769 (1966) extended the eligibility for federal disaster relief assistance to rural communities and unincorporated towns and villages. The OEP was also authorized to plan and coordinate all federal disaster assistance and made responsible for liaison with states and localities.

d. Special Federal Disaster Assistance Legislation

The government also has provided assistance to specific areas suffering from individual disasters.

These acts extended increased federal assistance to designated areas for limited periods.

Public Law 88-451, passed in 1964, expanded federal expenditures under the Alaska Omnibus Act to provide for the reconstruction of earthquake-damaged facilities. It increased federal contributions for highway construction, urban renewal projects and other public facilities. The Small Business Administration was authorized to grant 30-year loans to repair and replace individual homes.

The Pacific Northwest Relief Act of 1965, (PL 89-41) passed in response to extensive flood damage in this region, provided funds to repair and rebuild damaged highways.

Public Law 89-339, the Southeast Hurricane Disaster Relief Act of 1965, authorized the sale of federally provided mobile homes to certain disaster victims. This act also contained the first federal loan forgiveness provision.

e. Disaster Relief Act of 1969 (PL 91-79)

Public Law 91-79 was passed in response to heavy damage in the Gulf Coast states in 1969 and temporarily increased federal assistance to these areas. Aid was provided to repair and rebuild non-federal roadways; develop state disaster assistance plans; and replace or repair private property.

PL 91-79 was the first federal legislation containing a detailed description of temporary housing assistance. Temporary housing was defined to include: (1) unoccupied housing owned by the federal government; (2) unoccupied public housing; (3) leased private dwellings; and (4) leased mobile homes or other readily fabricated units.

Mobile homes or other fabricated units were to be placed on sites provided by state or local governments or by the owner-occupant, with no site charges to the federal government.

Rentals for temporary units were set according to the occupants'financial status. In certain cases, rentals could be adjusted or waived for up to 12 months and rentals could not exceed 25% of family income.

f. Disaster Relief Act of 1970 (PL 91-606) and Amendents

The Disaster Relief Act of 1970 was designed to provide a systematic, ongoing means of relief assistance to state and local governments. It revised, consolidated and broadened existing programs and improved federal cooperation and responsiveness. Importantly, the act enabled federal resources to be used to lessen the impact of disasters before they occurred. The act also significantly changed national policy by placing greater emphasis on the needs of victims.

Many provisions of PL 91-79 regarding temporary shelter were continued in PL 91-606. However, no rentals were to be charged for the first 12 months of occupancy. Thereafter, fair market rentals were to be established, geared to the tenant's financial ability. Federally acquired housing could be sold to its occupants. If mobile homes or other fabricated units were used, the state or local government or owner or occupant had to provide the site and utilities. However, other more accessible and economical sites could be provided at federal expense.

After Hurricane Agnes caused severe damage in 1972, Public Law 92-385 was passed. It authorized additional loan assistance under the Small Business Administration for refinancing of mortgages for disaster-damaged properties, and extension of loans to homeowners and small businesses to replace or repair structures. A review of existing disaster legislation was authorized to standardize benefits to victims, improve government response to individual needs, and prevent misuse of aid.

g. Flood Disaster Protection Act of 1973 (PL 93-234)

The Flood Disaster Protection Act of 1973 is a key link in federal efforts to encourage local governments to undertake activities which would mitigate the effects of disasters. Through Public Law 93-234, Congress recognized the need for ultimately eliminating non-flood-proof construction in flood-prone areas. By July, 1975, all communities with flood-prone areas must have adopted appropriate land use, development, and flood controls. Communities must either prohibit development and reconstruction in areas below 100-year-flood levels or require flood-proof construction. Without such controls, no federally regulated financial institution can provide a construction loan or mortgage on properties. Non-compliance may also affect eligibility for federal disaster relief.

The Flood Disaster Protection Act of 1973 expanded the national flood insurance program in two ways: (1) it substantially increased the limits of coverage and the total amount of authorized insurance, and (2) it required known flood-prone communities to participate in the program. The law required states and local governments to participate in the program and adopt adequate flood plain ordinances that would reduce or avoid future flood losses. Property owners buying land or improving land or structures within flood-prone areas must purchase flood insurance. Failure to comply with these regulations will result in loss of federal financial assistance and the loss of mortgages and loans made by federally regulated institutions.

h. Disaster Relief Act of 1974 (PL 93-288)

Public Law 93-288 (the Disaster Relief Act of 1974) encourages expanded state and local disaster preparedness planning. The law places greater emphasis upon individual, state, and local protection through expanded insurance coverage, better land use planning, and improved construction regulations. The law also provides for better long-range economic recovery programs for major disaster areas.

The provision of temporary housing assistance under PL 93-288 differs little from that in the 1969 and

1970 acts.

In general, provision of the site and utilities for temporary dwellings is to be handled by the state, locality, or occupant, without charge to the federal government, although other sites may be provided at federal expense if it seems appropriate.

PL 93-288 also permits temporary housing acquired by the federal government to be sold to the occupants of the unit or made available to a government or voluntary agency to temporarily house disaster victims. The effectiveness of the experimental mini-repair program after Tropical Storm Agnes led to incorporation of this assistance in the Disaster Relief Act of 1974. Under this measure, relief applicants may have their damaged house repaired if the unit can be restored easily.

i. Implications of Federal Legislation for Temporary Group Site Housing

Federal legislation does not explicitly define group site accommodations. Even PL 93-288, the most comprehensive disaster relief act, does not specifically mention temporary group site housing as a relief resource. In fact, few legislative changes affecting temporary housing have been made since the Disaster Relief Act of 1969 enabled this form of assistance.

HUD-FDAA regulations offer the only guidelines for the selection, design, and development of temporary group sites. According to the regulations accompanying the Disaster Relief Act of 1974, sites should be a reasonable commute from the occupant's former home. Distance to shopping or community facilities is not mentioned, nor are guidelines offered for the size, configuration, design, or development of sites.

The 1974 act does not assign specific responsibility for selecting and financing sites, but says these activities will be handled by state or local governments or the occupant.

The intensity of a disaster, its effect upon the local housing supply, and available resources are important factors in determining who should select sites and finance their acquisition and development. Because these factors vary from disaster to disaster, flexibility is necessary in assigning these responsibilities. Although the 1974 Act acknowledges the need for flexibility, it does not indicate the circumstances under which these costs should be borne by different governmental levels.

Under some conditions the federal government is authorized to select and provide utilities for sites, but the Act fails to describe these conditions, saying that such actions are authorized only if they are within the public interest.

Selection of sites before a disaster and their subsequent deactivation and re-use are not considered in the legislation and regulations. The lack of guidance on the design, development, and selection of sites reduces the promptness and quality of disaster relief.

2. STATE DISASTER ASSISTANCE PLANS AND THEIR IMPLICATIONS FOR TEMPORARY GROUP HOUSING

a. The Role of State Disaster Assistance Planning

Local governments have been unable to mobilize the services, organization, and material needed for disaster assistance. But state governments, with their superior resources, organization, and scope, are natural units for directing and coordinating federal disaster assistance.

Delivery of temporary housing assistance is complex and it can take up to eight weeks to provide such shelter. Problems related to assessment of housing needs and the design and preparation of sites underscore the need for better planning and coordination. Several key aspects of temporary housing relief are not clearly delegated to other levels of government. Also, while certain responsibilities traditionally have been within local control, community resources vary widely. By clarifying and organizing responsibilities for temporary housing, the state can improve the delivery of relief services, eliminate uncertainty, and hold down costs.

b. <u>The Influence of Federal Legislation Upon State Disaster Assistance Plans</u>

The history of federal disaster legislation shows that federal assistance is designed to supplement state and local efforts. However, since disaster-stricken states have been unable to mobilize adequate resources, increased federal assistance has become necessary. To encourage prompt delivery of relief services and spur preparedness planning, federal legislation has included incentives for the development of state disaster assistance plans.

The initial federal attempt to encourage an improved response by states and localities was embodied in Executive Order 10427 in 1953. This order directed the Federal Civil Defense Administration under PL 81-875 to foster state and local organizations charged with planning disaster relief. However, no funds were provided to do this.

Public Law 91-79 of 1969 provided for the first major allocation of federal funds to states for developing comprehensive plans for disaster assistance. Up to $250,000 was available to any state; the money could be used to pay up to half the cost of plans.

The law required the creation of state agencies to plan and administer disaster relief programs and appointment of state coordinating officers to direct relief efforts.

When PL 91-906 replaced PL 91-79 in 1970, the thrust of state disaster plans was modified to include lessening the effects of major disasters as well as providing individual relief and long-range recovery.

Grant limits on a matching fund basis remained at $250,000. However, states could obtain up to $25,000 on a matching basis to improve and maintain disaster assistance plans.

The Disaster Relief Act of 1974 continues the emphasis upon recovery and relief efforts in state disaster plans and expands the state's role in planning. The enlarged state role is carried out through outright grants of up to $250,000 to develop state plans, grants which reflect the federal desire for a greater state role in disaster preparedness. The awarding of grants on a matching fund basis for revising and improving state plans is continued.

c. <u>An Overview of State Disaster Assistance Plans</u>

Eighteen states provided information on disaster plans, but only nine states sent copies of their current related documents: California, Florida, Hawaii, Iowa, Massachusetts, Nevada, Rhode Island, Texas, and Virginia. (Table 1)

The documents represent varied orientations to emergency situations. Some plans are specifically directed toward natural disasters, while others stress nuclear attack or similar emergencies. Some plans merely supplement existing civil defense plans. Nevertheless, plans and organizations established as a result of the federal legislation can provide improved state mechanisms to respond to disasters.

Planning assistance available under PL 91-79 and PL 91-606 appears to have had limited appeal. Of the 24 states and territories which applied for federal funds by July 31, 1973, only California spent the maximum $250,000. Maryland applied for only $15,000. Several key disaster-prone states, such as Florida and Mississippi, have not yet prepared plans. More states will be encouraged to develop disaster relief plans if the matching funds requirement is dropped.

d. <u>The Provision of Temporary Housing</u>

The state plans reflect a lack of emphasis upon temporary housing as a relief resource. Most state plans do not even refer to temporary group site accommodations. This gap probably results from inexperience with such housing and unwillingness to anticipate a need for it. However, as recent experience in Pennsylvania and New York shows, such needs cannot be predicted. As Table 2 shows, only plans by California, Hawaii, Nevada, and Virginia contain significant reference to temporary shelter. The plans of Massachusetts, Florida, and Rhode Island reflect a primary concern with nuclear attack. The Texas plan merely says the governor may provide temporary housing. Iowa's plan does not mention temporary housing.

The plans give much greater emphasis to mass shelter, emergency housing, and other short-term accommodations. Although many of the plans refer to PL 91-606 as one of the laws from which they draw their authority, few even define temporary housing as described by the Act.

e. <u>The State Agency/Unit of Government Delegated Responsibility for Temporary Housing</u>

Responsibility for directing temporary housing assistance varies from state to state. Most plans do not delegate this power to a single state agency, implying that local government is responsible. State plans with significant discussions of temporary housing assistance invest state agencies with supervisory controls, thus enabling coordination of local efforts and better interaction with federal officials.

The California Emergency Plan provides the most detailed division of the responsibilities for temporary housing. The state Department of Housing and Community Development (HCD) acts as coordinating agency between city and county housing authorities, state agencies, and the federal government. HCD is responsible for evaluating local needs and submitting requests to HUD for temporary housing. HCD also must determine the availability of temporary housing from mobile home manufacturers and dealers and arrange for site preparation and other related facilities with private construction firms.

TABLE 1 - STATES RESPONDING TO REQUEST FOR DISASTER PLANNING RESOURCES

STATE	PROVIDED COPY OF STATE PLAN	DATE OF CURRENT PLAN	PRESENTLY REVISING PLAN	STATE LEGISLATION PERTAINING TO TEMPORARY HOUSING	EXPERIENCE WITH TEMPORARY HSG. ON GROUP SITES
California	Yes	1972	Yes	None	Yes
Colorado	No	1970	Yes	None	No
Florida	Yes	1971		None	No
Georgia	No			None	Yes
Hawaii	Yes	1971		None	No
Iowa	Yes	1972	No	None	Yes
Maryland	No	1970	Yes	None	Yes
Massachusett	Yes	1967		None	No
Missouri	No	1967	Yes	None	Yes
Nevada	Yes	1971		None	No
New Mexico	No	Initial plan being developed		None	Yes
New York	No			?	Yes
Pennsylvania	No			?	Yes
Rhode Island	Yes	1973		None	No
Texas	Yes	1974	Yes	None	Yes
Virginia	Yes	1972	Yes	None	Yes
West Virginia	No	1966		None	Yes
Wisconsin	No			None	No

TABLE 2

SUMMARY ANALYSIS OF STATE DISASTER PLANS AS THEY PERTAIN TO TEMPORARY HOUSING

STATE	PLAN REVIEWED	YEAR OF PLAN	INFORMATION PROVIDED ON TEMPORARY HOUSING	SPECIFIC MENTION OF TEMPORARY GROUP SITES	SITE SELECTION, DESIGN, DEVELOPMENT CRITERIA FOR TEMPORARY GROUP HOUSING SITES ENUMERATED	STATE AGENCY/UNIT OF GOVT. RESPONSIBLE FOR TEMPORARY HOUSING	PROVISION FOR PRESELECTED TEMPORARY GROUP HOUSING SITES
California	Yes	1972	Yes	Yes	No	Dept. of Housing and Community Development, Coordinator	No
Florida	Yes	1971	No	No	No	Responsibility not Delegated	No
Hawaii	Yes	1971	Yes	No	No	Dept. of Social Services, Hawaii Housing Authority	No
Iowa	Yes	1972	No	No	No	Responsibility not Delegated	No
Maryland	No	1970	No	No	No		No
Massachusetts	Yes	1967	No	No	No	Responsibility not Delegated	No
Missouri	No	1967	No	No	No		No
Nevada	Yes	1971	Yes	Yes	No	County	Yes
Rhode Island	Yes	1973	No	No	No	Responsibility not Delegated	No
Texas	Yes	1972	Yes	No	No	Responsibility not Delegated	No
Virginia	Yes	1974	Yes	Yes	No	Division of State Planning and Community Affairs	No
West Virginia	No	1966	No	No	No	Responsibility not Delegated	No

The state Departments of Real Estate and General Services provide assistance if temporary housing is needed. The Department of Real Estate is to compile a list of vacant sites available for temporary units. The Department of General Services must maintain an inventory of stockpiled, prefabricated housing available in case of emergency. Information concerning local housing needs is provided by city and county housing authorities and building inspection departments. The plan requires these agencies to prepare individual plans for assessing housing damage, locating temporary facilities, identifying vacant land for emergency housing, and coordinating housing and financial assistance of various agencies.

Hawaii's plan gives primary responsibility for disaster response to county governments. The state Department of Social Services and Housing provides additional resources and supervises coordination between HUD and local governments.

Nevada's Emergency Operations Plan makes counties responsible for drawing up detailed housing plans. State resources supplement local efforts, but no specific state agency is designated to coordinate local and federal efforts.

Virginia's Disaster Assistance Relief Plan delegates responsibility for temporary housing to the Division of State Planning and Community Affairs (DSPCA) in coordination with local and federal officials. If a major disaster is declared, this agency is to provide information to federal officials so they can assess housing needs. The DSPCA must determine what kind of temporary housing is needed and arrange for its location. Local governments are to provide temporary housing sites unless the federal government considers other sites more appropriate. The DSPCA is authorized to prepare a detailed plan for the delivery of temporary housing to displaced persons. This plan, however, has not yet been developed.

The plans of Florida, Iowa, Massachusetts, Rhode

Island, and Texas do not delegate specific responsibility for temporary housing to any agency. These plans describe only broad agency responsibilities, implying that local governments bear primary responsibility.

f. Explicit Criteria for the Selection, Design and Development of Temporary Group Housing Sites

None of the state plans reviewed provides any explicit criteria or guidelines for the selection, design, and development of temporary group housing sites.

g. Financing Temporary Group Housing

State plans also contain little information regarding the financing of temporary housing. PL 91-606, the federal legislation under which most plans were developed, assigns the cost of providing individual mobile homes or other similar dwellings to the federal government. The responsibility for furnishing the site and utilities is assigned to the occupant or owner of the site or to the appropriate local government. If the use of other sites is determined to be in the public interest, the federal government will furnish them. Responsibility for providing roadways and other public facilities for group sites is not specified. The plans of California, Hawaii, Nevada, and Virginia incorporate these provisions; the other state plans reviewed do not even go this far.

h. Deactivation and Reuse of Temporary Group Housing Sites

None of the state plans refers to the deactivation or reuse of temporary group housing sites.

i. Pre-Disaster Selection of Temporary Group Housing Sites

Of the plans reviewed, only Nevada's mentions preselection of sites for temporary group housing. This plan provides for one large, minimally developed site for group development in each county. Most sites selected under this plan are now devoted to such non-intensive, open uses as an auto speedway, fair grounds, and athletic field.

j. Conclusions

Review of the nine current state plans reflects a wide range of preparedness. A state's ability to react to a disaster quickly and efficiently reflects, in part, the quality of its planning. The plans reviewed reveal almost no appreciation of the potential value of temporary housing for disaster relief. This omission may have adverse impact on effective response.

The use of group site housing is frequently regarded as a last resort. Past experience has revealed that temporary group development has some disadvantages. However, this type of shelter is the only effective way to temporarily cope with disasters which seriously impair an area's housing supply. State disaster assistance plans must recognize the value of such housing and make sure it is provided. Uncertainty concerning responsibility for selection, design, and development of group sites indicates the need for state intervention. If the plans reviewed indicate the current state of the art, it is necessary to compensate for the inadequacies associated with temporary housing. Funds for state disaster preparedness planning to be provided under the Disaster Relief Act of 1974 may help. For example, through dissemination of sample disaster preparedness plans to states applying for federal assistance, greater interstate consistency in disaster response could be provided. Sample plans should include guidelines for delegating responsibilities for temporary housing, cost-sharing formulas, and deactivation and reuse of group sites.

Site selection, design, and development of temporary group housing is usually considered a state and local responsibility. Unfortunately, these governments rarely have had experience in providing disaster relief. As a result, response time has been poor, and those needing assistance have not been helped quickly.

B. SITE SELECTION, DESIGN AND DEVELOPMENT CRITERIA FOR TEMPORARY GROUP SITES

1. ANALYSIS AND REVIEW OF EXISTING STANDARDS AND PRACTICES

a. Introduction

This section will discuss existing standards for the selection, design, and development of sites for group housing and will examine ways to reconcile and improve upon these criteria. Sources examined include the temporary housing experience gained by HUD, and state and local agencies and the experience of commercial mobile home developers.

One problem is balancing conflicting needs and requirements. The criteria used in site selection, for instance, often are contradictory. One parcel of land may have some desirable features and others that should be avoided, while another parcel may have a different combination of good and bad features. The relative merits of the two sites would have to be evaluated.

Other areas of conflict are between immediate and long-range functions of disaster housing and between administrative and human needs. On one hand, it is important to get the site in operation as soon as possible, to keep costs down, to relocate occupants into permanent housing rapidly, and to restore the site to its original condition quickly and easily.

On the other hand, since most victims will be living in group sites for several months, decent living conditions must be provided. Also, victims already have suffered a severe trauma: many have lost their homes and possessions. Their psychological problems should be understood and allowed for -- and certainly not exacerbated.

Thus a disaster relief program cannot be viewed merely in terms of cost-effectiveness. It involves values that sometimes cannot be translated in terms of cost. In planning and developing sites, basic human needs should be met even if it costs a little more, makes occupants less eager to leave the site, or makes it somewhat harder to restore the site to its former condition. To do this requires amenities which are neither luxuries nor frills, but essential ingredients for human life.

Past experience with disaster housing and existing standards tend to emphasize the more easily quantifiable aspects of site handling. This is understandable; however, to compensate, less quantifiable but equally important aspects should also be emphasized.

b. Existing Guidelines

(1) Introduction

Development of guidelines for disaster housing has lagged behind increased federal involvement in disaster relief. However, as Wilkes-Barre, Pa. Congressman Daniel Flood said, after 200 years of natural disasters in this county, it is ridiculous to regard them as unpredictable and handle each one on an *ad hoc* basis.*

While it is impossible to predict when and where a disaster will strike, it is possible to look at past records and predict statistically how many and what kind of disasters may occur. Furthermore, the need for disaster housing is frequent enough to require more than an *ad hoc* approach.

*U.S. Senate Subcommittee on Disaster Relief, "Hearings to Investigate the Adequacy and Effectiveness of Federal Disaster Relief Legislation," Part 3 (Wilkes-Barre, Pa., May 11 and 12, 1973), U.S. Gov't. Printing Office, Washington, D.C., 1973, p. 903.

As the research team has estimated* HUD can expect to receive requests to supply temporary mobile homes to 62,000 families during the next 10 years. Among all disasters, hurricanes and tropical storms generate the heaviest temporary use of mobile homes.**

Between 1969 and 1973, there were three such storms for which HUD supplied over 25,000 mobile homes. Over the next decade there could be 14 hurricanes and tropical storms requiring more than 45,000 units.

A December 1972 report to Congress on the federal disaster program indicates that previous projections of disaster housing needs may have been too low. It notes that hurricanes and floods are by far the most frequent types of disasters, and that disaster tolls are rising sharply because of unwise building practices in flood-prone areas. For this reason, it suggests that even more disaster assistance may be required in the future.***

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* Abeles, Schwartz and Associates/Beyer-Blinder-Belle, Cost-Effective Housing Systems for Disaster Relief, Vol. 3, U.S. Dept. of Housing and Urban Development, Washington, D.C., 1974, Table 11, p. 88. This figure refers to imported housing, rather than existing dwellings that may also be used on a temporary basis.

** Ibid., Vol. 2, p. 2.

***The Federal Disaster Program: A Comprehensive Review, A Report to Congress submitted by OEP Director G.A. Lincoln and OMB Deputy Director Frank Carlucci, Co-chairmen of the Interagency PL 92-385 Disaster Study Task Force, December 29, 1972, p. 5.

However, one aim of the Flood Disaster Protection Act of 1973 (PL93-234) and the Disaster Relief Act of 1974 (PL93-288) was to stem this trend by encouraging better land use.

Another aim of PL 93-288 was to encourage state and local governments to develop disaster contingency plans. However, only four states have developed plans containing any significant reference to temporary disaster housing, and these plans simply define who is responsible for various aspects of a temporary housing program. None provides detailed criteria or guidelines for site selection or development.

Thus, governmental guidelines for housing sites exist only at the federal level. The following sections discuss these guidelines along with existing commercial standards.

The earliest federal guidelines for group sites were developed by HUD after Hurricane Camille (1969) and Tropical Storm Agnes (1972). HUD's Agnes-related Pennsylvania Housing Recovery Office compiled a preliminary draft of "Mobile Home Installation Requirements," and the main HUD office is preparing a mobile home/travel trailer handbook for use in disaster missions.

The Susquehanna District of the U.S. Army Corps of Engineers, which supervised the Agnes site work in Pennsylvania, produced a "Proposed Standard Specification for Emergency Mobile Home Site Development."*

HUD also developed a handbook setting forth required standards for commercial developers, entitled "Minimum Design Standards for Mobile Home Parks."

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*Published as Appendix A to the Supplement of Tropical Storm Agnes: Operation Noah II, An After-Action Report, Harrisburg, Pa., Dec. 1972.

Another handbook, the "Environmental Health Guide for Mobile Home Communities," was developed by the U.S. Public Health Service (PHS) of the Department of Health, Education and Welfare at the request of the Mobile Homes Manufacturers Association (MHMA). The impetus was the booming sales of mobile homes and the trend toward using them as permanent dwellings. The first edition appeared in 1966; revised editions were issued in 1968 and 1971. Its aim was to help minimize or eliminate health and safety hazards in mobile home developments.*

MHMA also publishes the "Standard for Mobile Home Parks" in conjunction with the National Fire Protection Association (NFPA), the Trailer Coach Association, and the American National Standards Institute (ANSI). This booklet is known both as ANSI A177.1 and as NFPA No. 501 A. First issued in 1939, it has been revised frequently.

Table 3 summarizes the most important quantifiable design standards set forth in each set of guidelines. Other aspects are summarized below, followed by a comparison of the various guidelines.

(2) Pennsylvania HUD Mobile Home Installation Requirements

This design guide was drafted by the Engineering Branch of the Management Planning Division of HUD's Pennsylvania Housing Recovery Office in May 1973. It carries the identification number MD-32-4. The intent was to use the experience gained in setting up sites in Pennsylvania after Agnes by describing problems that occurred, with instructions on avoiding them.

*U.S. Public Health Service, Department of Health, Education and Welfare, Environmental Health Guide for Mobile Home Communities, Mobile Homes Manufacturers Association, Chicago, Ill., 1971.

TABLE 3

DESIGN STANDARDS FOR MOBILE HOME DEVELOPMENTS

Dimensional Requirements	ANSI A177.1 by Mobile Home Manufacturers Association (MHMA) et al.	Public Health Service, U.S. Dept. of Health, Education and Welfare Recommended Ordinance Published by MHMA	Susquehanna Dist., U.S. Army Corps of Engineers Proposed Standard Specification	U.S. Department of Housing & Urban Development (HUD) Minimum Design Standards*	HUD/EPS Mobile Home/Travel Trailer Handbook (Draft Copy)**	HUD's Pennsylvania Housing Recovery Office, Management Planning Division, "Requirements for Emergency Housing Mobile Home Group Sites" MD-32-4 (Preliminary Copy)
Setbacks for units and general area requirements	25' from property line or public street 10' from another unit (occupied area shall not exceed 75% of lot area)	25' from property line or public street 10' from other boundary lines of development 10' from another unit 10' from abutting street (minimum recommendation of 2800 sq.ft./lot with 300 sq.ft. for outdoor living) (mobile home shall not exceed 1/3 of lot area)	25' front yard 11' side yard 15' rear yard 15' side yard at corner	15' from property or public street (fence if public arterial street or non-residential use) 8' from street or common parking or common sidewalk 20' from another unit (4' + 10% of unit length x 2) Alternate: allow 6' minimum but site width same as if 20' each side 36' minimum across a street to another unit (minimum 300 sq.ft. outdoor living area)	8' minimum from unit to street, walkway or parking Refers to ANSI A177.1, "Standard for Mobile Home Parks," for all other site planning and design criteria 30' minimum across a street to another unit	Overall unit site 35'x95' 10' front yard 10' rear yard 20'6" side yard
Densities (derived from setback standards and site designs)	6 - 8 units/acre	6 - 9 units/acre	6 - 10 units/acre	6 - 9 units/acre	6 - 9 units/acre	9 - 10 units/acre
Parking	2 spaces/unit	2 spaces/unit	1 space/unit	1 space/unit + 1 space/4 units for visitors, etc.	1.25 spaces/unit 9'x20' space	2 spaces/unit (18'x20') at edge of road. Rear edge 30' from centerline of 20' roadway. 5% slope for parking pad away from unit toward street.
Walkway widths	3.5' common; 2.0' private	3.5' common; 2.0' private	Not specifically mentioned	3.0' common; 1.5' private	See street widths	Not specifically mentioned
Street widths	24' minimum without parking allowance for collector streets 18' minimum without parking for minor streets with less than 40 lots (no parking) 14' minimum without parking for minor streets with less than 20 lots (no parking) 7' width for parallel parking lane	Same as MHMA	20' wide gravel	36' minimum: entry and collector streets with parking both sides 30' minimum: collector streets with no parking 28' minimum: minor street with parking one side 20' minimum: minor or cul-de-sac street with no parking 11' minimum: minor street with less than 25 lots	26' minimum for entry and collector streets with visitor parking on shoulder allowed; 24' if adjacent sidewalk is provided	20' width (2 10' lanes) parallel to cluster length 24' width parallel to side of cluster

II

TABLE 3

(cont'd)

Dimensional Requirements	ANSI A177.1 by Mobile Home Manufacturers Association (MHMA) et al.	Public Health Service, U.S. Dept. of Health, Education and Welfare Recommended Ordinance Published by MHMA	Susquehanna Dist., U.S. Army Corps of Engineers Proposed Standard Specification	U.S. Department of Housing & Urban Development (HUD) Minimum Design Standards*	HUD/EPS Mobile Home/Travel Trailer Handbook (Draft Copy)**	HUD's Pennsylvania Housing Recovery Office, Management Planning Division, "Requirements for Emergency Housing Mobile Home Group Sites" MD-32-4 (Preliminary Copy)
Site gradients	Not specifically mentioned	Adequate drainage minimum; 8% maximum except for short runs, where 12% maximum allowed	Not specifically mentioned	Adequate for drainage and access to mobile home stand Unpaved - 2% minimum Walks - 1% minimum - 2% maximum Parking - 5% maximum longitudinal - 1% maximum crown	Adequate drainage as required by good practice	Not specifically mentioned
Recreation area	Not specifically mentioned	Not less than 8% of gross site area - 100 sq.ft./lot minimum, 5000 sq.ft./site minimum	Not specifically mentioned	8% minimum of gross site area with appropriate design for tenants' needs	See: ANSI A177.1, "Standard for Mobile Home Parks"	Not specifically mentioned
Accessway to mobile home pad	Minimum 14' width unobstructed	Minimum 10' for improved driveway access to mobile home	Not specifically mentioned	Minimum 12' width plus maneuvering width of standard unit (12' x 60')	Minimum 14' width plus maneuvering width in street	Not specifically mentioned

* For commercial mobile home parks.

** For temporary group housing sites (disaster relief).

There are detailed instructions on designing and constructing water supply, sewage, and electrical systems; platforms, steps, and skirting for the mobile homes; and blocking and anchoring units. Included are specifics on dimensions, capacity, placement, and types of equipment to be installed, and many schematic drawings, cross-sections, and layouts. There also are schematic drawings of an individual lot, showing the placement and dimensions of the pad, road, walkway, parking area, and utility stubs; a basic cluster of mobile homes; and a typical site layout.

Chapters on fuel, landscaping, telephone, recreation area and TV cables are listed in the table of contents but not included in the preliminary copy made available to the research team. Also listed but missing is a section on land acquisition agreements, including chapters on leases, private contracts, public lands, and zoning regulations; and a section on mobile home structure.

A chapter on fire safety which is included is not listed in the table of contents. Other unlisted sections include specifications for the plumbing construction for a sewage treatment plant, a page of general notes and specifications from the COE on sewer and water lines and utility poles, a copy of the general provisions of HUD's standard supply contract and specifications for towing and installation, which contains paragraphs on towing and placement, blocking and leveling, electrical and sewer connections, water supply lines, gas service, platforms and steps, anchoring and strapping, and materials.

(3) HUD Mobile Home/Travel Trailer Handbook

This lists general criteria for site selection, design, and development. It indicates which features should be provided but gives few instructions on how to provide them. There are some specifics, such as load standards for sewage and electricity systems, but most criteria are discussed in general terms. There are no schematic drawings or layouts.

Features to be provided include roads, sidewalks, parking areas, sanitary facilities, outdoor service and living areas, mail boxes; facilities for garbage and trash disposal, laundry drying, and recreation; and systems of water supply (including fire protection), sewage disposal, electricity (including street lighting), storm drainage, and telephone conduits. More general design criteria call for protection against such adjacent uses as heavy traffic, commerce, industry, or brightly lighted activities. It specifies that full attention be paid to appearance and livability.

Among the site selection criteria are reasonable access to community facilities such as jobs and schools. The site also must be appropriate for residential use and not subject to such conditions as insect infestation, noise or odor pollution, or possible flooding or erosion. Also to be avoided are hazards from the soil, water table, drainage, rock formations, or topography. The road network serving the site must be suitable for transporting mobile homes and handling traffic generated by the occupants.

The handbook also contains instructions for utility connections; transporting, inspecting and setting up mobile homes; record-keeping and contract administration; maintenance and fuel management; and disposition of mobile homes after they are vacated. Also discussed are staging-area operations and the use of travel trailers versus mobile homes.

There also is a description of general HUD policy and procedures in setting up disaster housing sites, and an explanation of the division of responsibility between federal, state, and local governments.

(4) Corps of Engineers Specification

This contains detailed instructions for clearing the site, grading, filling, and trenching; installing the water supply, sewage, and electrical systems; and building roads and sidewalks.

Included are schematic drawings showing alternate layouts for blocks of mobile home pads and a plot plan for a single pad; front and side sections of various combinations of steps and entrance platforms; cross-sections of road, walkway, and parking area construction; details of trenches and piping for water and sewer lines, a water meter pit and lid, water and sewer connections, a manhole and sanitary cleanout; and details of the electrical system such as the meter installation, unit connection, power outlet, and distribution layout.

The specification recommends allowing seven days for designing the site and awarding the development contract, and another seven days for construction.

(5) HUD Minimum Design Standards for Mobile Home Parks

Topics covered include density; mobile home lot size, placement, and grading; setbacks; outdoor living areas; tenant storage facilities; street width, grading, pavement, and distribution pattern; access to lots; driveways, walkways, and parking areas; steps; laundry, toilet, and recreation; management office and other common facilities; grading of unpaved areas and storm drainage systems; fences, walls, and street signs; and lawns, trees, shrubs, and other ground cover.

There also are general structural standards for permanent buildings, plumbing, and electrical and heating systems. Also, provided are detailed instructions on water supply, sewage, and electrical systems, and less complete discussions of garbage and trash disposal, master TV antenna systems, and telephone service. There are no schematic drawings or layouts.

(6) PHS Environmental Health Guide for Mobile Home Communities

These guidelines are concerned primarily with aspects of site handling affecting health and safety. The contents are fairly general; often planners are simply referred to local applicable regulations. However, despite the few engineering details, such problems as water contamination, garbage disposal, and pest control are discussed extensively.

Site selection criteria mentioned include natural drainage, geological and topographical suitability; avoidance of adjacent land use such as heavy industry, swamps, marshes, or other breeding places for insects and rodents; zoning requirements; and access to public water and sewer systems.

Design features covered include roads, parking areas, walkways, recreation areas, laundry facilities, service buildings, and other structures. There also is discussion of the mobile home lot, including drainage and grading, setbacks, anchoring, and utility connections. There are sample site plans for difficult terrain and irregularly shaped sites, and nine sample layouts for mobile home clusters. Other diagrams show possible elevations and a floor plan for a multi-purpose service building, including laundry, toilet, and office facilities, telephones, and vending machines. There also are schematic drawings of individual pads, showing the dimensions and layouts for pier supports, utility connections, and paved areas.

There are comprehensive discussions of water and sewage systems; accompanied by detailed cross-section drawings of water and sewer connections. There also are detailed discussions of garbage and trash disposal systems (with a schematic drawing of a refuse-collection stand) and insect and rodent control, and less complete coverage of electrical systems and fuel supply and storage.

The booklet includes a recommended ordinance governing commercial mobile home communities. In the ordinance are detailed criteria for density; recreation area; setbacks, buffer strips and screening; streets; walks; the mobile home lot; water supply and distribution system; sewage disposal; garbage and trash disposal; electrical, gas, and fuel oil distribution systems; telephone and television; community sanitary facilities; and permanent buildings. Also included are criteria for management and resident responsibilities; accessory structures; mobile home placement and anchorage; garbage and trash handling; insect and rodent control; fuel supply and storage; and fire protection.

(7) MHMA Standard for Mobile Home Parks

This industry booklet is designed to give minimum guidance on design and land use for commercial mobile home parks in areas with no local laws regarding such parks. The standards included are very loose, and such subjects as site grading and recreation are not mentioned.

The apparent aim is to give the individual developer as much leeway as possible. Thus the quality of a commercial mobile home park often depends more on local regulations, the individual developer, and the probable market than on these guidelines.

Only two pages are devoted to setbacks, density, streets and access to them, parking, utility connections, stabilizing piers, and ground anchors. In contrast, five pages are devoted to accessory buildings and structures, such as cabanas, porches, awnings, carports, storage structures, fences, and windbreaks.

There are less than seven pages on utilities -- water supply, sewage disposal, electricity, gas, and oil fuel. Four pages are devoted to fire safety, but only one paragraph to garbage and trash disposal. There are no schematic drawings or layouts.

(8) Comparison of Guidelines

Three of the six sets of guidelines -- MHMA, PHS, and HUD's "Minimum Design Standards" -- are geared to commercial mobile home parks. Much of the information also is applicable to disaster housing, though the wording is not specific enough. The HUD mobile home/travel trailer handbook includes most of the important points from these other publications. Moreover, the HUD handbook is specifically designed for use in disaster relief and has additional pertinent material.

Technical issues are covered best in the COE specifications and the Pennsylvania HUD guidelines. Both are quite detailed; the COE material treats subjects in more detail, but its scope is less broad.

However, neither the COE specifications nor the Pennsylvania HUD guidelines contains any site selection criteria. The HUD mobile home/travel trailer handbook is best in this respect, even though it is less complete in scope and detail.

Also omitted from the COE and Pennsylvania HUD guidelines is a discussion of such subjects as garbage and trash disposal, recreation requirements, laundry facilities, mail service, and landscaping. (Chapters on recreation and landscaping are listed in the table of contents of the Pennsylvania HUD guidelines but do not appear in the copy available.)

Three of the guidelines -- COE, Pennsylvania HUD and PHS -- contain sample cluster layouts. The basic COE cluster contains 20 units; the Pennsylvania HUD example has 12 units. Both are arranged in a linear style that would be depressing in any but a small site. The PHS samples are of various numbers of units, and the layouts show much greater variety.

c. <u>Practical Experience with Group Sites in Disaster Relief</u>

(1) Introduction

This section examines the practical experience gained in site handling and shows how this experience could be used to formulate improved standards and guidelines for future use.

The comprehensive federal role in disaster relief began with the Disaster Relief Act of 1970 (PL 91-606). Most of the group sites examined in this section were developed under this legislation. There has not been any experience with group sites under the Disaster Relief Act of 1974 (PL 93-288). Table 4 lists the group sites developed under PL 91-606 for which HUD supplied detailed information.

Tropical Storm Agnes, one of the worst disasters in the nation's history, was by far the largest disaster in which mobile home group sites were used. Agnes was a full-fledged hurricane when it hit Florida in June 1972, but the worst damage came when it turned into a tropical storm and moved up the East Coast. Agnes dropped torrential rains on southern New York State and central Pennsylvania before finally breaking up. Much of this rain -- up to 18 inches -- fell on the Susquehanna watershed.

The two states* handled the problem of housing

*Pennsylvania actually is a commonwealth, but in this report the generic term "state" is used.

TABLE 4

MOBILE HOME GROUP SITES DEVELOPED BY HUD FOR DISASTER RELIEF HOUSING 1972-4

Disaster	Mobile Home Group Site	No. of Pads	Area (Acres)	Density (Pads/Acre)	Land Ownership
Flood, June 1972	SOUTH DAKOTA				
	Rapid City				
	Site 1				
	Site 2				
	Site 3				
	Site 4				
	Site 5				
Tropical Storm Agnes, June 1972	PENNSYLVANIA				
	Wyoming Valley				
	Ashley	44	7.5	5.9	Private
	Barnum I & II	999			Quasi-public
	Bartoli West	360	28.65	12.57	Private
	Carolina A & B	99	16.5	6.0	Private
	Casey Park	66	14.5	4.5	Quasi-public
	Coal Brook	200			Private
	Dundee	120	29.1	4.1	Private
	400 Club	71	8.4	8.4	Private
	Harvey Roer	180			Private
	Kester	141	24.4	5.7	Private
	Lombardo	612	95.4	6.4	Private
	Miners Mills	103			Private
	Mundy St.	304	37.0	8.2	Private

TABLE 4

(cont'd.)

Disaster	Mobile Home Group Site	No. of Pads	Area (Acres)	Density (Pads/Acre)	Land Ownership
	Wyoming Valley (cont'd)				
	Nanticoke West	253	44.95	5.63	Quasi-public
	Popple Brothers	99	12.4	7.98	Private
	Roosevelt #1	81	12.7	6.4	Private
	Scanlon Field	52	6.4	8.13	Public
	Sedor-Newton	112	11.0	10.1	Private
	Slocum State Park	282			Public
	Sunshine	175	23.8	7.35	Private
	Thomas St.	128	13.4	9.5	Private
	Minichello	255	12.12	21.04	Private
	Rutledge	254			Private
	Valley View	289	64.89	4.45	Private
	Moon Lake	177			Quasi-public
	Harrisburg area				
	Agnes Court	36	2.42	14.88	Quasi-public
	Marietta A	29			Public
	Marietta B	18			Public
	Trailer Rest	50			Public
	Capital Campus	73			Quasi-public
	High Spire Park	45			Quasi-public
	Steelton I	103	11.5	8.9	Quasi-public
	Steelton II	58	6.6	8.7	Quasi-public
	Harris Haven				Public
	Arsenal Haven	161			Public
	Naomi's Trailer Park	6			Private

II

TABLE 4
(cont'd.)

Disaster	Mobile Home Group Site	No. of Pads	Area (Acres)	Density (Pads/Acre)	Land Ownership
	Other areas				
	Reading Stadium	22			Public
	Roosevelt #2	21	2.55	8.24	Public
	Hay Creek	14	1.31	10.69	Public
	Millersburg	7	2.2	3.18	Quasi-public
	Lykens	21	2.64	7.95	Quasi-public
	Spotts Park				Public
	Green Meadows	8	11.1	0.7	Quasi-public
	Huntingdon	19	5.88	3.23	Public
	Lock Haven Municipal Park	20	2.64	7.58	Quasi-public
	Sechrist	41			Quasi-public
	Muncy Home	42	3.38	12.43	Quasi-public
	Athens Twp.				Public
	Pennhurst	12	3.09	3.88	Public
	Bloomsburg State College	40			Public
	Boyer/Shady Acres	24			Private
	Camelot	50			Private
	Ardner Acres	80	13.1	6.1	Public
	Memorial Park-Renovo	34	3.2	10.6	Quasi-public
	Danville #1	21			Quasi-public
	Danville #2	20			Private
	Danville #3	22			Private
	North Hills Park	20	5.73	3.49	Private
	White Hill				Public
	Mt. Union #2	20	50.3	0.4	Quasi-public
	Kinney	14	2.2	6.36	Private
	Runkle	6	0.5	12.0	Private

II

TABLE 4
(cont'd.)

Disaster	Mobile Home Group Site	No. of Pads	Area (Acres)	Density (Pads/Acre)	Land Ownership
	Other areas (cont'd)				
	McCormick	25	2.53	9.88	Private
	Water Valley	18			Private
	Hale				Private
	Mt. Union #1	20	0.55	36.36	Private
	Lewisburg J.H.S.	15	1.87	8.02	Public
	NEW YORK STATE				
	Chemung County				
	Holding Point	172	27.0	6.4	Quasi-public
	County Infirmary	107	16.5	6.48	Public
	Hawthorne St.	34	3.3	10.3	Public
	Sullivan St.	48	6.9	6.9	Quasi-public
	McKinnon #1	16	1.1	14.55	Public
	McKinnon #2	18	1.56	11.54	Public
	McKinnon #3	22			Public
	Diven Park	20	1.57	12.74	Public
	West Hudson St.	7	0.68	10.29	Private
	Mt. Zoar St.	7			Private
	Sly Park	12	0.64	18.75	Public
	Brand Park	54	12.5	4.32	Public
	Luce St.	8	0.71	11.27	Private
	Gaines St. Park	8			Public
	WENY Park	108			Private

TABLE 4
(cont'd.)

Disaster	Mobile Home Group Site	No. of Pads	Area (Acres)	Density (Pads/Acre)	Land Ownership
	Cattaraugus County				
	Portville	30			Private
	Steuben County				
	Willowbrook	15			Private
	Dann Park	287	40.0	7.18	Private
	Canada Rd.	307	50.0	6.14	Private
	Water St.	30	1.9	15.79	Public
	Craig Park West	35	2.49	14.06	Public
	Craig Park East	23	1.92	11.98	Public
	Lackawanna West	10	1.01	9.9	Public
	Lackawanna East	24	1.65	14.55	Public
	Sutherland	4			Private
	Stewart Park	70	7.9	8.86	Public
	Baker St.	30	2.3	13.04	Public
	Arthur St.	6	0.23	26.09	Public
	Leader Park	12	0.74	16.22	Private
	McKinney Park	41	5.11	8.02	Public
Flood, March 1973	TENNESSEE				
	South Pittsburg	11	1.0	11.0	Public
	Jasper	12	1.0	12.0	Private

TABLE 4
(cont'd.)

Disaster	Mobile Home Group Site	No. of Pads	Area (Acres)	Density (Pads/Acre)	Land Ownership
Tornado, May 1973	GEORGIA				
	Conyers	28	2.43	11.52	Public
Tornado, October 1973	KANSAS				
	Greenleaf				
Tornado, November 1973	NEBRASKA				
	Beatrice				
Tornados, April 1974	MISSISSIPPI				
	Hattiesburg				
	Redd St.	25	9.0	2.78	Private
	Barry St.	25	8.5	2.94	Public
	Katie Arnold	14	1.5	9.33	Private
	James St.	25	5.5	4.55	Public

TABLE 4
(cont'd.)

Disaster	Mobile Home Group Site	No. of Pads	Area (Acres)	Density (Pads/Acre)	Land Ownership	
	ALABAMA					
	Triana	10	2.78	3.6	Private	
	Guin	36	6.1	5.9	Private	
	Brent	20	5.5	3.64	Private	
	KENTUCKY					
	Brandenburg					
	Riverview	12	1.5	8.0	Public	II
	Nicholas	5	1.0	5.0	Public	
	INDIANA					
	Madison	24	5.4	4.4	Public	
	OHIO					
	Cincinnati	18			Quasi-public	

TABLE 4
(cont'd.)

Note: There may have been a few other places where HUD set up temporary group housing sites, but those shown on the table were all that HUD officials were able to confirm for the research team.

Sources: U.S. Army Corps of Engineers, Tropical Storm Agnes: Operation Noah II, An After-Action Report, Harrisburg, Pa., December 1972.

Laboratory for Environmental Design and Planning, Pennsylvania State University, Emergency Mobile Home Group Sites: Their Potential for Community Reuse, March 1974.

New York State Urban Development Corporation, Emergency Housing: A Report on the Role of the New York State Urban Development Corporation in the Recovery from Tropical Storm Agnes, New York, N.Y., June 1974.

HUD offices in Elmira, N.Y.; Topeka, Kan.; Huntsville, Ala.; and Chicago, Ill.

Walsh, Martin, Jr., Summary of Operations of the City of Cincinnati After the April 3, 1974 Tornado, Office of Buildings and Inspections, Cincinnati, Ohio, 1974.

flood victims quite differently. The federal legislation in effect at the time -- PL 91-606-- gave the states responsibility for site handling, with HUD providing only advice and mobile homes. In New York, the quasi-public Urban Development Corporation (UDC), which had been set up in 1968 to build housing and had done extensive work throughout the state, was the logical agency to direct the disaster mission. Pennsylvania, having no similar body, turned to the Corps of Engineers (COE).

The consensus is that the UDC, which handled the entire New York housing mission, was prompt and effective in selecting and preparing sites. There was more criticism of the housing mission in Pennsylvania. Part of the problem there seems to have been the division of responsibility among state agencies and the COE. In its after-action report, the COE acknowledged coordination problems and recommended that in future disasters, a single agency should handle site selection, acquisition and development.*

Tropical Storm Agnes has provided a wealth of experience for the future. However, its very size makes it atypical. The average disaster for which HUD would provide housing probably would require only one or two sites of no more than 25 homes each.

This is illustrated in Table 4, which shows that the largest sites in disasters other than Agnes were in Guin, Ala., which had 36 pads, and Conyers, Ga., which had 28 pads. All other non-Agnes sites contained 25 or fewer pads.

*U.S. Army Corps of Engineers Susquehanna District, Tropical Storm Agnes: Operation Noah II, Harrisburg, Pa., December 1972.

On the other hand, the Agnes experience is valuable in planning for larger disasters which occur periodically. The extent of its emergency housing need is shown in Table 5, which indicates that 6,691 pads were set up in group sites in Pennsylvania and 1,565 in New York -- a total of 8,256. In addition, families were accommodated in other forms of temporary housing, such as leased homes and apartments.

The larger a disaster, the greater the need and the more complex the problems that arise. For this reason it is even more important to learn from a large disaster than in a small one.

The Agnes experience is also important because it shows two very different ways of coping with a large-scale disaster. Some of the differences in the response in Pennsylvania and New York stemmed from differences between the two states and the extent of their preparation. But the New York-Pennsylvania comparison reveals more than a difference in state governments.

Two points should be made regarding the comparison. First, the research team was handicapped because many sites had been dismantled by the time this study was authorized, and personnel had dispersed.

Also, the aim of this study is to develop the best procedures for the future, not simply to criticize the past. In every disaster studied, the research team found that extremely dedicated and hard-working people were involved. However, the abilities of the relief workers often were not matched by the available procedures. The purpose of this study is to improve these procedures so they will be equal to the abilities of the workers.

TABLE 5

SIZE AND LAND OWNERSHIP OF MOBILE HOME GROUP SITES, BY STATE AND AREA

	Total No. of Sites	No. of Sites Reporting for This Table	No. of Pads: Total	No. of Pads: Average Per Site	No. of Pads: Range	Size (No. of Pads)*: Small: No. of Sites	Small: %	Medium: No. of Sites	Medium: %	Large: No. of Sites	Large: %	Land Ownership: Private: No. of Sites	Private: %	Quasi-Public: No. of Sites	Quasi-Public: %	Public: No. of Sites	Public: %
SOUTH DAKOTA	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PENNSYLVANIA																	
Wyoming Valley	25	25	5,456	218.24	44-999	1	4	6	24	18	72	19	76	4	16	2	8
Harrisburg area	11	10	579	57.90	6-161	5	50	3	30	2	20	1	10	5	50	4	40
Other areas	31	27	656	24.30	6- 80	25	93	2	7	--	0	10	37	9	33	8	30
Total Pa.	67	62	6,691	107.92	6-999	31	50	11	18	20	32	30	48	18	29	14	23
NEW YORK STATE																	
Chemung County	15	15	641	42.73	7-172	11	73	1	7	3	20	4	27	2	13	9	60
Cattaraugus County	1	1	30	30	30	1	100	--	0	--	0	1	100	--	0	--	0
Steuben County	14	14	894	63.86	4-307	11	79	1	7	2	14	5	36	--	0	9	64
Total N.Y.S.	30	30	1,565	52.17	4-307	23	77	2	7	5	17	10	33	2	7	18	60
TENNESSEE	2	2	23	11.50	11- 12	2	100	--	0	--	0	1	50	--	0	1	50
GEORGIA	1	1	28	28	28	1	100	--	0	--	0	--	0	--	0	1	100
KANSAS	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
NEBRASKA	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MISSISSIPPI	4	4	89	22.25	14- 25	4	100	--	0	--	0	2	50	--	0	2	50
ALABAMA	3	3	66	22	10- 36	3	100	--	0	--	0	3	100	--	0	--	0
KENTUCKY	2	2	17	8.5	5- 12	2	100	--	0	--	0	--	0	--	0	2	100
INDIANA	1	1	24	24	24	1	100	--	0	--	0	--	0	--	0	1	100
OHIO	1	1	18	18	18	1	100	--	0	--	0	--	0	1	100	--	0
GRAND TOTALS	118	106	8,521	80.39	4-999	68	64	13	12	25	24	46	43	21	20	39	37

* Small group site = 2 to 49 pads
Medium group site = 50 to 99 pads
Large group site = over 100 pads

Source: Table 4

II

(2) Site Selection and Acquisition

In New York, the Urban Development Corporation (UDC) handled Agnes-related site selection and acquisition. In Pennsylvania, the state Department of Community Affairs (DCA) handled it. HUD officials served as advisers and, in Pennsylvania, so did the Corps of Engineers (COE). After the flood in Rapid City, S. Dak., local governments selected sites in consultation with HUD.

The site selection process in Pennsylvania was confused, partly because it was impossible to determine quickly how many mobile homes were needed. As estimates climbed, more sites had to be found. Thus it was almost impossible to select sites in a coordinated, comprehensive manner.

(a) Method

The DCA coordinated site selection in Pennsylvania. COE advisers examined sites the state found and recommended certain ones, using HUD figures on homeless families as a guide. The process in New York State was similar, with the UDC handling the work of the DCA and the COE.

The first step in finding available land was to contact government agencies involved in planning and urban renewal. The mayor and other officials also were asked to recommend property that might be available, including municipal land.

If more sites were needed, field teams were dispatched to find out what land was vacant. Public records were examined to determine who owned the land and the owners were contacted to see if it was available. Finally, radio spots were broadcast appealing for usable land.

(b) Ratio of Sites Inspected to Sites Selected

Once available land was located each piece had to be inspected and analyzed -- a major undertaking. In Wilkes-Barre, for example, more than 300 potential sites were inspected before 30 were chosen.*

Table 5 shows that 67 sites were developed in Pennsylvania and 30 in New York -- nearly 100 altogether. And more sites are chosen than developed (30 to 35 chosen versus 25 developed in Wyoming Valley, which includes Wilkes-Barre, for instance). Applying the ratio of Wilkes-Barre -- 300 sites inspected to 30 chosen, or 10 to 1 -- to the other Agnes sites, it appears that at least 1,000 potential sites were identified, inspected, and analyzed to provide the nearly 100 sites ultimately developed.

(c) Criteria

In choosing the best sites from the various parcels available, some selection criteria developed naturally. The importance of other criteria became obvious only later.

The criteria are discussed below. Table 6 shows how many of them were met in the Agnes relief operation in Pennsylvania. The table

*Figures quoted by Robert Prescott, HUD's Assistance Director for Disaster Response during the Agnes recovery effort, in testimony before the Subcommittee on Disaster Relief of the U.S. Senate Committee on Public Works in Wilkes-Barre May 11 and 12, 1973; published as Part 3 of the "Hearings to Investigate the Adequacy and Effectiveness of Federal Disaster Relief Legislation," pp. 1288 (written testimony) and 1327 (oral testimony in response to questioning).

is based on data for 40 Agnes sites studied by the Laboratory for Environmental Design and Planning of Pennsylvania State University. The criteria used for the 35 subcategories are shown in Table 7. All criteria are arranged in a graded four-part scale. The parts of this scale are generalized in Table 6 as "good," "fair," "poor," and "none or unacceptable." This makes it possible to present all 35 subcategories in the same terms, whatever criteria are used in evaluating them. Table 6 shows the percentage of sites receiving various grades in each subcategory. Categories which relate to the location and physical features of sites are discussed below. Categories which refer to site design and development are discussed in subsequent sections.

i. Location

- Utilities. Water supply and sewer line are the most vital items for a site, but they are also the most expensive and difficult to provide. However, since PL 93-288 authorizes the federal government to pay for and install utilities, this legislation could overcome local or state opposition to a site because of expensive utility problems. The availability of electricity is less important because electricity is easier and cheaper to bring to a site.

- Proximity To a Population Center. Outlying sites are difficult to service and travel to, especially in bad weather and winter. They should be avoided. People living in sites far from population centers have trouble getting to jobs, schools, shopping, and the like.

TABLE 6

QUALITATIVE ANALYSIS OF 40 PENNSYLVANIA GROUP SITES

	No. of Sites Reporting for This Table	Percent of Sites			
		None or Unacceptable	Poor	Fair	Good
GEOLOGICAL					
Foundation Suitability	17	--	--	100	--
Bedrock Drainage	17	--	--	100	--
Total Geological (Avg.)		--	--	100	--
SOIL					
Surface Drainage	40	--	15	55	30
Subsoil Drainage	17	--	24	24	53
Porosity	17	--	24	29	47
Shrink/Swell	17	--	--	12	88
Erosion Potential	40	--	28	50	23
Water Table	14	7	36	43	14
Total Soil (Avg.)*		1	21	41	38
TOPOLOGICAL					
Average Slope	40	--	5	13	83
FLORA					
Trees on Site	39	44	26	26	5
ACCESSIBILITY					
Roads to Site	40	--	40	50	10
Pedestrian	40	40	40	18	3
Public Bus	27	41	7	22	30
Boundary of Site	40	18	55	13	15
Total Accessibility (Avg.)*		23	38	26	13
CIRCULATION					
Roads on Site	40	10	70	8	13
Public Parking	40	20	75	5	--
Pedestrian Paths	40	63	35	3	--
Total Circulation (Avg.)		31	60	5	4
UTILITY SYSTEMS					
Sewers	40	3	13	3	83
Water Supply	40	3	5	3	90
Storm Drainage	40	53	40	--	8
Electric	40	--	--	5	95
Gas	40	8	--	93	--
Total Utility Systems (Avg.)		13	12	21	55
FACILITIES					
Laundry	40	68	8	25	--
Community Space	40	75	20	--	5
Mail Delivery	40	10	88	3	--
Garbage Pick-Up	40	5	30	58	8
Total Facilities (Avg.)		40	37	22	3
RECREATION					
Passive	40	48	18	35	--
Active	40	48	13	28	13
Children	40	53	15	15	18
Total Recreation (Avg.)		50	15	26	10
INDIVIDUAL LOTS					
Size	40	--	35	63	3
Parking	40	5	28	65	3
Yard Quality (Avg.)	40	8	50	40	3
Patio Area (Avg.)	40	100	--	--	--
Storage Area (Avg.)	40	100	--	--	--
Walk (Avg.)	40	58	23	20	--
Total Individual Lots (Avg.)		45	23	31	2
OVERALL AVERAGE**		25	25	30	20

Note: Percentages may not add up to exactly 100 due to rounding off.

* Weighted to compensate for the differences in the number of sites reporting in the different subcategories.

** Adjusted to give each subcategory equal weight, rather than giving each main category equal weight no matter how many or how few subcategories it contains. In each column, the average for each category (weighted where necessary to compensate for differences in the number of sites reporting) was multiplied by the number of subcategories it represents. These figures were then added together and divided by the total number of subcategories (35).

Source: Laboratory for Environmental Design and Planning, Pennsylvania State University, Emergency Mobile Home Group Sites: Their Potential for Community Reuse, March 1974, Appendix II: "Site Data Sheets."

TABLE 7

CRITERIA FOR RANKINGS IN QUALITATIVE ANALYSIS OF 40 PENNSYLVANIA GROUP SITES (TABLE 6)

	None or Unacceptable	Poor	Fair	Good
GEOLOGICAL				
Foundation Suitability			Fair	Good
Bedrock Drainage			Fair	Good
SOIL				
Surface Drainage		Poor	Fair	Good
Subsoil Drainage		Poor	Fair	Good
Porosity		Poor	Fair	Good
Shrink/Swell			Moderate	Low
Erosion Potential		Severe	Moderate	Slight
Water Table	Incompatible	High	Moderate	Low
TOPOLOGICAL				
Average Slope (%)		16 - 25	7 - 15	0 - 7
FLORA				
Trees on Site	None	Light	Medium	Heavy
ACCESSIBILITY				
Roads to Site		Gravel	Paved	Improved
Pedestrian	None	Gravel	Paved	Improved
Public Bus (Runs/Day)	None	1 - 2	3 - 6	7^+
Boundary of Site	None	Temporary	Permanent	Natural
CIRCULATION				
Roads on Site	None	Gravel	Mixed	Paved
Public Parking	None	Gravel	Mixed	Paved
Pedestrian Paths	None	Defined	Paved	Improved
UTILITY SYSTEMS				
Sewers	None	Primary	Unconnected	Connected
Water Supply	None	Well	Unconnected	Connected
Storm Drainage	None	Swale	Drain	Sewer
Electric			Poles	Connected
Gas	None	Oil	Bottled	Connected
FACILITIES				
Laundry	None	Close By	Foundation for Craftex	Craftex
Community Space	None	Foundation for Craftex	Craftex	UGI Modular
Mail Delivery	None	Entrance	Improved	Door
Garbage Pick-up	None	Curb	Door	Stands
RECREATION				
Passive	None	Close By	Natural	Improved
Active	None	Close By	Natural	Improved
Children	None	Close By	Natural	Improved
INDIVIDUAL LOTS				
Size		Small	Medium	Large
Parking	None	Between Units	Gravel	Paved
Yard Quality (Avg.)	None	Poor	Fair	Good
Patio Area (Avg.)	None	Space	Paved	Improved
Storage Area (Avg.)	None	Space	Covered	Improved
Walk (Avg.)	None	Gravel	Paved	Improved

Source: Laboratory for Environmental Design and Planning, Pennsylvania State University, Emergency Mobile Home Group Sites: Their Potential for Community Reuse, March 1974, Appendix II: "Site Data Sheets."

- <u>Proximity To Occupants' Former Neighborhood</u>. An effort was made to locate Agnes sites as close as possible to the victims' former homes, to minimize disruption of the community fabric. Proximity to their old neighborhoods also made it easier for displaced residents to repair their damaged homes and thus return to them more rapidly. And it helped lessen the psychological impact of the disaster, allowing site occupants to continue familiar patterns of life. They were able to stay in contact with friends and neighbors and continue going to their former schools, churches, and the like.

  It also makes it easier to rehabilitate these facilities and eliminates the need for providing duplicate services or enlarging existing ones. A major shift in population density would further impair disaster-struck firms in the old neighborhood by reducing business, and would strain services in the new neighborhood, thus heightening community opposition to the site.

  Despite emphasis on the importance of location, some Agnes sites were located up to 20 miles from the flooded areas. However, this may have resulted from a scarcity of appropriate land, as much as the hasty selection process.

- <u>Community Opposition</u>. Many communities look unfavorably upon commercial mobile home developments in normal times. This attitude often carries over to mobile home group sites set up for disaster relief. Opposition is particulary intense when sites are proposed for neighborhoods other than those in which the victims usually live, especially if the newcomers are poorer or of lower social status.

Community opposition is often expressed in terms of zoning ordinances or other local regulations. However, these are apt to be waived or overridden in a disaster, as they were after Agnes in Pennsylvania and New York, where community opposition delayed site selection. In Pennsylvania the state civil defense organization issued a statewide waiver allowing development of group sites. The UDC took similar action in New York.

Community opposition stems from a reluctance to accept any large or sudden increase in population, with its attendant strains on community facilities, and a fear that the mobile home site might become a permanent fixture. Many people have unpleasant memories of the mobile home parks of the 1930's and 40's, which were characterized by high density, few amenities, unsightly appearance, poor sanitation, and a transient population. The answer to many of these objections lies in improved site design.

- Legal Factors. In selecting sites, it is advisable to avoid conflicts with rights-of-ways, easements, and other legal restrictions. However, such restrictions must be balanced against the desirability of a site in terms of other criteria. In Agnes, publicly owned land was usually the first choice for sites, because it was free and easy to obtain. Park land was a prime source. School grounds, college campuses, and the grounds of state hospitals and correctional institutions also were used.

- Land Availability. A major reason for the tendency to use public land for sites has been time pressure -- such land usually is the easiest to obtain for disaster housing. However, the use of public land resulted in the location of some sites within the flood plain. Other sites had drainage problems or were in outlying areas.

- Adjacent Land Use. This criterion was given little weight in the Agnes disaster. Sites were located near railroad tracks, major highways, large piles of mine waste, power stations, industrial areas, swamps, a drive-in theatre, a polluted creek, a sewage disposal area, and abandoned buildings.

  Some of the more inappropriate adjacent uses could have been avoided by less reliance on publicly owned land.

  At any rate, more attention should be paid to adjacent land use, including such factors as air, water, and noise pollution, safety hazards, and undesirable visual features.

- Access Road Network. The roads leading to a site should be able to accommodate the large mobile homes and heavy tractors that will be moved onto the site. They also will have to handle the months or even years of additional traffic generated by site occupants.

This criteria was given some weight in choosing sites in the Agnes disaster. Pennsylvania's DCA rejected a few sites because the agency believed that the increase in population would overload existing roadways.

Table 6 shows that only 10% of the sites studied had good access road networks. Half the sites had only fair networks, and 40% were poor. (Pedestrian access was even less suitable: 3% were good, 18% fair, 40% poor and 40% nonexistent.)

- Public Transportation. The availability of public transportation is especially important if sites are far from population centers and occupants need access to jobs, shopping, and other facilities. Public transportation also can help site occupants retain contact with their former neighborhood.

  Victims are especially likely to need public transportation, since their cars often are destroyed or damaged. In the case of floods, which usually strike poorer neighborhoods, many affected families have only one car, which the principal breadwinner uses to drive to work. The other members of the family must rely on public transportation.

  Free bus service was provided to alleviate transportation problems in Wilkes-Barre. According to Table 8 bus service to the sites studies was poor overall, despite the good situation in Wilkes-Barre. For 30% of the sites service was good, for 22% fair, for 7% poor, and for 41% nonexistent.

- Flood Plain. Several sites developed after Agnes were located within the flood plain,* where they would have been endangered by subsequent flooding. Fortunately, no further flood-producing storms occurred in the summer and fall of 1972.

  However, the civil defense director for Luzerne County (which includes Wilkes-Barre), Maj. Gen. Frank Townend (Ret.) testified in the Senate hearings that the COE had not repaired the Susquehanna dike system enough to protect against possible subsequent floods. The COE representative at the hearings, Maj. Gerald Vick, challenged that assertion.**

  However, rather than test the reliability of flood-control systems when sites involving large numbers of people are involved, sites should be located outside the flood plain.

ii. Physical Features

- Size is a factor in which conflicts between human and administrative needs and between immediate and long-range concerns are most apparent.

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* The Stage 1 and 2 analyses of the Penn State evaluation indicate that at least seven of the 40 sites studied were located within a flood plain.

**U.S. Senate Subcommittee on Disaster Relief, "Hearings to Investigate the Adequacy and Effectiveness of Federal Disaster Relief Legislation," Part 3 (Wilkes-Barre, Pa., May 11 and 12, 1973), U.S. Gov't. Printing Office, Washington, D. C., 1973, p. 1077.

Public Health Service guidelines for commercial mobile home parks recommend at least 50 mobile home lots in any new development."* In the Agnes disaster, larger sites proved easier to develop and to maintain.

In Wilkes-Barre especially, the assistance team stressed selecting fairly large tracts of land. Tables 4 and 5 show that the average number of pads in a site in Wilkes-Barre (Wyoming Valley) was 218, and that one double site, Barnum I and II, contained 999 pads. In contrast, only four other Agnes sites in Pennsylvania and New York contained much more than 100 pads.

Table 5 shows the size breakdown more graphically: 72% of the Wyoming Valley sites had more than 100 pads, while less than 20% of the Agnes sites elsewhere did. In fact 77% of the New York sites had less than 50 pads, as did 93% of the Pennsylvania sites outside of Wilkes-Barre and Harrisburg.

As for the most desirable size, the COE report states:

> Large mobile home sites were unpopular with families eligible for emergency housing . . . .Priority for the development of group sites should be given to sites of less than

*U.S. Public Health Service, Bureau of Community Environmental Management, Environmental Health Guide for Mobile Home Communities, Mobile Homes Manufacturers Association, Chicago, Ill., 1971, p. 3.

> 300 mobile homes. . . .
> Large sites should be avoided wherever possible.*

The research team also found:

> In Wilkes-Barre, for example, group sites that had more than about 125 homes experienced social difficulties, such as the proximity of units, the lack of privacy, a sense of stigma and unrelieved ugliness which resulted in a lack of pride, high maintenance costs and low user satisfaction.**

Large sites were selected in the Agnes relief effort partly because of the pressing need to move large numbers of people out of mass shelters and into decent homes. This need overshadowed long-range consideration.

Immediately after Agnes struck, few people realized that hundreds of victims would be living in group sites for two or three years.

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* U.S. Army Corps of Engineers, Tropical Storm Agnes: Operation Noah II, pp. 50-51.

**Abeles, Schwartz and Associates and Beyer-Blinder-Belle, Cost-Effective Housing Systems for Disaster Relief, Vo. 2, Federal Experience With Disaster Housing Assistance, U.S. Dept. of Housing and Urban Development, Washington, D.C., 1974, p. 53.

The Agnes experience shows that the larger the disaster and the more displaced victims, the harder it is to rehouse them and the longer they will stay in group sites.

Thus it seems clear that group sites should have less than 125 units, especially in large disasters. In fact, HUD recommends that sites have no more than 25 units each.

- Shape. A long, thin parcel of land is less suitable for development than a more regular one in which pads, utilities, and roads can be conveniently and economically arranged. (Figures 1 through 10 show the kinds of layouts and densities, service, and road runs possible on sites of different shape.)

- Topography. The slope of the land is important in terms of possible erosion, the level placement of pads and road grading. A site which needs little grading is preferable to one which needs a lot. Obviously a limited amount of grading is feasible.

  Sites also should have areas topographically suited for play and recreation.

  Table 6 indicates that the criteria for topological features were frequently met in selecting the Pennsylvania sites. Eighty-three percent were rated good, 13% fair, 5% poor, and none unacceptable.

- Flora. Landscaping is important to prevent erosion, and to relieve some visual and psychological defects of group living. The better suited a site is naturally, the less landscaping work will be required. The presence of flora is especially important because landscaping is often considered a luxury and is disregarded to save time or money.

Table 6 shows that this is one aspect of site selection to which the least attention was paid. Of the sites studied, 5% were good, 26% fair, 26% poor, and 44% had no natural cover at all.

- Fauna. Potential sites should be checked for rodents or insects. At least one Pennsylvania site reportedly was infested with rodents. Areas infested with annoying insects such as mosquitoes or gnats also should be avoided.

- Bedrock, Soil, and Water Table. These should be capable of supporting the number of units planned for the site. Conditions which foster ponding, wetness, or muddiness should be avoided.

  Table 6 indicates that most of these conditions were rated fair or good in the Pennsylvania sites studied. Twenty-one percent were poor. One site had a water table so high it was considered unacceptable.

(d) Conflicting Criteria

A major part of site selection is weighing various criteria and balancing them when they conflict. For instance, access to water supply and sewer systems is critical. However, if a site lacks this access but is exceptional in other ways, the use of portable utility systems should be considered.

Also, it was noted that a few large sites are considered easier and cheaper to develop and maintain than several small sites accommodating the same population. But the desire for larger sites can clash with the ease of using publicly owned land, the occupants' human needs, and the importance of minimizing social difficulties associated with extended living in group sites.

The criterion of land availability also often conflicts with the criterion of size. This is illustrated in Table 5, which shows that in Wilkes-Barre, where large sites predominated, 76% of the parcels were on privately owned land. But in other Agnes areas, where sites were smaller, 60% to 90% of the parcels were on public or quasi-public land.

Tables 8 and 9 show the relationship between size and land ownership more precisely. Table 8 breaks down site size in terms of land ownership. Table 9 breaks down land ownership in terms of site size. (The figures in these two tables represent sites from all disasters shown on Table 4, not just the Agnes sites.)

Table 8 shows small and medium-sized sites about evenly split between private and public ownership, while the large sites were 68% private and only 12% public.

Table 9 shows that in the case of small sites, the lowest percentage was on private land, and the highest percentage was on public land. For large sites, the reverse was true.

Another conflict exists between the desire to locate sites near their occupants' former neighborhoods or another population center, and the reluctance to locate sites

TABLE 8

SITE SIZE IN RELATION TO LAND OWNERSHIP

	Size (No. of Pads)							
	Small (2-49 pads)		Medium (50-99 pads)		Large (over 100 pads)		Total All Sizes	
Land Ownership	No. of Sites	%	No. of Sites	%	No. of Sites	%	No. of Sites	%
Private	24	35	5	39	17	68	46	45
Quasi-public	13	19	3	23	5	20	21	20
Public	31	46	5	39	3	12	39	37
Total All Ownership	68	100	13	101*	25	100	106	100

* Due to rounding off.

Source: Table 4.

II

TABLE 9

LAND OWNERSHIP OF SITES IN RELATION TO THEIR SIZE

Size	Land Ownership							
	Private		Quasi-Public		Public		Total All Ownership	
	No. of Sites	%	No. of Sites	%	No. of Sites	%	No. of Sites	%
Small (2 - 49 pads)	24	52	13	62	31	80	68	64
Medium (50 - 99 pads)	5	11	3	14	5	13	13	12
Large (100^+ pads)	17	37	5	24	3	8	25	24
Total All Sizes	46	100	21	100	39	101*	106	100

* Due to rounding off.

Source: Table 4.

II

within a flood plain.

Other problems are peculiar to a particular area, such as Wilkes-Barre, which is in the middle of a coal mining region. Several sites there were located on or near huge piles of mine waste -- locations which may have been considered the best available but presented drainage, landscaping, and environmental problems.

Table 6 can be helpful in balancing various criteria. It shows which factors have been slighted in the past and therefore should receive proper consideration in the future.

(e) Cost

In Pennsylvania, sites were leased to the state for a dollar a year or made available through written agreement. The state agreed to leave all improvements when the site was returned to its owner, unless the owner wished them removed. In New York, the UDC paid for sites if they were not provided free; the UDC did not pass this cost on to site occupants.

In Rapid City, local governments often had to pay substantial amounts to lease land from private owners. The cost was passed on to site occupants in the form of ground rent that averaged $30 a month per pad. This upset occupants who had been told mobile homes would be provided rent-free for 12 months, and assumed the land would be free too. However, small financially-pressed communities do not have the financial resources to absorb land costs for emergency housing, especially after a disaster.

(f) Need for Pre-Planning

PL 91-606 gives the responsibility for site selection to state or local governments, but past efforts have shown that they are often inexperienced and unsure of how to proceed. State and local governments also are usually preoccupied with more pressing aspects of disaster recovery, such as searching for survivors and reopening roads. Frank Carlucci, a Presidential representative sent to Wilkes-Barre to direct the relief effort, told the Senate Subcommittee on Disaster Relief there was continuous conflict between federal and state officials over responsibility for various aspects of site selection and development.

PL 93-288 was designed to correct some of the inadequacies of PL 91-606. One of its main purposes was to encourage pre-planning for disasters on the local, state, and federal levels.

Identification and inspection of potential sites before a disaster occurs, without time constraints, would enable pre-selection of the best sites possible. The advantages of pre-selection also can be seen from the discussions of individual selection criteria and the section on conflicting criteria -- conflicts that could be resolved or alleviated if approached without the time pressure inherent in unplanned disaster response.

(3) Site Design

Site design requires more than merely laying out road and utility systems and arranging mobile home pads along them. Good design entails planning all the elements that help make a site livable, including those that cannot be shown on a blueprint.

The more thought and planning that go into a design, the better the site will be. One reason the Agnes sites in Pennsylvania were criticized so much was the unrealistically short time set aside for design. The COE, for instance, gave one architectural/engineering firm five days to prepare a topographical survey, construction documents, and utility, road, and grading designs for a 100-acre site. In future disasters time constraints should be balanced with the need for careful design.

The best alternative is pre-planning -- preparing general design plans ahead of time, and when a disaster strikes, adapting them to the particular sites available. The COE and HUD guidelines discussed earlier represent a beginning. Comprehensive guidelines are presented in Chapter IV.

(a) Designers

In New York, the UDC farmed out most design work to architectural and engineering firms with which the agency had worked in the past. In Pennsylvania, the COE supervised design work and turned to local government agencies for recommendations on firms.

What caused the changeover from the state to the COE as overall supervisor in Pennsylvania is a complicated and sensitive issue. HUD's Assistant Director for Disaster Response, Robert Prescott, said he and HUD Philadelphia Administrator Ted Robb had daily contact with the state for the first week after the disaster. The aim was to develop a plan for Pennsylvania's DCA to administer the temporary housing program, aided by HUD's supervision, technical support, policy guidance, and funding. One week after the disaster, at the point the contract was to be signed, Prescott said the governor rejected that arrangement. Instead, the governor asked the federal government to set up the necessary organization.* The Federal Coordinating Officer, Office of Emergency Preparedness (OEP)Regional Director Frank Carney, said the OEP recommended that the COE handle the site work.**

DCA Secretary William Wilcox testified at the Senate hearings that the DCA did an architectural/engineering design for the first site that proved unworkable.*** But in a subsequent letter to the subcommittee chairman, Wilcox said one reason the state refused to direct the housing program was that the federal government insisted on the right to disallow state expenditures, leaving the state with no right of appeal.

City agencies also were involved in the housing mission at one point. Two officials of the Wilkes-Barre Redevelopment Authority testified that their organization was asked a few days after the disaster to act as management agent for the housing program in Luzerne County. They said their agency had no prior experience in such work, and said they were appalled by the lack of guidelines. They said the agency realized the job was beyond its capability and role. They thought

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* U.S. Senate Subcommittee on Disaster Relief, "Hearings to Investigate the Adequacy and Effectiveness of Federal Disaster Relief Legislation," Part 3 (Wilkes-Barre, Pa., May 11 and 12, 1973), U.S. Gov't. Printing Office, Washington, D. C., 1973, p. 1289.

** Ibid., p. 1258

***Ibid., p. 1185

no local or state agency could deal with a problem that size -- only a federal agency could handle the job.*

Partly because of these criticisms and partly because of the smaller scope, HUD did the design work for sites established after the 1973 and 1974 disasters in Tennessee, Georgia, Mississippi, Alabama, and Indiana.** In Brandenburg, Ky., no architect or engineer was needed because of the small, simple sites. HUD representatives dealt directly with the contractors, using agency specifications for commercial mobile home parks.*** In Cincinnati, Ohio, after the April 1974 tornado, the city Director of Public Works took charge of the site preparation, plans and contracts.****

(b) Design Elements

In Pennsylvania, COE architects were told to aim for an overall density of seven to eight units per acre, a standard that probably came from HUD. The UDC also based its guideline for density and setbacks on

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* Ibid., Part 3, pp. 1118 and 1121.

** Letters to the research team from the HUD Region IV office in Atlanta, December 20, 1974, and the HUD Region V office in Chicago, Dec, 18, 1974.

*** Letter to the research team from HUD's Louisville Disaster Field Office, Dec. 17, 1974.

****Walsh, Martin P., "Tornado '74: Summary of Operations of the City of Cincinnati After the April 3, 1974, Tornado," City of Cincinnati, Ohio, 1974, mimeographed, p. 6.

HUD recommendations. Beyond this, designers and developers of Agnes sites received little guidance. Because of time pressure and the lack of pre-planning and government guidance, the design process focused mainly on utility layouts.

Most criteria for utilities were taken from local, state, or national codes, which were easily available to the supervising agencies and familiar to local architects, engineers, and contractors. The COE used the national electrical code; the UDC used the New York State Building Code.

Amenities such as community facilities and recreation were seldom included in the specifications for sites. There was time pressure, and no one foresaw how long some sites would be occupied.

Experimental paper-based structures were installed at a few Pennsylvania sites, but within months they developed structural problems and were unusable. No substitutes were provided, partly because it was becoming apparent that people might be reluctant to leave the sites and amenities were being cut back to discourage long-term residency.

i. Density

Density is the most important element in site design. Density determines how close individual pads must be, how much the layout of pad clusters can be varied, and how much space is available for community facilities. Overall density is determined by dividing the number of pads on a site by the total acreage.

In situations like Agnes, in which occupants will remain in temporary housing for a long time, more amenities are needed and the overall density, therefore, will be lower.

The architectural/engineering firm of Peters and Riggi says if it had known how long sites in Wilkes-Barre would be occupied, an overall density of five to six pads per acre would have been preferable to the seven to eight the firm designed.

Table 4 shows the population, acreage, and density figures for all sites analyzed in this study. Table 10 summarizes these figures by state and area. The emphasis on larger sites in Wilkes-Barre (Wyoming Valley), in terms of population and acreage, can be seen in Table 10, along with the explanation: more than 3,200 pads were required in Wilkes-Barre and about 600 in other areas of Pennsylvania, compared to 500 in Chemung County and less than 900 in Steuben County, both in New York.

Thus, it is understandable that the average number of pads per site in Wilkes-Barre is more than 180, while the average for other Agnes areas is between 22 and 73. The average site in these other areas is between six and ten acres, while in Wilkes-Barre it is 26 acres.

However, the density figures reflect a different trend. Sites in Wilkes-Barre have an average density of less than eight pads per acre compared with averages of more than 12 in Steuben and more than eight in other areas of Pennsylvania. Table 11 shows more clearly how density varies in relation to site size. Only three of the small New York

TABLE 10

POPULATION, AREA AND DENSITY OF GROUP SITES, BY STATE AND AREA

	Total No. of Sites	No. of Sites Reporting for This Table	Size (No. of Pads) Small No. of Sites	Small %	Medium No. of Sites	Medium %	Large No. of Sites	Large %	No. of Pads Total	No. of Pads Average Per Site	No. of Pads Range	Area (Acres) Total	Area (Acres) Average Per Site	Area (Acres) Range	Density (Pads/Acre) Average Per Site	Density (Pads/Acre) Range
SOUTH DAKOTA	5	--	--	--	--		--	--	--	--	--	--	--	--	--	--
PENNSYLVANIA																
Wyoming Valley	25	18	1	6	6	33	11	61	3,261	181.17	44-612	463.11	25.73	6.4 -95.4	7.91	4.1 -21.04
Harrisburg area	11	3	1	33*	1	33*	1	33*	197	65.67	36-103	20.52	6.84	2.42-11.5	10.83	8.7 -14.88
Other areas	31	18	17	94	1	6	--	0	398	22.11	6- 80	114.77	6.38	0.5 -50.3	8.39	0.4 -36.36
Total Pa.	67	39	19	49	8	21	12	31	3,856	98.87	6-612	598.4	15.34	0.5 -95.4	8.36	0.4 -36.36
NEW YORK STATE																
Chemung County	15	11	8	73	1	9	2	18	496	45.09	7-172	72.46	6.59	0.64-27.0	10.32	4.32-18.75
Cattaraugus County	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Steuben County	14	12	9	75	1	8	2	17	875	72.92	6-307	115.25	9.6	0.23-50.0	12.65	6.14-26.09
Total N.Y.S.	30	23	17	74	2	9	4	17	1,371	59.61	6-307	187.71	8.16	0.23-50.0	11.54	4.32-26.09
TENNESSEE	2	2	2	100	--	0	--	0	23	11.5	11-12	2.0	1.0	1.0	11.5	11.0 -12.0
GEORGIA	1	1	1	100	--	0	--	0	28	28	28	2.43	2.43	2.43	11.52	11.52
KANSAS	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
NEBRASKA	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MISSISSIPPI	4	4	4	100	--	0	--	0	89	22.5	14-25	24.5	6.13	1.5 - 9.0	4.9	2.78- 9.33
ALABAMA	3	3	3	100	--	0	--	0	66	22	10-36	14.38	4.79	2.78- 6.1	4.38	3.6 - 5.9
KENTUCKY	2	2	2	100	--	0	--	0	17	8.5	5-12	2.5	1.25	1.0 - 1.5	6.5	5.0 - 8.0
INDIANA	1	1	1	100	--	0	--	0	24	24	24	5.4	5.4	5.4	4.4	4.4
OHIO	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
GRAND TOTALS	118	75	49	65*	10	13*	16	21*	5,474	72.99	5-612	837.32	11.16	0.23-95.4	9.01	0.4 -36.36

*Do not add up to 100 due to rounding off.

Source: Table 4.

TABLE 11

POPULATION, AREA AND DENSITY OF SITES
IN RELATION TO SIZE OF SITE

Site Size	Location and Designation	No. of Pads	Area (Acres)	Density (Pads/Acre)
LARGE	PENNSYLVANIA			
(100+	Bartoli West	360	28.65	12.57
pads)	Dundee	120	29.1	4.1
	Kester	141	24.4	5.7
	Lombardo	612	95.4	6.4
	Mundy St.	304	37.0	8.2
	Nanticoke West	253	44.95	5.63
	Sedor-Newton	112	11.0	10.1
	Sunshine	175	23.8	7.35
	Thomas St.	128	13.4	9.5
	Minichello	255	12.12	21.04
	Valley View	289	64.89	4.45
	Steelton I	103	11.5	8.9
	Total Pa.	2,852	396.21	--
	NEW YORK STATE			
	Holding Point	172	27.0	6.4
	County Infirmary	107	16.5	6.48
	Dann Park	287	40.0	7.18
	Canada Rd.	307	50.0	6.14
	Total N.Y.S.	873	133.5	--
	TOTAL (16 sites)	3,725	529.71	--
	AVERAGE	232.81	33.11	8.13
	RANGE	103-612	11.0-95.4	4.1-21.04
MEDIUM	PENNSYLVANIA			
(50 - 99	Carolina A and B	99	16.5	6.0
pads)	Casey Park	66	14.5	4.5
	400 Club	71	8.4	8.4
	Popple Brothers	99	12.4	7.98
	Roosevelt #1	81	12.7	6.4
	Scanlon Field	52	6.4	8.13
	Steelton II	58	6.6	8.7
	Ardner Acres	80	13.1	6.1
	Total Pa.	606	90.6	--

TABLE 11
(cont'd)

Site Size	Location and Designation	No. of Pads	Area (Acres)	Density (Pads/Acre)
MEDIUM (cont'd)	NEW YORK STATE			
	Brand Park	54	12.5	4.32
	Stewart Park	70	7.9	8.86
	Total N.Y.S.	124	20.4	--
	TOTAL (10 sites)	730	111.0	--
	AVERAGE	73	11.1	6.94
	RANGE	52-99	6.4-16.5	4.32-8.86
SMALL (2 - 49 pads)	PENNSYLVANIA			
	Ashley	44	7.5	5.9
	Agnes Court	36	2.42	14.88
	Roosevelt #2	21	2.55	8.24
	Hay Creek	14	1.31	10.69
	Millersburg	7	2.2	3.18
	Lykens	21	2.64	7.95
	Green Meadows	8	11.1	0.7
	Huntingdon	19	5.88	3.23
	Lock Haven Municipal Park	20	2.64	7.58
	Muncy Home	42	3.38	12.43
	Pennhurst	12	3.09	3.88
	Memorial Park - Renovo	34	3.2	10.6
	North Hills Park	20	5.73	3.49
	Mt. Union #2	20	50.3	0.4
	Kinney	14	2.2	6.36
	Runkle	6	0.5	12.0
	McCormick	25	2.53	9.88
	Mt. Union #1	20	0.55	36.36
	Lewisburg J.H.S.	15	1.87	8.02
	Total Pa.	398	111.59	--
	NEW YORK STATE			
	Hawthorne St.	34	3.3	10.3
	Sullivan St.	48	6.9	6.9
	McKinnon #1	16	1.1	14.55
	McKinnon #2	18	1.56	11.54

TABLE 11
(cont'd)

Site Size	Location and Designation	No. of Pads	Area (Acres)	Density (Pads/Acre)
SMALL	NEW YORK STATE (cont'd)			
(cont'd)	Diven Park	20	1.57	12.74
	West Hudson St.	7	0.68	10.29
	Sly Park	12	0.64	18.75
	Luce St.	8	0.71	11.27
	Water St.	30	1.9	15.79
	Craig Park West	35	2.49	14.06
	Craig Park East	23	1.92	11.98
	Lackawanna West	10	1.01	9.9
	Lackawanna East	24	1.65	14.55
	Baker St.	30	2.3	13.04
	Arthur St.	6	0.23	26.09
	Leader Park	12	0.74	16.22
	McKinney Park	41	5.11	8.02
	Total N.Y.S.	374	33.81	--
	TENNESSEE			
	South Pittsburg	11	1.0	11.0
	Jasper	12	1.0	12.0
	Total Tenn.	23	2.0	--
	GEORGIA			
	Conyers	28	2.43	11.52
	MISSISSIPPI			
	Redd St.	25	9.0	2.78
	Barry St.	25	8.5	2.94
	Katie Arnold	14	1.5	9.33
	James St.	25	5.5	4.55
	Total Miss.	89	24.5	--
	ALABAMA			
	Triana	10	2.78	3.6
	Guin	36	6.1	5.9
	Brent	20	5.5	3.64
	Total Ala.	66	14.38	--

TABLE 11
(cont'd)

Site Size	Location and Designation	No. of Pads	Area (Acres)	Density (Pads/Acre)
SMALL (cont'd)	KENTUCKY			
	Riverview	12	1.5	8.0
	Nicholas	5	1.0	5.0
	Total Ky.	17	2.5	--
	INDIANA			
	Madison	24	5.4	4.4
	TOTAL (49 sites)	1,019	196.61	--
	AVERAGE	20.8	4.01	9.72
	RANGE	5-48	0.23-50.3	0.4-36.36
ALL SIZES	GRAND TOTAL (75 sites)	5,474	837.32	--
	AVERAGE	72.99	11.16	9.01
	RANGE	5-612	0.23-95.4	0.4-36.36

Source: Table 4

sites have less than 10 units per acre, while only three of the large Pennsylvania sites have more than 10 units per acre.

Table 12 summarizes the categories shown in Table 11. It too shows that small sites have a greater average density than large ones.

Two points should be made. Some acreages were calculated from site plans drawn on a scale of 1":800' and the figures are not precise. Also, density figures can be misleading. An example is the Mt. Union #2 site, which shows 20 pads on 50 acres, or a density of 0.4 units per acre. However, much of this site was steep and heavily wooded, and the usable area was about five acres, for an actual density of four units per acre.

ii. Layout

Most layouts are based on the arrangement of a small number of pads in a cluster and the repetition of this cluster -- or several different clusters -- throughout the site. The density within each cluster is greater than the overall density to allow for open areas.

A monotonous arrangement of row upon row of identical units should be avoided for psychological and aesthetic reasons. However, another priority is an efficient layout of utilities, which is determined by the arrangement of mobile home pads. Each lot also must have access to a road, and all site occupants should be able to reach common facilities without walking through other people's lots.

The water supply system should include

TABLE 12

SITE SIZE IN RELATION TO POPULATION, AREA AND DENSITY

	Size (number of pads)											
	Small (49 sites)			Medium (10 sites)			Large (16 sites)			Total (75 sites)		
	Total	Average Per Site	Range	Total	Average Per Site	Range	Total	Average Per Site	Range	Total	Average Per Site	Range
Number of Pads	1,019	20.8	5 - 48	730	73	52 - 99	3,725	232.81	103 - 612	5,474	72.99	6 - 612
Area (in acres)	196.61	4.01	0.23 - 50.3	111.0	11.1	6.4 - 16.5	529.71	33.11	11.0 - 95.4	837.32	11.16	0.23 - 95.4
Density (number of pads/acre)	---	9.72	0.4 - 36.36	---	6.94	4.32 - 8.86	---	8.13	4.1 - 21.04	---	9.01	0.4 - 36.36

Source: Table 4.

hydrants and other fire protection provisions. For easier maintenance, water and sewer lines should be laid under or along roadways, not under mobile home pads. Lines should include shutoffs, bypasses, and loops so portions can be closed for repair without affecting the whole system.

A storm drainage system also should be provided, along with grading. Some Wilkes-Barre sites were too flat and ponding occurred in rainy weather.

Another problem in Wilkes-Barre was the lack of sidewalks along site roads, producing a safety hazard. The gravel paving of the roads also was inadequate, resulting in dust, mud, poor drainage, and ruts.

An electrical system, including exterior street lighting, should be provided. Electrical lines can be run along roads, feeder lines connecting to a meter pole at each pad. The telephone company should install conduits.

Outdoor recreation areas should be provided along with children's play areas visible from kitchen or living room windows. In the early development stage, it is neither costly or time-consuming to provide recreation and play areas: simply set aside the space and develop it later.

Another consideration is landscaping, which provides psychological benefits and enhances privacy. Landscaping also delineates spaces and separates their uses, screens undesirable views, controls noise, gives shade, and prevents erosion.

iii. Individual Lots

Each lot should have a paved parking space for one car. Common areas for extra cars might be provided within each cluster. The lot might also include a patio area and storage space for garbage cans, tricycles, yard tools, and other items which cannot be stored inside the home.

Design plans should show how the pad is positioned on the lot and delineate a walkway from the parking area to the front entrance. Specifications for entrance steps and possibly an entrance platform or small porch should be included.

Each mobile home must have a proper foundation or blocking and provision for anchoring or tie-downs. If the site is located in a cold climate, subject to strong winds, or to be occupied for a long time, the space between the mobile home and the ground should be enclosed by skirting.

iv. Common Facilities and Services

Common laundry facilities should be provided each site. Otherwise, each lot should have clothes drying equipment, such as an umbrella type clothesline.

Indoor facilities for community gatherings and passive recreation should be provided because the disaster population will probably include elderly people. An on-site office for management and maintenance is recommended, especially for large sites.

The installation of private phones will depend on the wishes of individual residents and the telephone company, but, in any case, a few public phones should be provided in some common location. Also needed is a storage facility, on-site or off, for large household items.

Two services whose absence or inadequacy in the Agnes sites received much criticism were garbage collection and mail delivery. Problems apparently arose even in arranging for common pick-ups and delivery. Also important are public transportation, ambulance service, and access to medical care. In Wilkes-Barre, free bus service was provided for nine months after the disaster.

Communities near group sites sometimes were reluctant to have their services strained to accommodate site occupants. This usually stemmed more from practical problems than from animosity toward site residents. Some communities were especially unwilling to place additional strain on volunteer ambulance services or fire departments.

Another problem that occurred in Pennsylvania was the lack of medical facilities, especially critical because of the children and elderly people among site occupants. At the same time, medical offices established at the sites did not have enough business to stay open full-time. The reason for this apparent contradiction was not clear from the information available.

(c) Past Experience

To illustrate the range of possible site design and development features, plans and key information for nine group sites selected from Table 4 have been drawn up at the same scale, along with a typical commercial mobile home site. Figures 1 through 10 show the layouts for these sites. Information on the sites is summarized in Table 13.

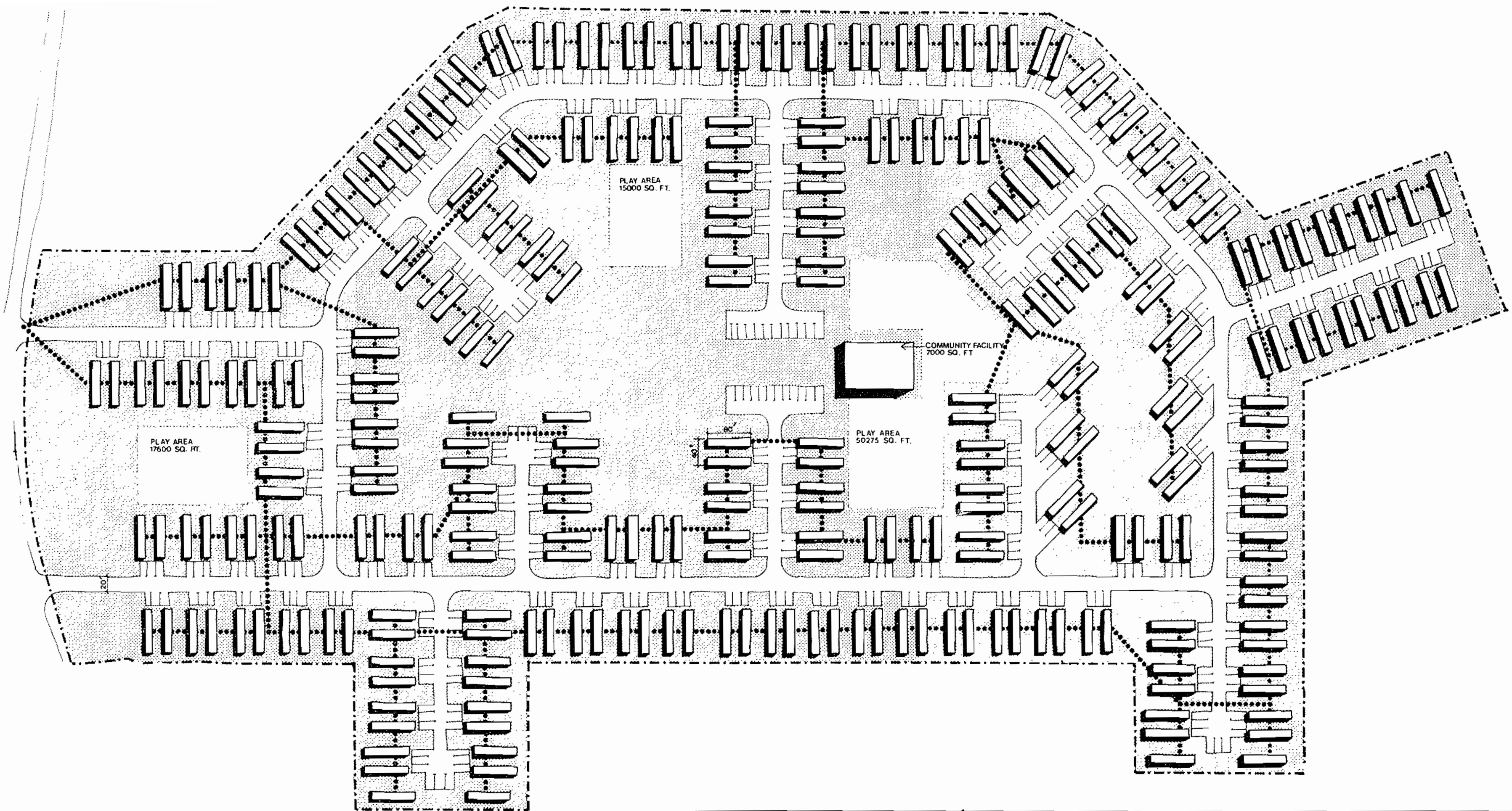
Six sites are included from the Agnes disaster; one small, one medium and one large from Pennsylvania and from New York. Several layouts are quite linear, but others show interesting variations in the way units and clusters of units are arranged.

Tables 6 and 7 show which design features were given most attention in Pennsylvania and which were slighted. Categories dealing with site selection features were discussed.

The tables show that the utility systems were generally quite good, except for storm drainage, which was completely lacking in more than half the sites and poor in most of the rest. None of the sites had common on-site laundry facilities, and only 8% had such facilities nearby. In the study on which the tables are based, a site would be rated as fair if there was a foundation for a laundry facility, however, some of the facilities were never actually built, despite the existence of a foundation.

No community gathering facilities were available at 75% of the sites, and only 20% had foundations for such facilities. In 88% of the cases, mail was delivered only to the entrance of the site; garbage pick-up was only somewhat better, with 88% of the sites rated fair or poor.

No recreation facilities existed in about half the sites. Most of the rest had either natural recreation areas or off-site facilities nearby.



	PER UNIT	TOTAL
LINEAR FT. OF ONSITE ROADS:	23	7000
LINEAR FT. OF ONSITE SEWER LINES:	42	12700
COMMUNAL RECREATION FACILITIES (DEFINED SPACES):	SQ. FT.	90000 SQ. FT.
COMMUNAL OPEN AREAS (UNDEFINED SPACES):	SQ. FT.	610000 SQ. FT.
INDIVIDUAL LOT AREAS (INCLUDING 50% ROADWAY):	3000 SQ. FT.	912000 SQ. FT.
PARKING SPACES PER UNIT:	11/2	456

Mundy Street Group Site
WILKES BARRE, PENNSYLVANIA
SOURCE: H.U.D.

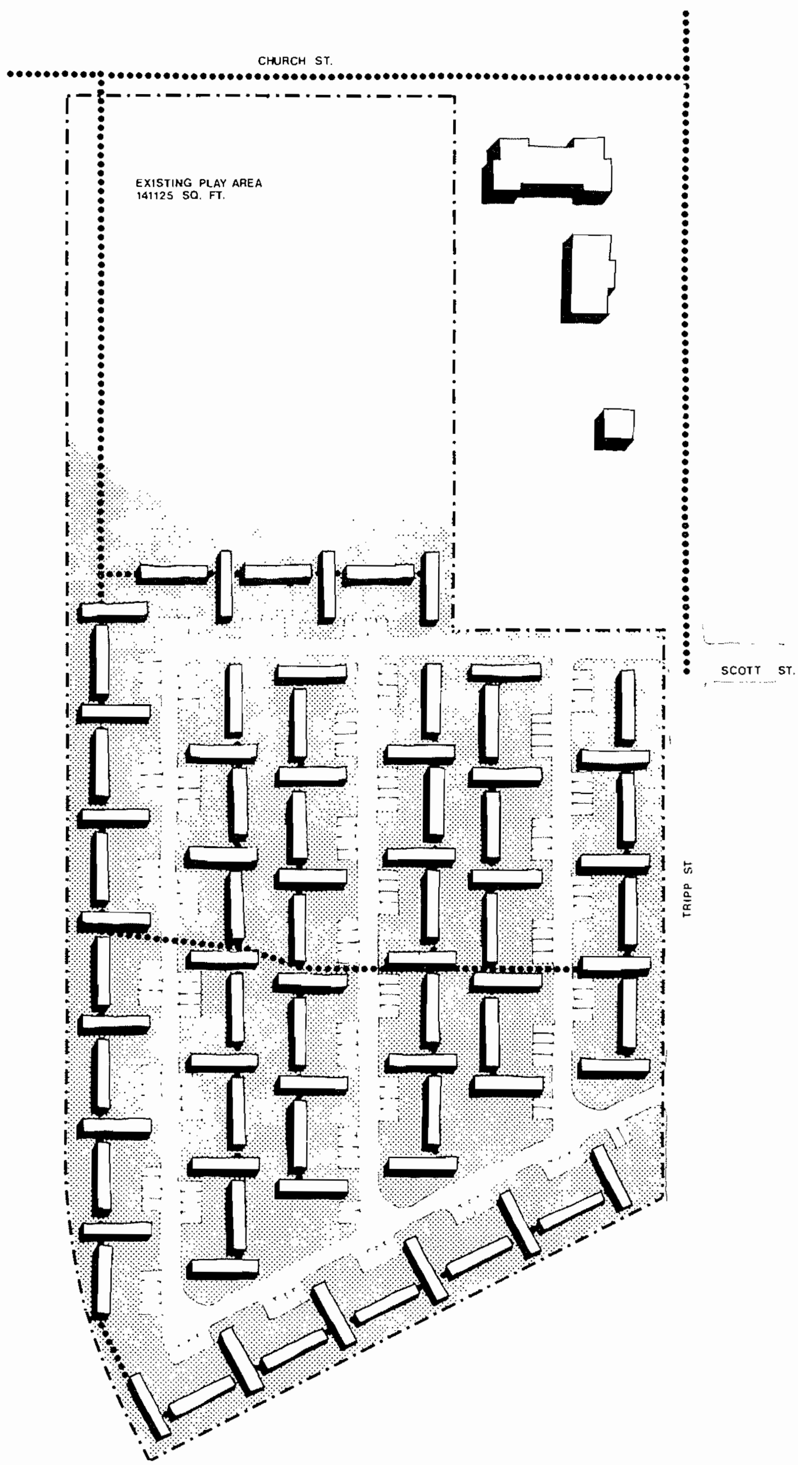
GROSS SITE AREA: 37 ACRES
MOBILE HOMES ON SITE: 304 UNITS
DENSITY: 8.2 UNITS/ACRE

MOBILE HOME UNIT
SEWER
SITE BOUNDARY
PARKING

0 50 100 150

FIGURE 1
MUNDY STREET GROUP SITE
WILKES BARRE, PENNSYLVANIA

II



	PER UNIT	TOTAL
LINEAR FT. OF ONSITE ROADS:		2650
LINEAR FT. OF ONSITE SEWER LINES:		4900
COMMUNAL RECREATION FACILITIES (DEFINED SPACES):	SQ. FT.	141125 SQ. FT.
COMMUNAL OPEN AREAS (UNDEFINED SPACES):	SQ. FT.	22000 SQ. FT.
INDIVIDUAL LOT AREAS (INCLUDING 50% ROADWAY):	3000 SQ. FT.	246000 SQ. FT.
PARKING SPACES PER UNIT:	2	164

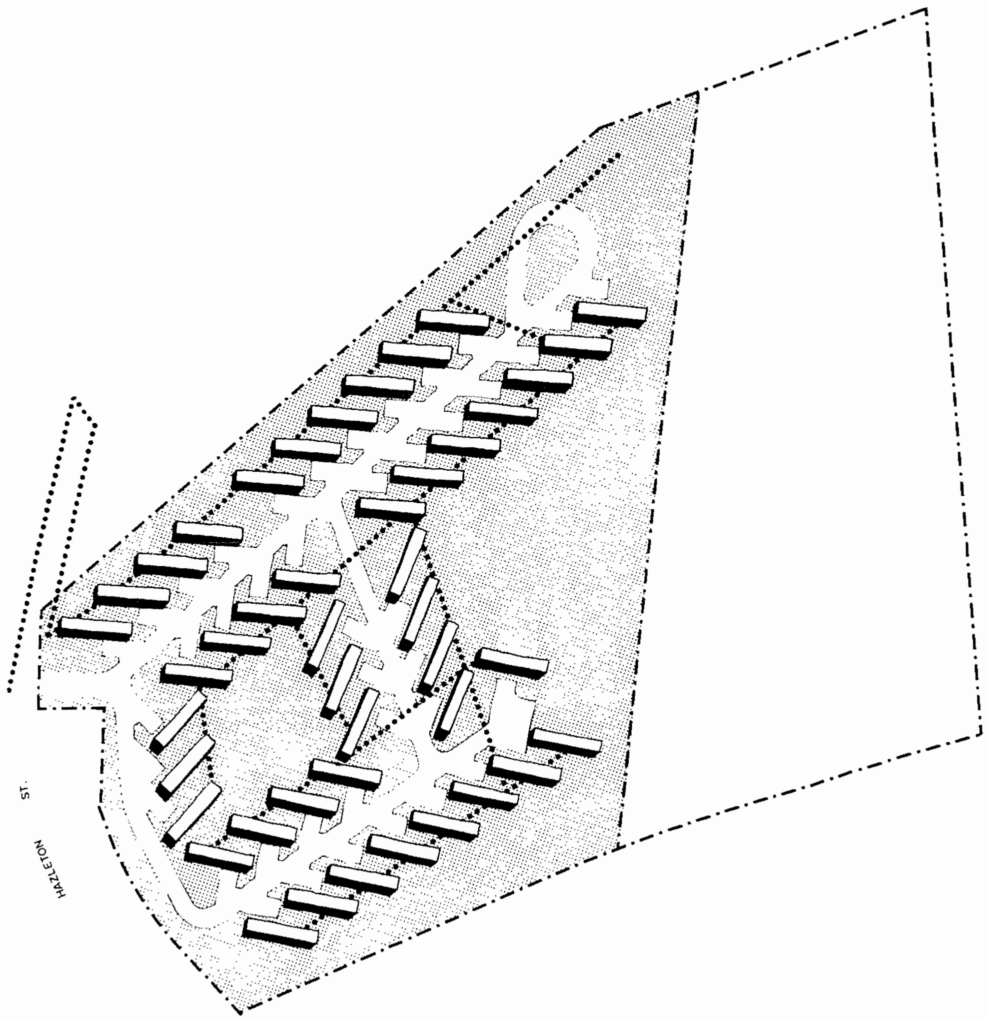
Roosevelt Park
Swoyersville, Pa.
SOURCE: H.U.D.

GROSS SITE AREA: 12.7 ACRES
MOBILE HOMES ON SITE: 81 UNITS
DENSITY: 6.4 UNITS/ACRE

MOBILE HOME UNIT
SEWER
SITE BOUNDARY
PARKING

0 50 100 150

FIGURE 2
ROOSEVELT PARK, SWOYERSVILLE, PENNSYLVANIA



	PER UNIT	TOTAL
LINEAR FT. OF ONSITE ROADS:	38.6	1700
LINEAR FT. OF ONSITE SEWER LINES:	68.2	3000
COMMUNAL RECREATION FACILITIES (DEFINED SPACES):	SQ. FT.	SQ. FT.
COMMUNAL OPEN AREAS (UNDEFINED SPACES):	SQ. FT.	195000 SQ. FT.
INDIVIDUAL LOT AREAS (INCLUDING 50% ROADWAY):	3000 SQ. FT.	132000 SQ. FT.
PARKING SPACES PER UNIT:	1	44

Ashley Group Site
ASHLEY, PENNSYLVANIA
SOURCE: H.U.D.

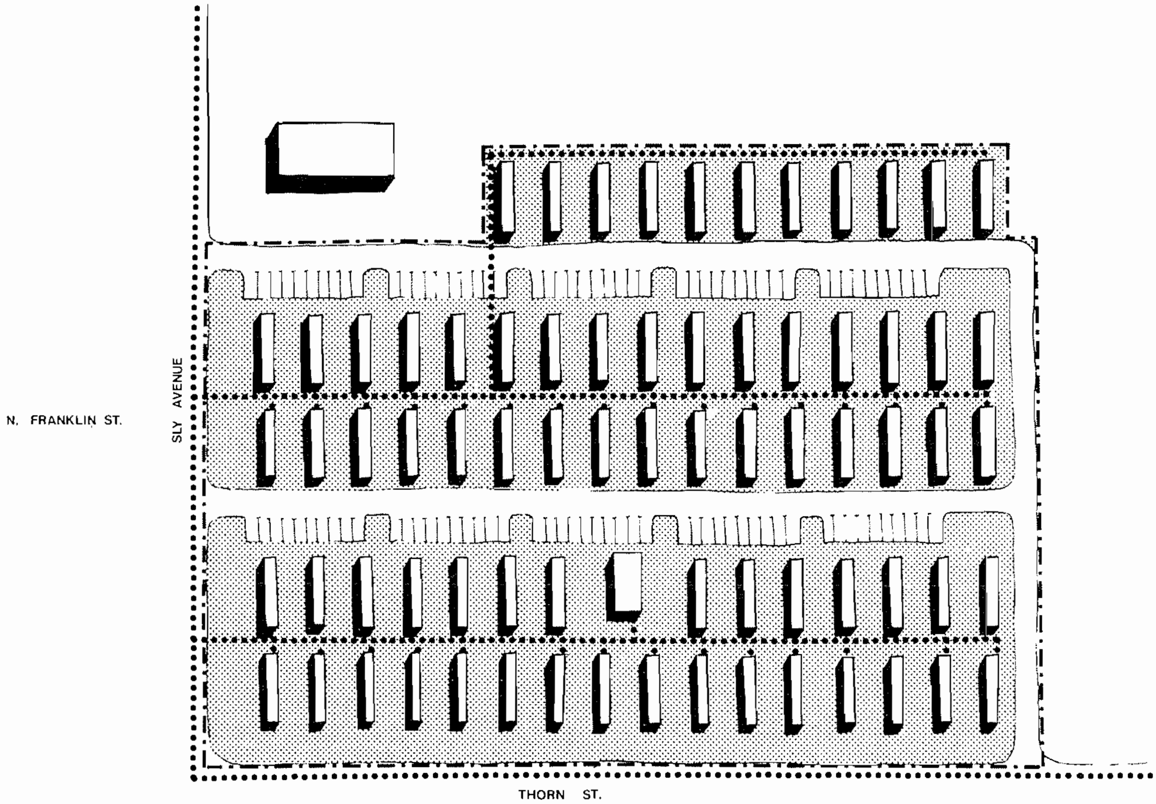
GROSS SITE AREA: 7.5 ACRES
MOBILE HOMES ON SITE: 44 UNITS
DENSITY: 5.9 UNITS/ACRE

MOBILE HOME UNIT
SEWER
SITE BOUNDARY
PARKING

0 50 100 150

FIGURE 3

ASHLEY GROUP SITE
ASHLEY, PENNSYLVANIA



	PER UNIT	TOTAL
LINEAR FT. OF ONSITE ROADS:	26.4	1850
LINEAR FT. OF ONSITE SEWER LINES:	37.1	2600
COMMUNAL RECREATION FACILITIES (DEFINED SPACES):	SQ. FT.	6000 SQ. FT.
COMMUNAL OPEN AREAS (UNDEFINED SPACES):	SQ. FT.	58000 SQ. FT.
INDIVIDUAL LOT AREAS (INCLUDING 50% ROADWAY):	4000 SQ. FT.	280000 SQ. FT.
PARKING SPACES PER UNIT:	1 1/2	105

Stewart Park
CORNING, NEW YORK
SOURCE: N.Y.S.U.D.C.

GROSS SITE AREA: 7.9 ACRES
MOBILE HOMES ON SITE: 70 UNITS
DENSITY: 8.7 UNITS/ACRE

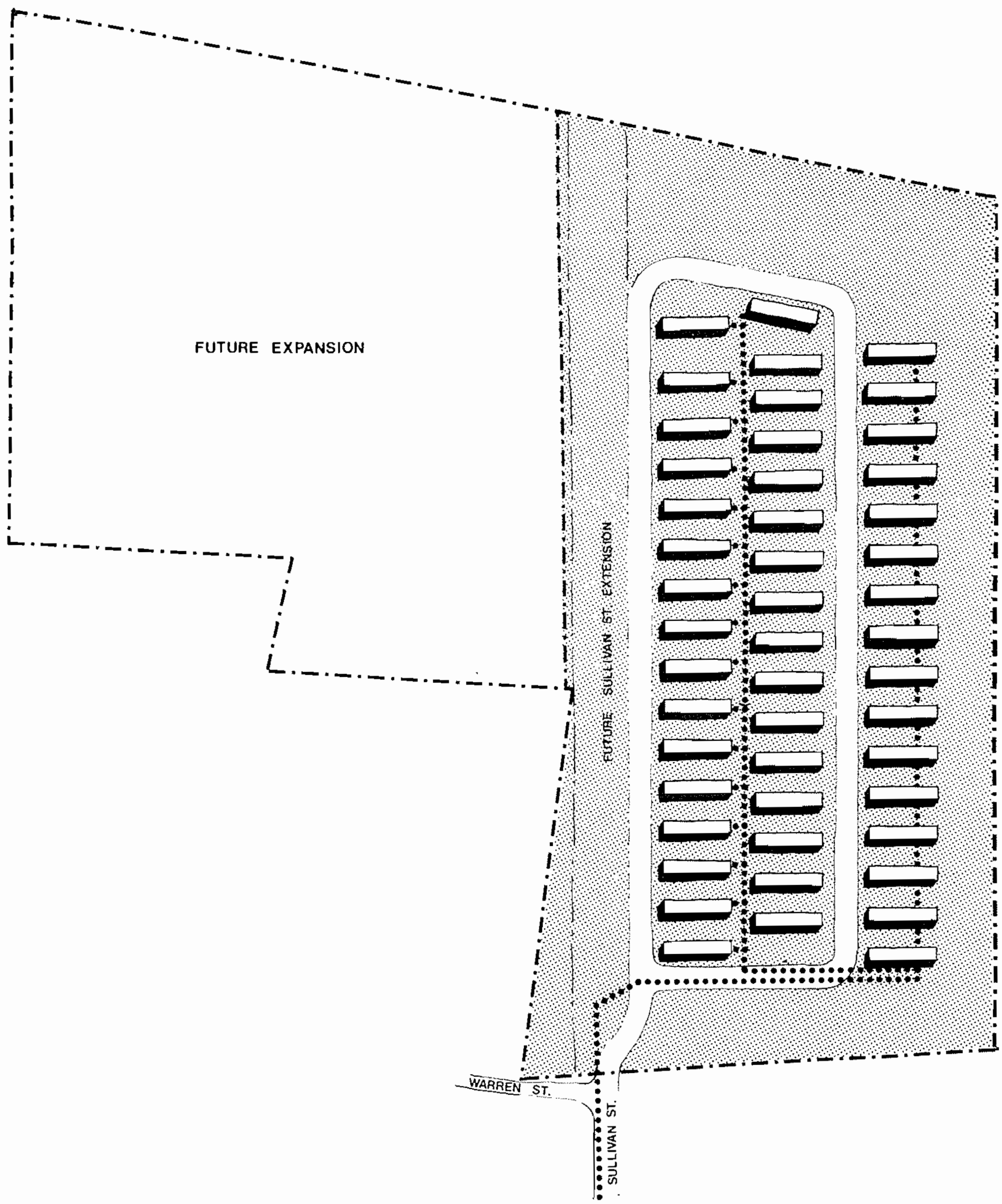
MOBILE HOME UNIT
SEWER
SITE BOUNDARY
PARKING

0 50 100 150

FIGURE 4

STEWART PARK

CORNING, NEW YORK



	PER UNIT	TOTAL
LINEAR FT. OF ONSITE ROADS:	33	1600
LINEAR FT. OF ONSITE SEWER LINES:	44	2100
COMMUNAL RECREATION FACILITIES (DEFINED SPACES):	SQ. FT.	SQ. FT.
COMMUNAL OPEN AREAS (UNDEFINED SPACES):	SQ. FT.	128000 SQ. FT.
INDIVIDUAL LOT AREAS (INCLUDING 50% ROADWAY):	3600 SQ. FT.	172800 SQ. FT.
PARKING SPACES PER UNIT:	1	48

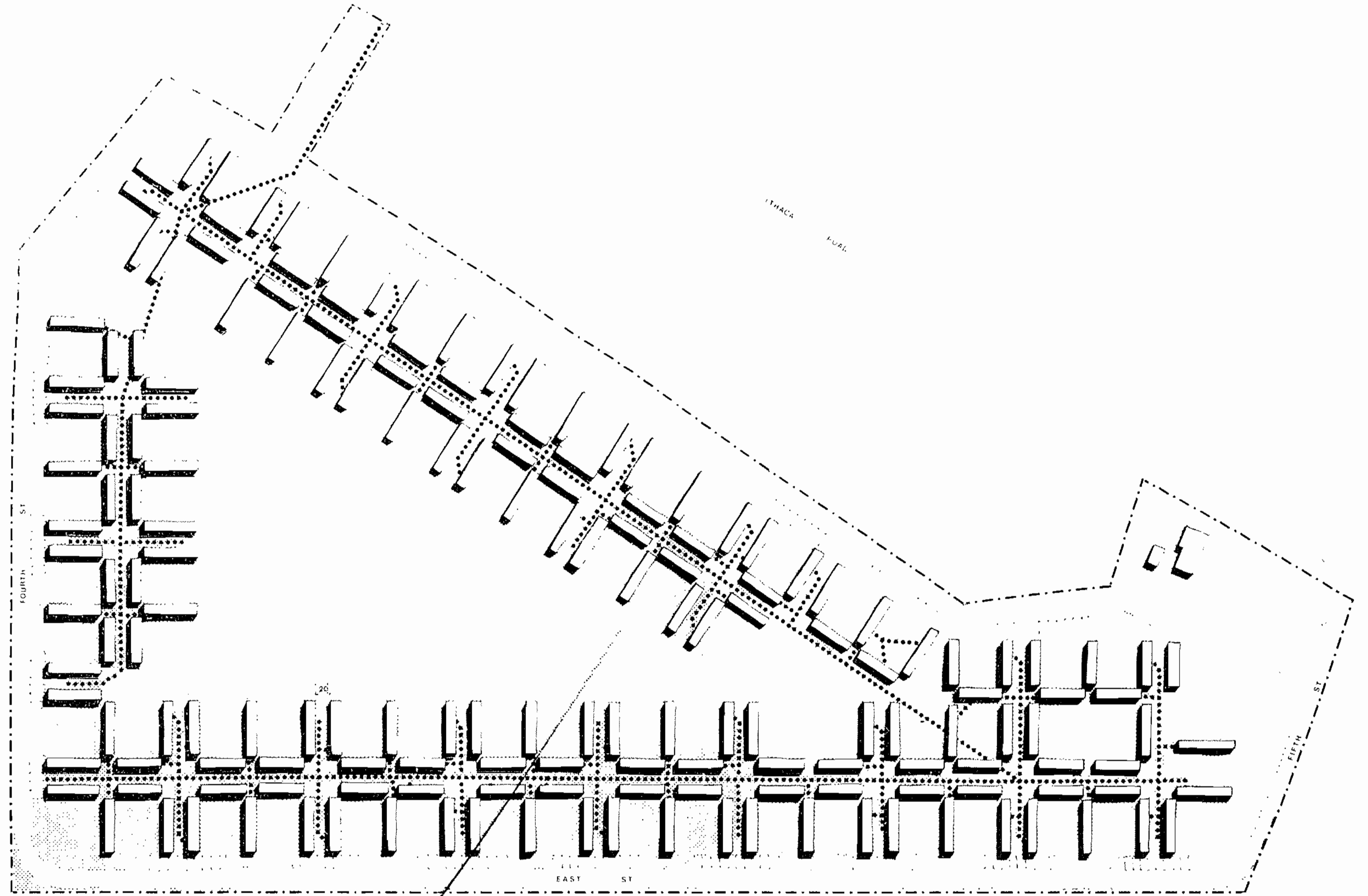
Sullivan Street
ELMIRA, NEW YORK
SOURCE: N.Y.S.U.D.C.

GROSS SITE AREA:	6.9 ACRES
MOBILE HOMES ON SITE:	48 UNITS
DENSITY:	7 UNITS/ACRE

MOBILE HOME UNIT
SEWER
SITE BOUNDARY
PARKING

0 50 100 150

FIGURE 5
SULLIVAN STREET
ELMIRA, NEW YORK



	PER UNIT	TOTAL
LINEAR FT. OF ONSITE ROADS:	27	4700
LINEAR FT. OF ONSITE SEWER LINES:	41	7000
COMMUNAL RECREATION FACILITIES (DEFINED SPACES):	SQ. FT.	SQ. FT.
COMMUNAL OPEN AREAS (UNDEFINED SPACES):	SQ. FT.	576000 SQ. FT.
INDIVIDUAL LOT AREAS (INCLUDING 50' ROADWAY):	2–5000 SQ. FT.	344–860000 SQ. FT.
PARKING SPACES PER UNIT:	1	172

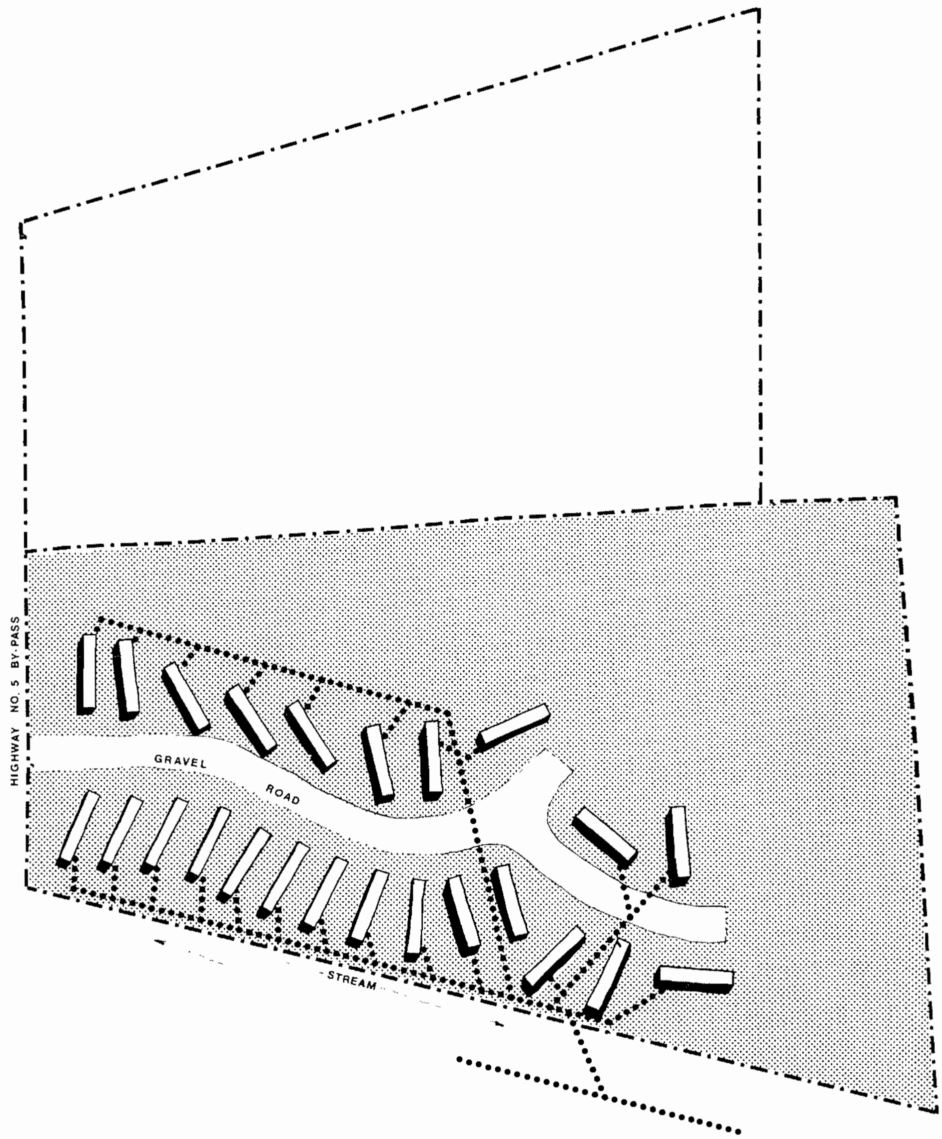
Holding Point
HORSEHEADS, N.Y.
SOURCE: N.Y.S.U.D.C.

GROSS SITE AREA:	27 ACRES
MOBILE HOMES ON SITE:	172 UNITS
DENSITY:	6.0 UNITS/ACRE

MOBILE HOME UNIT
SEWER
SITE BOUNDARY
PARKING

0 50 100 150

FIGURE 6 - HOLDING POINT HORSEHEADS, N.Y.



	PER UNIT		TOTAL	
LINEAR FT. OF ONSITE ROADS:	29.2		700	
LINEAR FT. OF ONSITE SEWER LINES:	75		1800	
COMMUNAL RECREATION FACILITIES (DEFINED SPACES):		SQ. FT.		SQ. FT.
COMMUNAL OPEN AREAS (UNDEFINED SPACES):		SQ. FT.	222000	SQ. FT.
INDIVIDUAL LOT AREAS (INCLUDING 50% ROADWAY):	4000	SQ. FT.	96000	SQ. FT.
PARKING SPACES PER UNIT:	1		24	

Group Site
BRENT, ALABAMA
SOURCE: H.U.D.

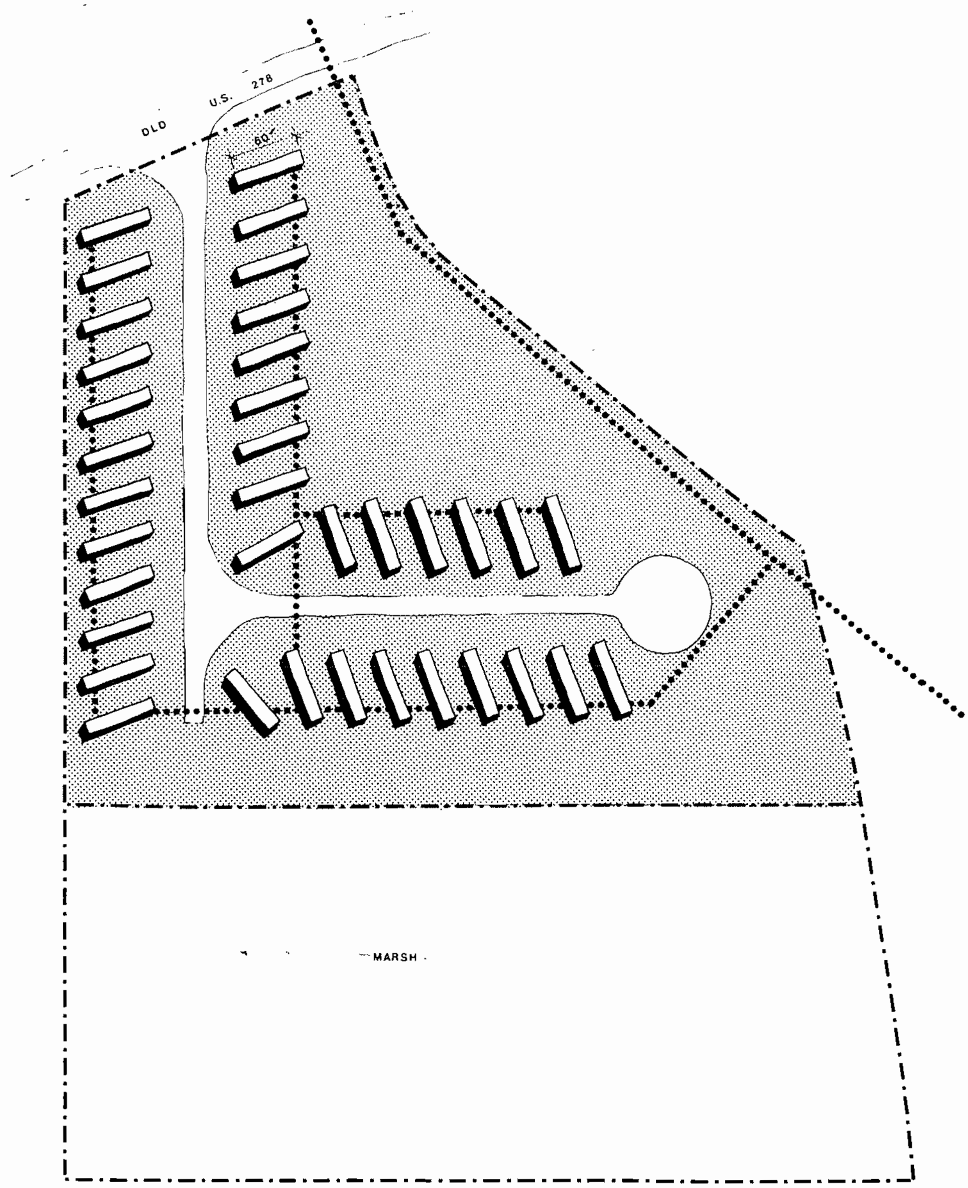
GROSS SITE AREA: 7.3 ACRES
MOBILE HOMES ON SITE: 24 UNITS
DENSITY: 3.3 UNITS/ACRE

MOBILE HOME UNIT
SEWER
SITE BOUNDARY
PARKING

0 50 100 150

FIGURE 7

GROUP SITE
BRENT, ALABAMA



	PER UNIT	TOTAL
LINEAR FT. OF ONSITE ROADS:	26.4	950
LINEAR FT. OF ONSITE SEWER LINES:	66.6	2400
COMMUNAL RECREATION FACILITIES (DEFINED SPACES):	SQ. FT.	SQ. FT.
COMMUNAL OPEN AREAS (UNDEFINED SPACES):	SQ. FT.	122000 SQ. FT.
INDIVIDUAL LOT AREAS (INCLUDING 50' ROADWAY):	4000 SQ. FT.	144000 SQ. FT.
PARKING SPACES PER UNIT:	1	36

Group Site
GUIN, ALABAMA
SOURCE: H.U.D.

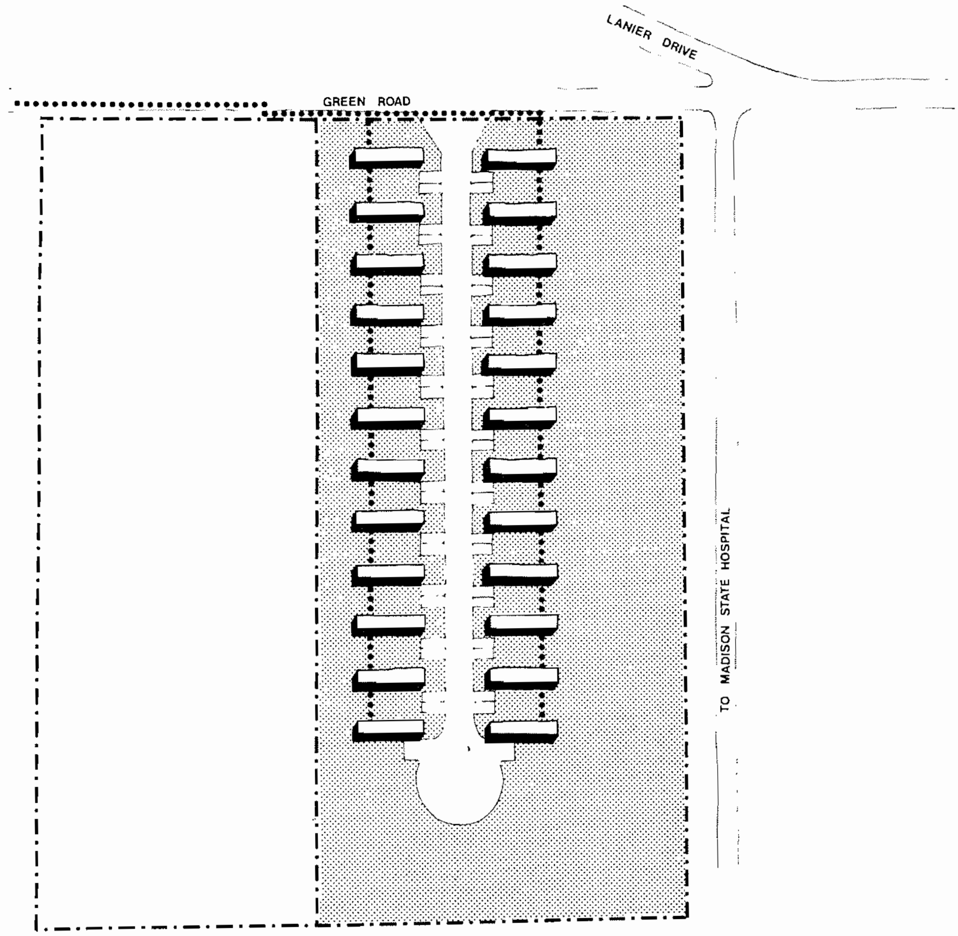
GROSS SITE AREA: 6.1 ACRES
MOBIL HOMES ON SITE: 36 UNITS
DENSITY: 5.9 UNITS/ACRE

MOBIL HOME UNIT
SEWER
SITE BOUNDARY
PARKING

0 50 100 150

FIGURE 8

GROUP SITE
GUIN, ALABAMA



	PER UNIT	TOTAL
LINEAR FT. OF ONSITE ROADS:	27	650
LINEAR FT. OF ONSITE SEWER LINES:	46.6	1100
COMMUNAL RECREATION FACILITIES (DEFINED SPACES):	SQ. FT.	SQ. FT.
COMMUNAL OPEN AREAS (UNDEFINED SPACES):	SQ. FT.	115000 SQ. FT.
INDIVIDUAL LOT AREAS (INCLUDING 50% ROADWAY):	5000 SQ. FT.	120000 SQ. FT.
PARKING SPACES PER UNIT:	1	24

Group Site
MADISON, INDIANA
SOURCE: H.U.D.

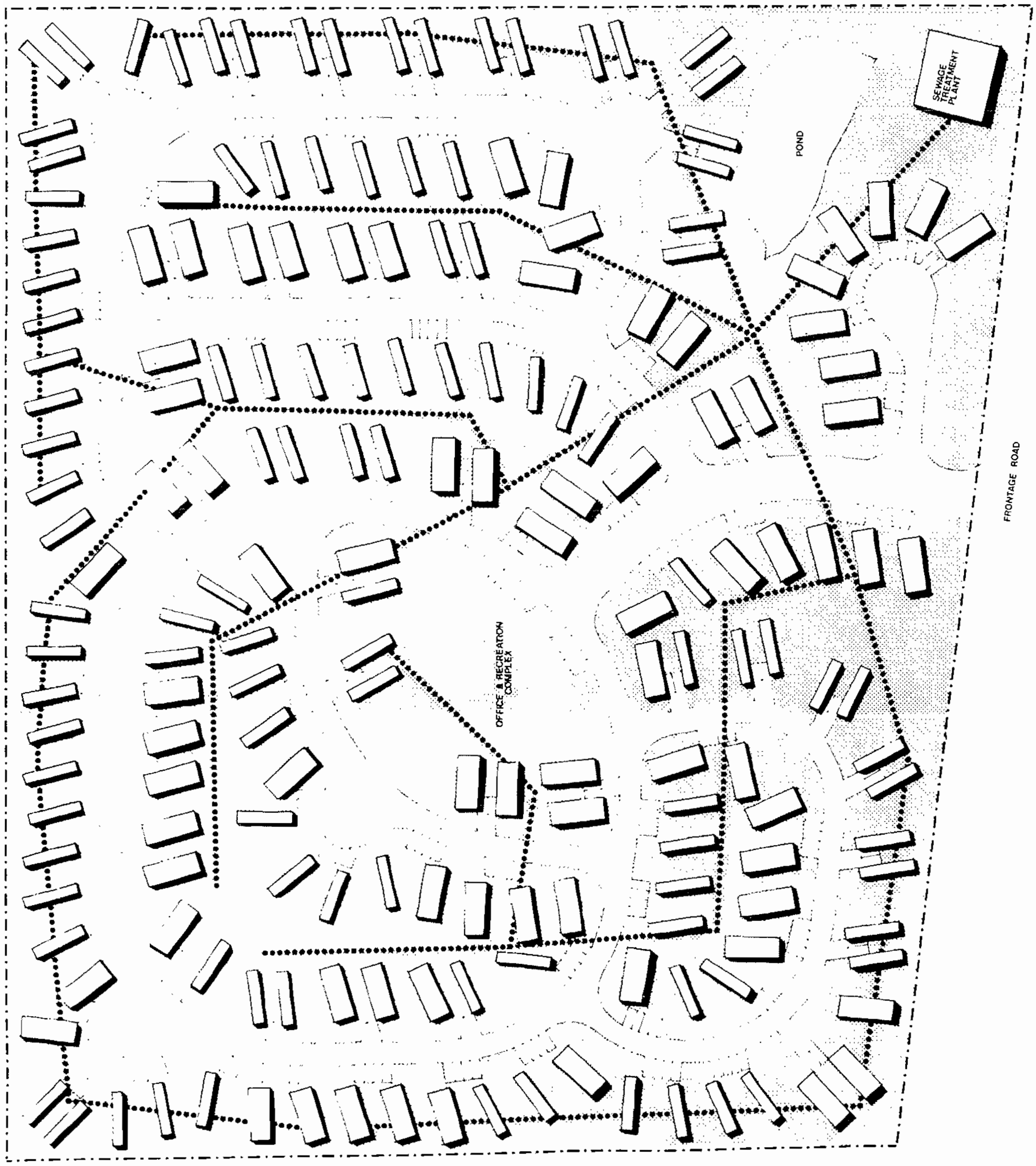
GROSS SITE AREA: 5.4 ACRES
MOBILE HOMES ON SITE: 24 UNITS
DENSITY: 4.4 UNITS/ACRE

MOBILE HOME UNIT
SEWER
SITE BOUNDARY
PARKING

0 50 100 150

FIGURE 9

GROUP SITE
MADISON, INDIANA



	PER UNIT		TOTAL	
LINEAR FT. OF ONSITE ROADS:	33		6300	
LINEAR FT. OF ONSITE SEWER LINES:	44		8250	
COMMUNAL RECREATION FACILITIES (DEFINED SPACES):		SQ. FT.		SQ. FT.
COMMUNAL OPEN AREAS (UNDEFINED SPACES):		SQ. FT.	324000	SQ. FT.
INDIVIDUAL LOT AREAS (INCLUDING 50% ROADWAY):	5500	SQ. FT.	1000000	SQ. FT.
PARKING SPACES PER UNIT:	11/2		282	

Yorktown Mobile Homes, Inc.
LEXINGTON, KENTUCKY
SOURCE: M.H.M.A.

GROSS SITE AREA: 30.4 ACRES
MOBILE HOMES ON SITE: 188 UNITS
DENSITY: 6.2 UNITS/ACRE

MOBILE HOME UNIT
SEWER
SITE BOUNDARY
PARKING

0 50 100 150

FIGURE 10
YORKTOWN MOBILE HOMES, INC.
LEXINGTON, KENTUCKY

TABLE 13

FEATURES OF SELECTED MOBILE HOME DEVELOPMENTS

Location	No. of Pads	Area (Acres)	Density (Pads/Acre)	Congregate or Recreational Facilities
Mundy St. Wilkes-Barre, Pa. June 1972	304	37	8.2	Play areas with equipment; community facilities in trailer.
Roosevelt #1 Swoyersville, Pa. June 1972	81	12.7	6.4	Existing playground and open space.
Ashley Ashley, Pa. June 1972	44	7.5	5.9	Open land adjacent to site.
Stewart Park Corning, N.Y. June 1972	70	7.9	8.86	None
Sullivan St. Elmira, N.Y. June 1972	48	6.9	6.9	None
Holding Point Elmira, N.Y. June 1972	172	27	6.4	Adjacent play area and fields.
Brent Brent, Ala. April 1974	20	5.5	3.64	Adjacent play areas.
Guin Guin, Ala. April 1974	36	6.1	5.9	Adjacent play areas.
Madison Madison, Ind. April 1974	24	5.4	4.4	None
Yorktown Mobile Homes, Inc. Lexington, Ky.	188	30.4	6.2	Pond; recreational center indicated for development.

Sources: Architects' plans and specifications on file at HUD regional offices.
Plans on file at the New York State Urban Development Corporation regional office in Elmira, N.Y.
Laboratory for Environmental Design and Planning, Pennsylvania State University, Emergency Mobile Home Group Sites: Their Potential for Community Reuse, March 1974.
Mobile Home Manufacturers Association.

Design of individual lots varied. The size of the lot and the parking area were ranked as fair or poor in most of the sites.

Nearly 60% of the sites had no walkways leading to unit entrances and none of the walkways that existed were rated good.

Two features were almost completely lacking in all sites -- patio area and storage area.

For the 40 sites studied the overall quality of site selection and design was good in 20% of the cases, fair in 30%, poor in 25% and unacceptable in 25%.

(d) Effect of Occupancy on Design and Planning

Good design is necessary for an efficient, livable group site. But it has other benefits. It can overcome or improve many factors that make mobile home developments undesirable to a prospective host community. A good design also can overcome, at least partially, drab or unsightly general appearance.

Because of the trauma disaster victims have suffered, they are especially vulnerable to the depressing effects of poor design, such as a monotonous linear layout unrelieved by trees, shrubbery or even grass. (Some of the Pennsylvania Agnes sites were built on giant piles of coal mine wastes, which, among other problems, were inherently depressing.)

Site design also can compensate for some of the shortcomings of mobile homes. Mobile homes often are used to disregard local tax and building codes and respond to the demand for cheap housing. Cheap shelter almost inevitably means inferior housing.

For example, most mobile homes are manufactured in the south and often are not insulated properly for northern winters. As a result, occupants of HUD mobile homes in Pennsylvania, New York, and South Dakota complained of cold in winter and enormous fuel bills. One partial solution is to provide skirting around the bottom of the unit.

One objection to emphasizing design features such as low density, varied layouts, and the provision of amenities is that these items increase the cost of the site. This issue commands attention because it usually arises at the same time sites are under construction and contractors are receiving much overtime pay because of the need to prepare sites rapidly. Cost is also a greater consideration when a state or local government is paying for site design and development.

However, as noted above, the added cost of good design brings important benefits and, since sites are often occupied for much longer than initially anticipated, good design becomes more important and its cost more justifiable. The Pennsylvania Agnes sites are most relevant in this regard. But an examination of other sites developed since early 1972 indicates that none on which information was available operated for less than a year.

The South Dakota sites established in summer, 1972 still provided living space for some 500 people seven months later; the New York Agnes sites were in operation for nearly two years; the May 1973 tornado sites in Georgia and Alabama were occupied for 16 months; and all the sites established after the April 1974 tornadoes were still in operation in December 1974 with at least half their original population.*

What prevents disaster victims from finding permanent housing or repairing their former homes more quickly? Several factors were at work.

- Disaster victims tended to be disproportionately young, old, poor, or minority members. People in these categories generally have particular trouble finding new housing or repairing their former homes.

- There was a shortage of construction and repair workers, and the cost of wages and materials doubled or tripled because of the sudden imbalance of supply and demand. There was widespread support in the Senate testimony for the imposition of strict controls on wages, prices, and rents after a disaster.

- New construction was delayed by red tape in federal housing programs, such as urban renewal, which were not geared to disaster situations nor to the need for large numbers of units and quick action. Also, many local officials were eager to use urban renewal programs to control future land use, especially in the flood plain.

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* Letters to the research team from HUD regional offices in Atlanta and Chicago and a telephone interview with the Cincinnati Director of Public Works.

- There was no clear definition of the flood plain, which delayed renewal plans. Bitterness also arose between victims who were compensated for damaged homes and businesses taken for urban renewal, and those who had to obtain mortgages to rebuild structures that might be more heavily damaged than those whose owners were compensated.

- A housing shortage existed in the area even before the disaster.

- Some site occupants found mobile homes inadequate, though they were better than the housing they had left or could find elsewhere. For some, it was the first experience with single-family dwellings. Sometimes the communities from which the disaster victims came were not eager to help them return. At the same time, if occupants from inner city areas were assigned to sites in suburban locations, they naturally preferred the better environment.

Some site occupants felt HUD exerted excessive pressure to move them from the sites into permanent housing. HUD's effort is understandable, but it is easy to see why some occupants felt they were being forced out of the sites when they had no place to go.

One solution was for HUD to sell the mobile homes to their occupants. HUD's Elmira director, L. A. Daugherty, told the Senate hearing that about 500 mobile home occupants in New York probably would eventually buy their dwellings and reported that 327 had already done so within a year of the disaster.*

The government could also provide at least part of its disaster assistance in the form of Fast Delivery Permanent Homes, as outlined in the research team's previous study.**

This seems cheaper than developing and maintaining long-term group facilities for families which have great difficulty finding permanent housing. Obviously, families with the worst housing difficulty stay longest in group sites. HUD officials in Wilkes-Barre said nearly two-thirds of the families still living on the sites two years after the disaster had annual incomes under $6,000.

(4) Site Development

Developing a group site can be complicated. Much criticism of the housing mission in Pennsylvania focused on the time required to prepare sites for occupancy, which resulted from problems in site development. Table 14 compares the development time and cost for various sites. Compared to the Pennsylvania Agnes sites, New York Agnes sites took less time to prepare for occupancy and cost less to develop.

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* U. S. Senate Subcommittee on Disaster Relief, "Hearings to Investigate the Adequacy and Effectiveness of Federal Disaster Relief Legislation," Part 4 (Hearings in Elmira, N.Y., June 1-2, 1973), P. 2068.

** Abeles, Schwartz and Associates and Beyer-Blinder-Belle, Cost-Effective Housing Systems for Disaster Relief, Vol. 4, Ch. III, Part B-3, pp. 222-316. (Also available as a separately bound excerpt from the research team).

TABLE 14

HISTORICAL COMPARISON OF SELECTED GROUP SITES

Disaster	Location: State/Locality	Total Families Assisted	No. of Families Assisted in Mobile Homes: Group Sites / Individual Sites	No. of Group Sites	% of Total Families Assisted Who Were Housed in Group Sites	Ranges of Density Among Group Sites (Units Per Acre)	Approximate Group Site Development Cost Per Pad*	Group Site Development Time
Tropical Storm Agnes June, 1972	Pennsylvania Wyoming Valley (Wilkes-Barre), Harrisburg area, Williamsport and other sites	20,330	4,678** / 1,307	65***	23	0.4 - 10.6	$3,300	12-13 weeks for all sites' completion from day of disaster; some were ready in 4 weeks' time.
Tropical Storm Agnes June, 1972	New York Southern Tier area (including Elmira and Corning)	5,964	1,565 / 193	30	27.8	4.32 - 26.09	$2,000	10-11 weeks to move in for all sites from day of disaster; some were ready in 2 weeks' time.
Tornado April, 1974	Alabama Triana, Guin and Brent	N.A.	57** / 0	3	N.A.	3.6 - 5.9	$700****	N.A.
Tornado April, 1974	Indiana Madison	N.A.	18** / 0	1	N.A.	4.4	N.A.	N.A.

II

* Includes cost of utilities, roads, grading and pads.

** These figures refer to the number of families actually housed in group sites. The figures in Tables 4-7 and 10-13 refer to the number of pads planned for the sites. Not all pads that were planned were built, and not all those that were built were occupied, especially in the Wilkes-Barre area.

*** Here again there is some discrepancy between this and other tables, since some sites were planned but never developed or occupied, and others were used only for storage.

**** Cost of utilities only; no costs for grading or other factors were listed.

Sources: HUD offices in Wilkes-Barre, Philadelphia, Chicago and Huntsville, Ala.
U.S. Senate hearings of the Subcommittee on Disaster Relief of the Committee on Public Works, May 11 and 12, 1973, and June 1 and 2, 1973.
New York State Urban Development Corporation.

One reason was that Pennsylvania needed more than twice as many sites and the sites there generally were much larger. Another factor may have been the differences between the COE and the UDC.

(a) Contractors

Although none of UDC's previous housing experience involved mobile home development, UDC did use the same kind of firms they had worked with previously. The agency was able to negotiate contracts with these firms quickly and knew their strengths and weaknesses. These firms probably were better than average because the UDC had a reputation for being selective. Because the UDC was highly regarded and very active, these firms were anxious to do well in order to receive future business.

The COE, however, had no previous experience with housing design and construction firms, and the scale of the disaster was so large the agency could not be too selective in selecting firms. The firms themselves had no reason to link their performance with the possibility of future work, since this was a one-shot operation for the COE.

Also, many firms felt that government contracts did not pay well enough to command their best work. And, although COE had done some flood relief work in the past, it apparently had little or no experience with mobile home group sites.

The COE's after-action report suggests that part of the agency's trouble stemmed from its internal organization. The COE would bring in as few permanent staffers from other areas of the country as possible and instead would hire local civilians on a temporary basis. This arrangement may have met the COE's internal needs, since it avoided disrupting agency work elsewhere but it probably deprived the disaster area of the proper kind of guidance. Also, most COE personnel were assigned to the disaster area for only 60 days, requiring repeated breaking-in of new staffers and adding to the confusion and lack of coordination.

Also, in some cases the COE did not supervise its subcontractors' work closely enough. This was especially true in Pennsylvania, where the severe shortage of labor and materials added to any tendencies to skimp on site work.

(b) The Mobile Home Unit

Opinion varies on the suitability of mobile homes for disaster housing. Criticism of the standard mobile home focuses on two issues: the livability of the unit, especially for long-term occupancy, and the time and cost needed to set it up on the site.

Obtaining units apparently was not as great a problem as anticipated, even in Agnes. For the Pennsylvania sites, HUD sent an SOS to mobile home manufacturers as far away as Louisiana and Texas. The manufacturers stepped up their production schedules and altered their techniques to meet HUD's request.

However, mobile homes are usually made to be transported only once -- from the factory to a site -- and some of those hauled longer distances and at higher speeds than usual needed repairs when they arrived. A number were unusable. But the damage apparently was not structural -- subsequent maintenance problems were no greater than for units obtained closer to the sites.

In fact, HUD eventually had an oversupply of mobile homes in Pennsylvania. Because of confusion in the housing application process, HUD found that it needed many fewer mobile homes than anticipated. However, the units it had ordered were already on the road. So, at HUD's request, Pennsylvania police reportedly just sealed the state's borders to mobile homes and turned back units as they arrived.

(c) Occupancy

An accurate estimate of the number of pads needed should be provided as soon as possible. The larger the disaster, the more this is a problem. After Agnes, disaster workers in New York kept track of displacees through computer lists. This system undoubtedly contributed to the relative orderliness of developing New York sites and moving victims into them.

In Pennsylvania, however, there was mass confusion. Those waiting for housing grew so frustrated that in August 1972 what was described as a near-riot occurred at HUD's Wilkes-Barre housing office.

Much of the problem was administrative. People complained about long waits at HUD offices; impolite, uninformed, and unsympathetic personnel, bureaucratic red tape that meant long delays and repeated visits before housing could be obtained; lack of definite word as to when housing would be available; and frequent misplacement of records.

Part of the trouble in Wilkes-Barre was the institution of other temporary housing programs. While worthwhile, they contributed to the confusion. Programs such as mini repair and interim assistance began after people had already signed up for group sites. When many of them decided to take advantage of the new programs, they neglected to take their names off the waiting list for mobile homes. One result was a large overproduction of group site pads.

(d) Discrimination

There were conflicting reports on possible racial discrimination in the Agnes relief mission. The American Friends Service Committee (AFSC), which analyzed this subject in Pennsylvania, reported that none of the blacks it interviewed thought there was any discrimination in dispensing relief or assigning housing. In fact, some blacks in Wilkes-Barre felt HUD made a conscious effort to assign black victims to group sites before whites, possibly to avoid any taint of discrimination.

HUD's care in this area may have stemmed from an incident a few days after the disaster when local agencies were assigning victims to available housing before group sites were ready. Citizen volunteers, who had been recruited as watchdogs by the state Commission on Human Relations, found that housing was being assigned along racial lines -- whites to a new suburban development, blacks to a high-rise housing project. One inspector was ultimately fired and the AFSC reported little difficulty afterwards.

The AFSC credited the absence of discrimination largely to the state's awareness of the possibility of discrimination and the vigilance of the Human Relations Commission.

The state gave the commission $374,000 to monitor the relief program for possible discrimination. The AFSC report expressed concern, however, that the anti-discrimination mechanisms of the federal government were not in themselves effective enough to prevent discrimination.

The AFSC noted that Office of Emergency Preparedness (OEP) plans called for hiring a civil rights compliance officer, but that none was appointed until two weeks after the disaster -- and then only after political pressure was exerted. The AFSC said the officer assigned was transferred after several weeks and civil rights compliance was turned over to an OEP public relations man.

Concern about federal anti-discrimination mechanisms also was expressed by the director of the Pennsylvania Human Relations Commission's flood recovery program, Thomas Arnoldi. He said some federal officials tended to think that few minority members were affected by the disaster and that therefore no enforcement program was needed. However, he noted, more than 25% of those applying for temporary housing in Harrisburg were black and nearly 50% of Wilkes-Barre's black population lived in flooded areas.

Arnoldi said the most complaints about discrimination occurred in areas where federal relief agencies had the closest contact with victims. Complaints focused on inadequate service and the attitude of employees.

He suggested that part of the explanation may be that temporary personnel were hired quickly and did not get adequate training or information about federal anti-discrimination rules.

In contrast to the AFSC, Arnoldi cited numerous reports, including some confirmed instances, of segregated patterns of placement in temporary housing.

(e) General

Although the Agnes relief mission was the largest in the country's history, many victims found it inadequate. The federal contribution of money, planning, and manpower was compared unfavorably with that accorded the space program, the Marshall Plan, and the Vietnam war.

It was observed in the Senate testimony that the military might have been better used in the relief effort. Some witnesses suggested that military architects and engineers should design group sites and military labor should help develop them. The feeling seemed to be that the military might do the job cheaper, better, and faster. There also was repeated and unanimous urging that extensive pre-planning be undertaken to prepare for future disasters. The recommendations included developing guidelines and training personnel at all levels of government. The most frequently mentioned needs were for clarification of roles, so various agencies would know who was responsible for what, and for much greater cooperation among different agencies.

d. Applicability of Commercial Standards and Experience

(1) Site Selection, Design and Development

(a) Site Selection

Selection of a site for a commercial mobile home park is based primarily on two factors not applicable to selection of disaster housing sites. The first element -- marketability -- is an essential criterion for the commercial developer. Disaster sites, however, are not subject to this test.

The second element -- zoning -- is also essential for the commercial developer. In locales with land use controls, commercial mobile home parks must be developed on appropriately zoned land. Disaster housing sites, on the other hand, are rarely subject to zoning controls.

Both commercial and disaster sites should be in centralized locations. Sites should be as close as possible to jobs, schools, and other community services. From the commercial point of view, a central location would enhance marketability; for a disaster site it would cause minimum disruption to established living patterns.

Other site selection elements such as topography, soil conditions, and availability of water and sewer lines effect the selection of any housing site.

(b) Design

The design of a commercial site is related to marketability. Such items as extensive landscaping, enclosed community buildings, and swimming pools, are often provided by a commercial developer, but are not necessary for disaster housing sites. Furthermore, the commercial site is designed for long-term use and in some cases lots will be sold. Thus, the commercial developer must consider occupant privacy and minimum lot size. Disaster housing sites, however, are only temporary, although privacy is still a requirement.

i. Density

Commercial mobile home parks developed recently have about five units per acre. This figure reflects demands for privacy and the increasing use of double-wide units for permanent dwellings. Disaster housing sites do not need as low a density. However, experience has shown that problems occur with densities of more than nine units per acre. Thus, a density of about six to nine units per acre -- similar to most commercial parks -- would provide both efficiency and privacy.

ii. Setbacks

Setbacks are related to privacy and lot use. Although the front setback for the standard commercial park is 25 feet, this would be excessive for disaster sites. However, the 10-foot sideyard setback usually required for commercial parks does not provide adequate privacy. Thus a single setback dimension of about 12 feet should be considered as a minimum standard for disaster sites.

iii. Parking

Both the USPHS and the MHMA suggest two parking spaces per unit, but this requirement seems excessive for disaster sites. HUD recommends 1.25 spaces per unit.

iv. Walkways

Conventional concrete sidewalks are not needed at disaster sites, but some separation of vehicular and pedestrian traffic should be provided. The factors of cost, development time, and subsequent site restoration suggest that gravel would be better than asphalt or other hard paving. A 2-foot gravel walkway leading to the unit's entrance also should be provided.

v. Streets

Street dimension requirements should be the same for commercial and disaster sites. Most streets in a commercial development are 24 feet wide, except for collector streets, which are 30 feet. (These dimensions do not include allowance for parking.) Gravel paving instead of a hard surface is adequate for disaster sites.

vi. Site Gradients

An 8% slope should be the maximum for any housing site. Land with a greater slope would have to be graded or left vacant. However, the overall site must have a minimum slope to permit surface water runoff.

vii. Recreation

At least 8% of the entire site should be set aside for recreation in both commercial and disaster sites. Recreation is important for disaster housing because it helps reduce the strain on victims, although commercial developments usually provide more recreation.

(c) Development

The development processes for commercial and disaster sites are quite different. The commercial site uses the conventional development process of obtaining interim and permanent financing and then beginning construction. It can take many months to develop a commercial site. For disaster housing, the process is greatly accelerated. Conventional financing is not needed and construction firms often work around-the-clock. It takes only a few weeks to develop a disaster site.

(2) Influence of the Mobile Home on Group Site Design

The unusual configuration of the mobile home -- 12'X60' (64' overall with the hitch) -- has a limiting effect on site design, especially when development costs must be kept down. As publications of the MHMA illustrate, site plans can be varied and interesting. However, such variations require more linear feet of street, sewer, and water lines per unit than commonplace layouts.

In its Agnes operation, the COE demonstrated the most economical development scheme: straight rows of units. Such an arrangement minimizes the need for grading, the amount of paving, and the length of utility lines per unit. However, too monotonous a layout can have a damaging psychological effect.

It is probably best to use a series of rectangular lots with enough area to accommodate the unit and provide adequate setbacks.

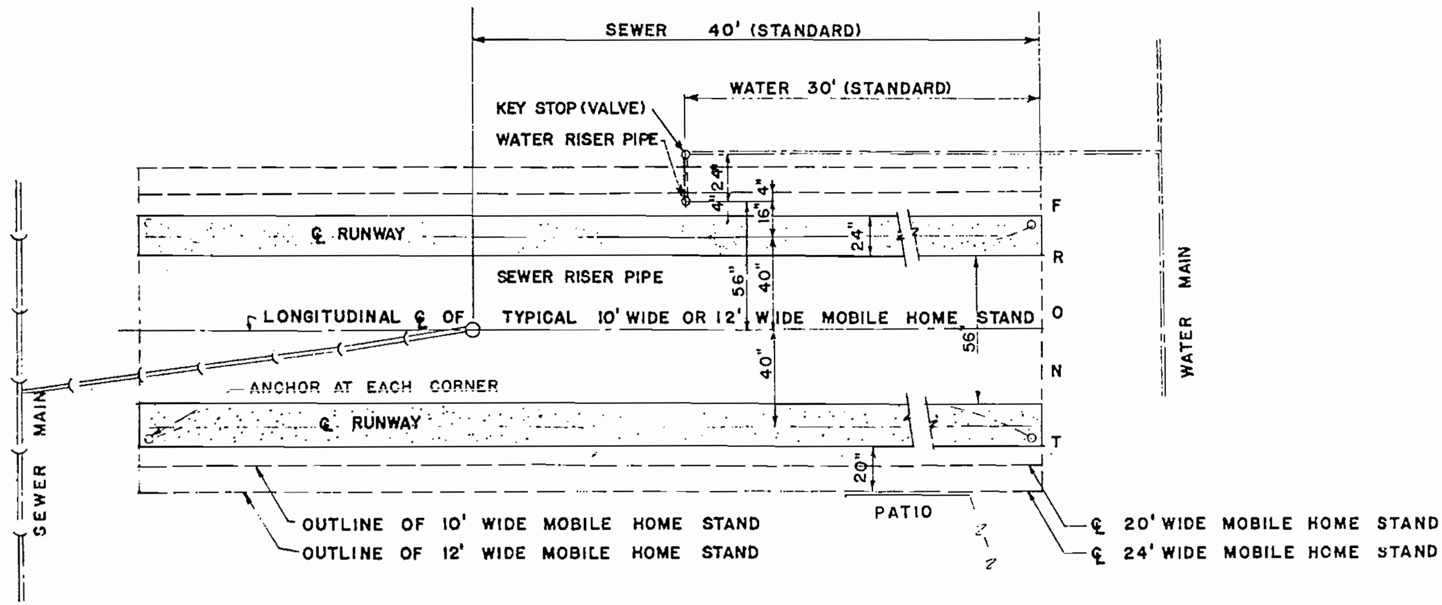
Streets should have a minimum corner-turning radius of 15 feet so units can be hauled to any part of the site. Enough space must be left between units so they can be selectively removed once they become vacant.

The mobile home influences site design primarily in terms of the layout of utility lines. The most efficient method is to lay utility mains along the rows of pads, with branch lines connecting individual units to the mains. Because almost all mobile home manufacturers locate utility stubs in a standard place, branch lines should be designed to terminate in the locations shown in Figure 11.

FIGURE 11

LOCATION OF STANDARD WATER AND SEWER PIPE

CONNECTIONS TO MOBILE HOMES



Source: Mobile Homes Manufacturers Association.

Use of a Special Design Mobile Home, instead of a standard mobile home, will not affect any of these site design elements.* However, its shorter length -- 48 feet rather than 60 feet -- would permit slightly smaller individual lot dimensions and less maneuvering space than for the standard mobile home. Figure 12 shows the floor plan of the Special Design Mobile Home.

2. TENANT SERVICES AND COMMUNITY FACILITIES FOR GROUP SITES

a. Present Standards for Group Sites

The lack of guidance on tenant services and community facilities for group sites has resulted in wide ranges of quality in temporary housing environments To help establish standards and criteria for services and community facilities, the research team evaluated published materials concerning recent disasters in Pennsylvania.

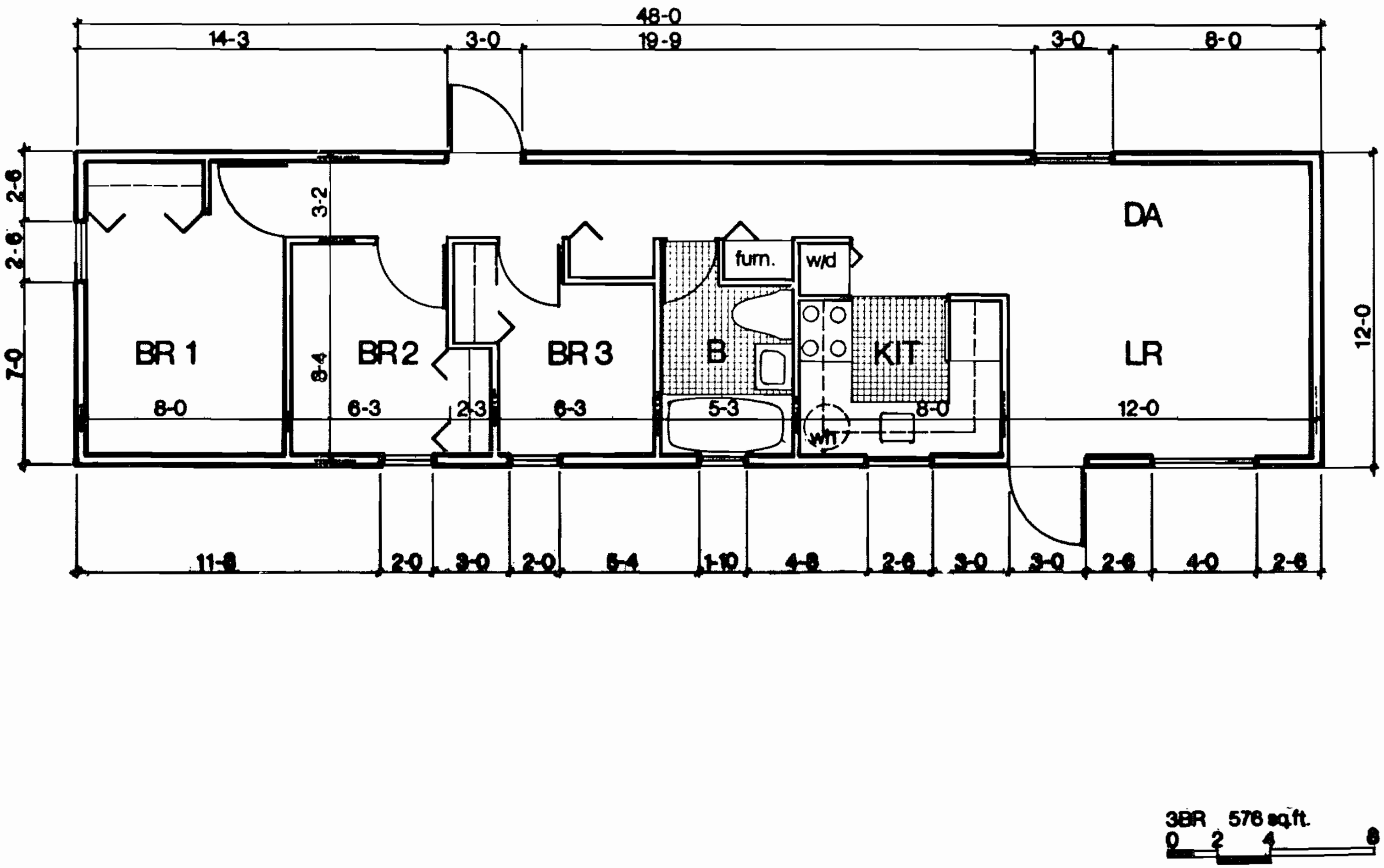
(1) The American City Report

The most comprehensive analysis of the subject is found in a study prepared by the American City Corporation for the Pennsylvania Department of Community Affairs. "A Report on Community Services and Life Support Systems for Flood Victims Who Will Live in Mobile Home Units" assigns the highest priority to reestablishing normal community life after the disaster. The report maintains that interim services and programs must be developed for victime who have been

* A study undertaken by Abeles, Schwartz and Associates and Beyer-Blinder-Belle, Cost-Effective Housing Systems for Disaster Relief, concluded that a Special Design Mobile Home would be the most cost-effective disaster housing system. See Volume 4, Chapter IV and Volume 5.

FIGURE 12

FLOOR PLAN FOR SPECIAL DESIGN MOBILE HOME



Source: Cost-Effective Housing Systems for Disaster Relief, Volume IV, DHUD, 1974.

separated from their former neighborhood.

> ...the quality of living for people in these temporary conditions will be maintained at as high a level as possible. The 'refugee camp' psychology must be avoided at all costs. The people who must live in temporary quarters will be accorded every consideration and dignity due to a fully functioning citizen... Response to a community emergency cannot be neutral. The physical, economic and social implications of temporary solutions can either accelerate or retard the recovery process in the years to follow.

The report makes specific recommendations concerning facilities at group sites. For example, it recommends that each site have laundry facilities. Since mobile homes have space and connections for washers and dryers, each unit could have this equipment.

The interior space of mobile homes should be supplemented by additional storage space, particularly for large families. Regularly used articles could be stored on-site in metal sheds, while larger, less frequently used items could be placed in off-site warehouses and basements.

When the report was prepared, group site specifications did not call for exterior lighting. However, for reasons of safety and security, it should be provided.

Individual mobile homes and on-site facilities should be distinctly marked. A clear and readable numbering system for mobile homes and conveniently placed signs and site layout maps should be part of each site.

Mail service is important so site occupants can maintain contact with friends and relatives. Clustered mailboxes, serving 16 to 20 units, are recommended.

Each site should have an office-trailer for the park manager and staff. The office also could be used to disseminate information on permanent rehousing, employment, and legal assistance. Bulletin boards would be useful to publicize social events, public notices, and community meetings.

A multi-purpose center for each site is recommended. Its size would depend upon the number of units on the site. The center would be available for meetings, interviews for job placement and permanent housing selection, day care, indoor recreation, senior citizen activities, and other events.

The physical design of the group sites should assure adequate open space and play areas. Nearby facilities such as schools can be used for additional recreation space.

The Pennsylvania sites varied greatly in their convenience to shopping. Some parks adjoined town centers while others were distant from shopping. The report recommends that shopping areas and group sites should be connected by bus service or that deliveries to group sites should be made on a pre-arranged schedule.

The large number of elderly persons and children at group sites underscores the importance of proper health care. Public transportation should be provided between concentrations of medical offices and distant group sites.

(2) The NAHRO Report on Temporary Housing

"Temporary Homes for Permanent People," a report by the National Association of Housing and Redevelopment Officials, is concerned with a management, maintenance, and service program for occupants of Agnes-related sites. The report recognizes that mobile homes will be the only housing available for many families for some time and it stresses ways to make these accommodations as livable as possible.

The report recognizes the importance of such services as trash and garbage collection, police and fire protection, and exterior lighting. It recommends that the first trailer placed on a site should be used by the park manager and his staff. The trailer should be placed at the entrance to the park where it will ensure security, help control traffic, and be easily identifiable by residents.

The report emphasizes that site residents need access to public and private agencies to help them resume their normal lives. The park manager and his staff should facilitate these contacts. Services for site occupants should include permanent rehousing assistance and a breakdown of agencies available for individual relief guidance.

Although specific recommendations for recreation facilities are not included, the report recommends that play areas be placed at a convenient central location.

(3) HUD/EPS Mobile Home Handbook

The Emergency Preparedness Staff's "Mobile Home/Travel Trailer Handbook" briefly describes community facilities and services which should be available to site residents. The emphasis is on using familiar community resources. The report recommends that persons selecting sites consider their proximity to jobs, shopping, schools, recreation, and police and fire protection. By making optimal use of existing community facilities, duplicate services will not have to be provided.

The HUD/EPS handbook recommends that several facilities and services be provided at sites. Electricity should be adequate for exterior park lighting. Outdoor spaces large enough to accommodate outdoor living should be provided, along with children's play areas. Space for drying clothes, garbage and trash disposal, and mail boxes should be provided. Tenants should be allowed to install such amenities as patios, storage huts, and fences.

The handbook does not define recommended community facilities in a way that would encourage them to be provided. Nor does it discuss site needs in terms of the severity of the disaster or the characteristics of the victims.

b. <u>Recent Experience with Group Sites in Pennsylvania</u>

In the Pennsylvania Agnes sites, which represent HUD's largest housing mission, the key factor in the provision of community facilities and services seems to have been the attitude of HUD officials toward the appropriateness of such services and facilities for group sites.

Interviews with HUD staff in Wilkes-Barre and Harrisburg indicated that the primary concern was restoring the community to pre-flood conditions. Temporary housing was regarded strictly as an interim solution. Thus, to discourage a feeling of permanency toward mobile home living, services and amenities were kept to a minimum. In fact, after the first 18 months, when it became clear that some families viewed mobile homes as permanent shelter, services were curtailed.

The strong desire to discourage an attitude of permanency was revealed by the Senate testimony of Frank Carlucci:

> Group sites placed flood victims in environments away from their former home and community. While great effort and expense was put forth to make these group sites viable communities by providing recreation, transportation, and essential community services, the effort by its very nature is counter productive in rebuilding the damaged community and aiding individuals to return to their

> new homes. We succeeded in creating new communities within communities and new communities outside of communities. The aim of disaster relief should be to revitalize the existing flood stricken community. By using the group site method of temporary housing, I feel that we are taking an economically and psychologically damaging step.

Compounding the federal attitude was the response of some localities which were asked to provide services to the sites. Restoration of basic services was a burden some municipalities were not prepared to assume.

(1) Transportation Services

Since many sites were located in outlying areas, additional transportation was needed to enable people to get to get to jobs, schools, and community services. The federal government provided free bus service for these sites for nine months.

(2) Telephone Service

The disruption of normal personal contacts magnified the importance of telephones for site residents. In some areas, pay phones were placed in various on-site locations, and temporary residents were eventually able to obtain individual telephones.

(3) Mail Service

Mail service should have been provided to individual mobile homes. Unfortunately, money and manpower did not permit it. At some sites, mail was initially picked up at the post office; later, communal boxes were placed at the sites.

(4) On-site Storage

Many residents had furniture and other possessions too large to fit into mobile homes, but which they would eventually need. The need for storage space beyond that provided in the mobile home was a continuing problem. HUD did not permit on-site storage sheds.

(5) Laundries

On-site clothes washers and dryers were not permitted. Tenants had to use off-site facilities, often at considerable inconvenience.

(6) Recreation

Most group sites lacked adequate outdoor recreation space, either on-site or nearby. Frequently only a paved area, without any playground equipment, was available. No distinction was made between play areas for older and younger children. Outdoor activities were unsupervised and indoor facilities were unavailable.

(7) Congregate Facilities

Communal facilities, such as dining halls or day care centers were not developed at any sites.

(8) Multi-Purpose Centers

At several large sites, pre-fabricated paper structures were erected for indoor activities. However, these buildings were unusable in winter. None actually went into operation nor were replacements installed.

(9) Resident Advisory Services

Although initial problems arose in coordinating the various social agencies responsible for disaster assistance, most tenant needs eventually were satisfied. Health care and aid for the elderly were adequate, and legal and housing assistance were provided.

c. Considerations for Future Group Site Development

HUD's temporary housing program must recognize the need for flexibility in delivering community facilities and services. Although existing guidelines may be appropriate for most situations, new standards are required for more devastating disasters. To enforce a refugee camp psychology by minimizing services can only further injure a vulnerable population.

(1) Factors Influencing the Need for Group Site Facilities

Services and facilities provided for sites should reflect the impact of the disaster upon the housing supply, existing community services and facilities, their relationship to the site, and the site's capacity. The size of the stricken population and its characteristics, such as age and income, will help define specific needs. By estimating how long sites will be occupied, victims' needs can be better assessed.

(2) The "Permanency" of Temporary Housing

Efforts by HUD officials in Pennsylvania to discourage attitudes of permanency among site residents are understandable. However, discouraging a sense of permanency by curtailing services does not solve the problem and in fact may exacerbate it.

Restoration of the community is the best way to return a disaster struck area to normal. Temporary housing complexes which create new communities generally do not aid such restoration.

Group sites should be located and developed so residents can make maximum use of existing community facilities. This approach will help provide psychological and emotional security for residents and will encourage restoration of pre-disaster relationships.

Sites should provide convenient access to shopping, schools, and jobs, and permit tie-ins to existing utility systems. Sites should be accommodated within pre-disaster settlements. Locating sites outside of settled areas shifts settlement patterns, weakening the value of existing facilities and requiring new transportation services or new facilities.

(3) Group Site Community Facilities

As much as possible, shopping, transportation, consumer services, and utilities should be provided by existing systems. However, certain on-site services, such as storage, exterior lighting, trash collection, security, outdoor recreation, and mail collection, are still required. These services represent minimal needs and should not be regarded as a way of avoiding permanent restoration of the community.

In addition to these services, others may be needed. Remote locations may require supplementary public transportation to schools, jobs, and shopping. If retail trade is seriously affected, mobile services may be required to deliver food and other goods.

If site residents have lost much of their clothing, remaining items will have to be laundered more frequently. Laundry facilities must be accessible, preferably within each mobile home or grouped together on the site.

Additional on-site facilities, such as recreation and communal spaces, should be provided within all but small sites. Recreation and social services such as day-care should be available.

In a severe disaster, sites may have to assume a more permanent character. Although community restoration should be the paramount goal, occupants should not suffer from a lack of services.

C. OCCUPANCY, TENANT RESPONSE, MANAGEMENT, AND MAINTENANCE OF TEMPORARY HOUSING SITES

1. CHARACTERISTICS OF MOBILE HOME OCCUPANTS

a. Introduction

The social and economic characteristics of families accommodated on group sites should be considered in the selection and design of these facilities. Family size, composition, and age will help determine requirements for recreation, open space, density, community facilities, and transportation. Family income and amount of housing damage will help indicate how long temporary housing will be required and the probable turnover rate. Site selection can be improved through an understanding of commuting patterns of the jobholders, the number of school-age children, dependency upon public transportation, and the availability of automobiles.

Although the characteristics of site population will vary with each disaster, some similarities exist among families which have been assisted in the past.

The most comprehensive information available concerning site residents is contained in a report written by Ide Associates for the Pennsylvania Department of Community Affairs. This report, "A Survey of Pennsylvania Flood Victims Residing in HUD-Provided Mobile Homes," was prepared in 1973. The research team obtained additional information through interviews with officials in the affected areas.

b. Pre-disaster Living Situation

Of the areas affected by Agnes, Corning and Elmira, N.Y., and Wilkes-Barre, Pa., sustained the worst damage to the existing housing supply. Since these cities were located along rivers, the older housing was especially vulnerable to the storm because it usually was located in mixed-use districts within low-lying flood plains. This older rental housing of wood frame construction was least able to withstand flooding. As a result, many families displaced by Agnes were poorer occupants of lower quality housing.

A large proportion of site occupants had been renters. The median rent plus utilities for pre-flood units ranged between $100 and $124 per month. The median value of homes owned by site occupants was $15,000 to $20,000.

The housing and personal property of site occupants suffered severe damage. In Pennsylvania, median household damage ranged between $8,000 and $10,000 and more than a quarter of the site occupants suffered $20,000 or more in damage.

c. Household Characteristics

Families displaced by Agnes tended to be older and less affluent. Among all Pennsylvania site occupants, the median age of heads of households was 45 to 49 years and more than 56% were 55 or older. Among households of one or two persons, 55% had heads of households 60 or older.

Among Pennsylvania site occupants, the median education of the principal wage earners (or heads of households if no one was employed) was 12 years of school. More than a third of the principal wage earners fell in this category.

More than 60% of all mobile home households included one or more employed members; in 31% no one was in the labor force, and in 7% no one was employed, but someone was looking for work. Of the principal wage earners, 21% worked in white collar occupations, 50% in blue collar occupations, and 11% in service occupations. The employment picture for small households was far worse than for large ones, reflecting the concentration of older, retired persons among small households.

Among Pennsylvania site occupants, median post-flood household income ranged from $4,000 to $5,000, slightly below pre-flood levels.

d. Implications for Site Selection and Design

The areas most severely affected by Agnes created a high demand for temporary housing among two groups -- the elderly and the poor. These groups require particular consideration in the preparation of group sites.

Applications for temporary housing submitted by victims can provide the socio-economic information needed to determine specific household requirements. A large number of elderly applicants indicates that sites should stress ready access to shopping areas, medical facilities, and community activities. The site should provide access to public transportation and perhaps be located within walking distance of community facilities.

Identification of family characteristics such as the number of children and schooling requirements provides a valuable resource for selecting and designing sites. The limited space within mobile homes and the small lots they are placed on present serious problems for large families. On-site recreation space should be provided if none exists nearby. The probable length of time the site will be occupied and prevailing climatic conditions will determine the value of indoor community facilities. Sites which are distant from public indoor spaces should include on-site facilities.

The elderly and the poor often rely upon outside public services, such as medical and mental health care, legal services, and employment counseling. Consolidation of these services within a one-stop multi-service center -- perhaps on-site -- may give occupants better access to disaster recovery assistance.

2. OCCUPANT RESPONSE TO TEMPORARY HOUSING

a. Introduction

The reactions of occupants to temporary group housing can be useful in identifying the limitations and problems of this type of relief and can help improve the design and development of future sites.

The Ide Associates report offers the most complete analysis of victims' responses to temporary housing, particularly the section which surveyed the attitudes of about 400 group site residents.

b. Mobile Home Situation vs. Pre-flood Situation

The survey indicated that the response of victims to mobile home living was slightly unfavorable: 40% thought mobile home living was worse than their pre-flood situation, while only 32% thought it was better. Attitudes toward mobile home living were more favorable among households with fewer years of schooling and lower incomes. These findings presumably reflected less desirable pre-flood accommodations. Attitudes toward mobile homes were less favorable among homeowners, elderly households, and those planning to return to pre-flood accommodations or to relocate into single-family homes.

c. Convenience to Jobs and Shopping

Most site residents thought they were farther from shopping than they had been before the disaster; 35% thought group sites were less convenient, 47% thought they were the same, and only 17% thought they were more convenient. Older, smaller, and more prosperous households thought mobile homes were less convenient to shopping and jobs.

d. Attitudes Toward Neighbors, Schools and Safety

Households were assigned to group sites as soon as mobile homes were available. Initially, occupants had little choice of the site to which they were assigned, removing any control over the selection of neighbors. Twenty-four percent thought their neighbors were worse than before, 54% thought they were the same, and 21% thought they were better.

Site occupants felt slightly less safe in their mobile homes than in their previous neighborhoods. Twenty-eight percent thought the level of safety was worse than at their pre-disaster location, 45% thought it was the same, and 26% thought it was better.

For many families, the move meant temporarily better schools and an improved community setting. Fifteen percent thought the new schools were better, 48% thought they were the same, and 14% thought they were worse.

e. Favorable Aspects of Mobile Home Living

The most frequently cited favorable responses to mobile homes were:

(1) convenient, everything handy (27%);

(2) all on one floor (25%);

(3) easy to clean (20%);

(4) very nice, nice place to live, like it (20%);

(5) provided shelter when needed, roof over our heads (17%);

(6) good heating, heat cost less, no furnace to cause problems (16%);

(7) modern conveniences, appliances, new furniture (15%);

(8) by yourself, have privacy, like a single home (15%);

(9) clean, everything new, looks nice (10%).

Only 7% thought mobile home living had no good points.

Small households were more likely to approve of mobile home living than large ones. Site occupants with lower incomes were also more likely to approve of mobile home living.

f. Unfavorable Aspects of Mobile Home Living

The most frequently cited unfavorable aspects of mobile home living were:

(1) not enough interior space, too cramped (31%);

(2) not enough storage space (21%);

(3) not enough exterior space, too close to neighbors, no yard (17%);

(4) heating too costly, problems with heating (15%);

(5) too cold in winter, too hot in summer, poorly insulated (15%);

(6) poorly built, flimsy, leaks, pipes rattle, faulty wiring (12%);

(7) not enough policing or security, undesirable people in park (12%);

(8) no place for children to play, too small for children (9%);

(9) bad location, too far from everything (8%).

Twenty percent said there were no bad points about mobile home living. Most complaints focused on the mobile home unit rather than the location and development of the site. Predictably, household size was related to attitudes regarding mobile home living; among large households, 44% cited the lack of interior space, 27% cited the lack of storage space, and 21% cited the lack of exterior space. Families with children complained of inadequate recreation space and indoor space. Older households complained about the mobile home heating system and the inconvenience of the site location. Young families with children criticized the limited interior and exterior space.

Among households earning less than $4,000 a year, 29% said mobile home living had no unfavorable aspects. For these families the limitations of the mobile home were not severe enough to negate what they saw as substantial advantages. Other factors which affected occupant's responses to mobile home living were type of pre-disaster housing, expected duration of mobile home occupancy, and type of permanent housing to be obtained.

g. <u>Ideas for Improving Mobile Home Living</u>

Occupants' suggestions for improving mobile home living may be classified as follows:

(1) better and more solidly build, sturdier, more insulation (17%);

(2) more interior space, larger rooms, more rooms (14%);

(3) more exterior space, bigger lots, more privacy (13%);

(4) better heating, hot water or air conditioning (10%);

(5) playground facilities for children, play area (10%);

(6) improve roads and appearance of grounds (9%);

(7) more supervision, policing, regulation, security (9%);

(8) add porch or patio, improve steps, provide exterior lighting (6%);

(9) better locks and latches on doors, doors should open in instead of out (6%).

3. MANAGEMENT OF GROUP SITES

a. Introduction

An understanding of the management problems associated with temporary group housing can be useful in evaluating the selection, design, and development of these sites. A review of the management problems encountered in the Pennsylvania Agnes mission provides a broad basis for evaluating existing practices.

Under the initial system devised for Pennsylvania, each major site had a resident manager. Large sites also had one or two assistant managers and an on-site clerk/receptionist. Because of the large number of sites and the broad geographic area involved, an extensive horizontal and vertical administrative structure emerged. Control was widely dispersed, impeding rapid and effective decision-making.

In October 1973, the administration of group sites was reorganized into a system of non-resident district managers. Consolidating the vertical hierarchy into a more centralized structure made possible a more effective response to group site housing problems.

b. Location of Group Sites

Many group sites in the Wyoming Valley were some distance from the stricken neighborhoods and many victims were housed far from their original homes. As the recovery proceeded, the remote locations of certain sites became a problem. Many families tried to move to other sites where friends and neighbors were living. As vacancies at sites increased, managers permitted people to move from one site to another.

If group sites are developed outside of severely damaged neighborhoods, will this effect the permanent re-housing choices of site residents? In the Wyoming Valley, many families driven from older inner-city areas were relocated in suburban communities that offered better housing, schools, and public services.

Several Wilkes-Barre officials speculated that the relocation did influence future housing decisions for some households. Of course, for families with limited incomes, little change was possible, and the mobility of homeowners was restricted by pre-disaster property investments. However, among households which were more affluent and had previously been renters, temporary occupancy at a suburban group site could have a major effect upon the permanent re-housing choice. Improved schools at the new location often were a particular incentive to relocate.

Long-term results of such a trend would include changing residential patterns, new retail bases, and an increased demand for housing at new locations.

c. Size, Design and Physical Layout

The size of sites varied considerably -- from as few as eight mobile homes to more than 400. Size, however, appears to have had little effect on management problems. HUD officials in Wilkes-Barre reported that some small sites had more severe management difficulties than large ones. The primary factors affecting manageability were the type of tenants, interactions among tenants, and problems in securing services for the occupants.

Although the capacities of the sites varied, the linear layouts and designs were fairly standardized. According to housing officials, no specific management problems arose as a result of site designs.

In general the sites provided few communal facilities, such as indoor recreation space, meeting rooms, outdoor play equipment, laundry rooms, or day care centers. During the initial phase of occupancy, this lack did not appear to cause specific management problems. However, as the recovery effort progressed, the lack of amenities became more objectionable. The lack of space and outdoor recreation facilities was strongly criticized. The small size of the mobile home was felt most acutely by large families. Even on sites which had outdoor play areas, young children had to compete with older ones for the limited space. Roadways, parking areas, and the small yards between mobile homes came to serve as supplemental recreation space. These areas were inadequate and unsafe; their use as play space led to tensions between families and greater management intervention was required to resolve problems.

On sites with large number of children and inadequate play facilities, boredom among young occupants was a problem. Vandalism and property damage often resulted, requiring greater time and attention from the management.

d. <u>Responsibility for Managing Group Sites</u>

Federal legislation does not specify who is responsible for managing group sites, although in most cases the federal government has assumed this responsibility.

Theoretically, local government management of group sites should offer certain advantages. Local officials are more familiar with their area and should be skilled at coordinating local agencies. They should have a better understanding of local residents and their needs.

In Pennsylvania some attempt was made to use local government for managing sites. However, sites under local control had more management difficulties and met tenants' needs less successfully than those managed by HUD. According to HUD managers, local agencies lacked the experience, personnel, and qualifications to properly manage sites. Local officials were charged with nepotism and wastefulness. Local agencies often did not provide services that poorer and elderly site residents required. Some critics suggested this was done deliberately to discourage these persons from re-entering the community.

When victims from inner-city neighborhoods were moved to suburban group sites, some local officials in the new areas were reluctant to provide adequate services, in an effort to discourage poor or elderly temporary occupants from becoming permanent residents.

e. Perception of Temporary Housing by Group Site Residents as Permanent Housing

Since some families occupied group sites for more than two years, they naturally developed an attitude of permanency towards them. Pennsylvania officials cited this problem as one of the major obstacles hindering the phasing out of temporary housing.

While many families found temporary housing superior to their pre-disaster accommodations, group sites are not a permanent solution for displaced families. Yet families which remain longest at group sites tend to have the hardest time finding permanent quarters. They generally have more social problems and lower incomes and are more likely to be unemployed. Some of them have been refused public housing. For this group, mobile homes represent the best housing available.

Management problems sometimes have arisen when officials tried to close group sites and find permanent housing for the remaining occupants. When services were cut back, some residents retaliated by abusing the mobile home and vandalizing the property. Other families continued to maintain the dwelling, anticipating that it would become their permanent residence. Some sought permission to install interior improvements, fences, porches, and patios -- even a swimming pool.

In Wilkes-Barre the re-housing of the remaining group site residents remains a severe problem because the community does not have enough housing they can afford. Since it is nearly impossible to evict group site residents, some Pennsylvania sites are still in use three years after Agnes.

The permanent resettlement of families which tend to remain on group sites is more a social problem than a housing problem. These families are most in need of outside resources and have the fewest options. The pattern in Pennsylvania is not unique. An analysis of reactions to Hurricane Camille in several Virginia communities revealed similar problems among long-term site residents. The study found that these families were disadvantaged, low status households and concluded:

> Mobile homes present an effective solution to one of the oldest problems of disaster relief, temporary housing for victims. The survey shows they are acceptable as temporary housing for all income levels, but the higher income victims are eager and able to leave at an early date. At the end of the period, the temporary housing problem becomes part of the community's continuing welfare problem.

4. MAINTENANCE PROBLEMS ASSOCIATED WITH GROUP SITES

The large number of group sites developed in Pennsylvania required a sophisticated maintenance system. During the first weeks, a great many repairs were needed to correct problems arising from the transportation and installation of mobile homes. The most extensive and responsive maintenance system was developed in the Wyoming Valley. Here, maintenance crews and their 70 vehicles were on call 24 hours a day. Indeed, HUD officials noted that perhaps the system was too good, because site occupants came to rely too heavily upon outside maintenance and demand assistance for tasks they could have handled themselves.

a. Location

Since many of Pennsylvania's group sites were in remote locations, maintenance crews had to make lengthy trips to reach them. Repairs at outlying sites were not done as promptly as repairs at more centrally located sites.

b. Density and Size

The density of sites ranged from five to 10 units per acre. HUD officials did not think that maintenance would have been significantly affected by higher or lower densities.

Nor did the size of the site appear to affect the level of maintenance problems. Although large sites received better maintenance services, this was related to the concentration of problems within a small area.

c. Layout

One of the few variations in site design was the placement of utility lines either above ground or below ground. Each variation presented certain problems. Above ground utility lines, although readily accessible for repair, caused problems in winter when water pipes would easily freeze. With underground utilities, it was necessary to remove the unit to repair the pipes. Also, the lack of shut-off valves, bypasses, and loops made it impossible to repair the plumbing systems without disruption to other units.

Winter severly affected the mobile homes. Inadequate winterization of plumbing connections and the mobile homes made them susceptible to cold weather. Freezing and ground swelling led to frequent leaks, and pipe seam splits. Heat tape and other forms of winterization were needed to prevent water and sewer lines from freezing.

Part III

Use of Portable Life Support Systems for Temporary Disaster Housing

A. INTRODUCTION

Disaster housing sites should be located where there are existing utilities. In some cases, however, existing systems have been damaged or are not available. In such cases, alternative systems or portable systems must be considered.

In this section, systems are evaluated for effectiveness. Selection criteria and supporting data are included.

The procedure for selecting an appropriate system is as follows:

- Estimate the number of units at a site (figure six to eight units per acre).

- Estimate how long the site will be used; This depends upon the availability of existing housing and the time needed to relocate victims.

- Investigage the availability and capacity of existing sewer and water utilities.

- Investigate the availability of electrical power. The site should be connected to an existing power line. On-site generation should be avoided except in unusual circumstances. The amount of electricity needed depends upon whether the mobile homes uses all-electric or partial-electric power; with partial-electric power, bottled gas should be used for the remaining power needs.

- Select portable life support systems according to size of site, period of use, and other relevant criteria.

B. ASSUMPTIONS OF THE ANALYSIS

The analysis of portable life support systems is based on certain assumptions regarding:

- System requirements;
- Site considerations;
- System configurations;
- Costs;
- Methodology of cost-effective analysis

Every disaster is different. Factors such as size of the housing development, its duration, characteristics of the site, climate, and the availability and cost of utilities must be investigated for each disaster. A report like this cannot cover every possible set of circumstances. Therefore, an engineer should be consulted before final decisions are made.

1. SYSTEM REQUIREMENTS

Requirements for support systems were established in Volume 4 of Cost-Effective Housing Systems for Disaster Relief, submitted by Abeles, Schwartz and Associates and Beyer-Blinder-Belle to HUD in September, 1974.

The requirements are:

a. Water

Assuming no water-saving devices are installed in individual housing units:

average flow - 280 gallons/dwelling unit/day

peak flow - 7½ times average flow; no averaging peaks with system size; no fire fighting assumed necessary

pressure - 30-60 psi

Assuming water-saving devices are installed in individual housing units:*

50% reduction in water usage (low-water-using toilets, no laundry on site, aerators in faucets, low-water-consumption shower heads)

average flow - 140 gallons/unit/day

peak flow - 10 times average flow; no averaging peaks with system size; no fire fighting assumed necessary

pressure - 30-60 psi

b. Sewer

Assuming no water-saving devices are installed in

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*A 72% reduction which substituted a dry toilet like the "Ecolet" was investigated. Because HUD does not favor dry toilets, the system is not discussed in this report. However, the impact of continued water reduction is worth presenting and is therefore included in the summary table. The costs of continued water reduction with or without dry toilets are approximately equal, except in the pressure sewer system where grinder costs are less with dry toilets. The requirements for 72% reduction are:

water supply

average flow - 80 gallons/unit/day
peak flow - 15 times average, no fire fighting
pressure - 30-60 psi

sewage disposal

average flow 72 gallons/unit/dry
peak flow - 15 times average
treatment level - secondary
raw waste characteristics - 70-80% of strength of normal domestic sewage

individual housing units:

average flow - 250 gallons/unit/day

peak flow - $7\frac{1}{2}$ times average flow

treatment level - secondary

raw waste characteristics - normal domestic sewage (assuming clothes washing machines in each unit, no garbage grinders or dish washing machines installed)

Assuming water-saving devices are installed in individual housing units.*

50% reduction in water usage (low-water-using toilets, no laundry on site, aerators in faucets, low-water-consumption shower heads)

average flow - 125 gallons/unit/day

peak flow - 10 times average flow

treatment level - secondary

raw waste characteristics - double strength of normal domestic sewage

c. <u>Gas and Electric</u>

(1) Electric

(a) All-Electric

Service	150 Amp, 120/240 V, 1Ø, 3 Wire

*Ibid.

Peak Demand/Unit 30 KVA

Average Consumption/Unit
12 mos. 27,000 KWH

Average Consumption/Unit
3 mos. 2,700 KWH

(b) Partial-Electric

Service 100 Amp, 120/240 V,

Peak Demand/Unit 15 KVA

Average Consumption/Unit
12 mos. 4,500 KWH

Average Consumption/Unit
3 mos. 1,125 KWH propane

(2) Propane

Heating, cooking, and hot water requirements as necessary for Wilkes-Barre, Pa. climate.

No heating requirements for a three-month deployment.

SITE CONSIDERATIONS

Since some alternative systems require that pipes be laid underground, assumptions made regarding the site are critical. The site must be investigated as part of the procedure of selecting systems. The following assumptions are made regarding the site:

a. Housing Density

Individual units are placed on individual lots.

b. Water Supply

A raw water supply 1,000 feet from the site needs coagulation, settling, filtration and disinfection to provide a potable supply.

c. Sewage Disposal

A stream requiring only secondary treatment for discharged wastes lies 1,000 feet from the site.

d. Slope

The slope leading to sewage disposal points is relatively even.

e. Soil

The soil varies in permeability; there is no bedrock or peat which would interfere with any installations. Only usual construction methods would be required.

f. Climate

The climate is similar to that of Wilkes-Barre, Pa. Wilkes-Barre is selected because of experience with disaster housing there and because the climate is representative of the flood-prone Northeast, where system requirements are more stringent. The three-month deployment occurs in summer.

3. SYSTEM CONFIGURATIONS

The requirements and characteristics of alternative systems are shown for a variety of system sizes, deployment periods, and water demand patterns. These requirements are spelled out in Sections C and D. System configurations are specified below:

a. Water Supply

- Raw water source...intake pipe...intake pump... raw water pipe...package treatment unit... storage (covered redwood tank)...pressurizer (hydropneumatic)...distribution pipe...household connection.

- Trucking in water...central storage tank... pressurizer...distribution pipe...household connection.

- Trucking in water...storage at individual housing unit.

b. Sewage Disposal

- Gravity sewage collection...package waste treatment...convenient discharge.

- Pressurized sewage collection...package waste treatment...convenient discharge.

- Storage of sewage at individual housing unit (underground tank)...trucking away (to an existing sewage collection system).

- Individual septic tanks and tile fields.

c. Gas and Electricity

- On-site electricity generation...local distribution.

- Primary electric service connection... transformer...local distribution.

- Propane storage at individual dwelling unit for heating needs.

4. ITEM COSTS

Where possible, costs are based on the section "Water Supply and Sewage Disposal for Disaster Housing" of Volume 4 of Cost-Effective Housing Systems for Disaster Relief.

Unit costs taken directly from Volume 4 are shown in Table 15. Total costs are drawn from generalized cost curves and scaled to meet the needs of a 100-unit project. They are shown in Table 16. Contingencies should be added to these costs. All costs are for the mid-Atlantic region for the year 1974.

TABLE 15

MATERIAL AND INSTALLATION UNIT COSTS FOR
PORTABLE WATER SUPPLY AND SEWAGE DISPOSAL SYSTEMS

ITEM	APPLICABLE TO:*	UNIT COST	
		Material	Installations
Water Supply			
Intake	1	$500/intake	$500/intake
Supply pumpt	1	$400/pump	$500/pump
Treatment plant	1	(See Table 16)	$1000/plant
Pipe to storage	1	$100/pipe	$200/pipe
Storage tank	1,3	(See Table 16)	$1500/tank
Piping from storage	1,3	$100/pipe	$200/pipe
Pressure pump	1,3	(See Table 16)	$1000/pump
Dist. valves	1,3	$4/valve	$4/valve
Dist. piping	1,3	$4/foot	$8/foot
Connections	1,3	$30/connection	$70/connection
Individual water storage tank	2	$500/tank	----
Electrical connections	1,3	----	2,000**
Sewage Disposal			
Treatment plant	4,5	(See Table 16)	$4000/plant
Gravity pipe	4	$3/foot	$20/foot
Package lift station	4	(See Table 16)	$5000/station
Manholes	4	$300/manhole	$500/manhold
Connections	4	$150/connection	$400/connections
Septic tank	7	$475/tank	$550/tank
Tile Field: Good soil	7	----	$1.07/gallon
Fair soil	7	----	$2.23/gallon
Poor	7	----	$4.46/gallon
Individual sewage storage	6	$400/tank	$100/tank
Pressure pump unit	5	1000/unit	----
Pressure collection connections	5	50/connections	$150/connections
Pressure main	5	$3/foot	$7/foot
Electrical	4,5	----	$2000/plant

* Applicability Code:

1. Water - Package treatment
2. Water - Truck to individual storage
3. Water - Truck to pipeline distribution
4. Sewage - Activated sludge, gravity collection
5. Sewage - Activated sludge, pressure collection
6. Sewage - Trucking
7. Sewage - Septic tanks

** $1500 proportioned to treatment plant connections

Source: Cost-Effective Housing Systems for Disaster Relief; Volume 4

TABLE 16

MATERIAL COSTS FOR PORTABLE WATER SUPPLY AND SEWAGE DISPOSAL SYSTEMS DERIVED FROM GENERALIZED COST CURVES AND SCALED TO MEET COSTS FOR 100 UNITS*

NO. OF UNITS	25	50	100	150	200
% WATER REDUCTION	0.50	0.50	0.50	0.50	0.50
Item	(all figures are in $000's)				
Water Supply Treatment Plant	29-29	29-29	37-29	66-37	73-37
Central Water Storage Tank	2.0-1.6	2.0-1.8	2.5-2.0	3.0-2.2	3.4-2.4
Water Pressurizer	4.6-4.5	4.9-4.8	5.7-5.0	7.2-5.7	8.8-6.5
Sewage Treatment Plant	30-29	32-30	37-32	46-32	46-33
Package Lift Station	12-12	13-12	15-13	19-15	23-19

* See Tables 19 - 30 and 32 through 47 for sizes of items noted in the Table.

** First number on the list assumes no water saving; the second number a water saving of 50%.

Source: <u>Cost Effective Housing Systems for Disaster Relief</u>, Volume 4

TABLE 17

SALVAGABLE ITEMS AND RECOVERY COSTS FOR PORTABLE WATER SUPPLY AND SEWAGE DISPOSAL SYSTEMS

ITEM	RECOVERY COST
Water supply treatment plant	$1500/plant
Central water storage tanks	$300/tank
Water pressurizers	$200/pressurizer
Individual water storage tanks	$16/tank
Sewage treatment plants	$1000/plant
Package lift stations	$500/station
Individual sewage storage tanks	$100/tank
Sewage pressure pump units	$30/unit

A salvagable item is an item which has a salvage value (reuse value) which is greater than the recovery cost of the item.

Recovery cost is the dollar cost of removing an item from its place of installation, cleaning it, repairing it, painting it if necessary and loading it on a truck for shipment from the site.

Operation and maintenance costs are shown in Volume 4 and not repeated here. The costs are modified only for trucking of water and sewage. A flat rate of $40/1,000 gallons of water delivered to individual storage is used instead of $/truck trip. The change makes it easier to calculate this cost. Trucking water to pipeline distribution is based on $160/5,000-gallon truck trip, a savings of $40/5,000-gallon truck trip resulting from the time saved because trucks do not have to service individual homes.

Salvagable items and recovery costs are shown in Table 17. A salvagable item is an item for which the salvage value (reuse value) is greater than the recovery cost. A recovery cost is the cost of removing an item from the place it was installed; cleaning, repairing, and if necessary, painting it; and loading it on a truck for shipment from the site.

It is assumed that the central water storage tank can be assembled and unassembled six times. All other items are assumed to have a useful life of 10 years.

Gas and electricity costs are discussed in Section E.

5. METHODOLOGY FOR ANALYSIS OF COST-EFFECTIVENESS

A system should be selected on the basis of its cost-effectiveness. Cost-effectiveness is calculated in terms of dollars per household or dollars per thousand gallons of water supplied or disposed. In determining the cost-effectiveness of various systems the following assumptions are made:

a. Costs *

(1) Capital Costs

The cost of all items which must be purchased at the start of housing construction. This includes the cost of delivering the items to the site and the cost of predeployment (storage and interest). However, these last costs are not evaluated.

* All costs are for the mid-Atlantic region for the year 1974.

(2) Installation Costs

All expenditures necessary to install capital items so they work properly.

(3) Operation and Maintenance Costs (O & M)

All expenditures during the life of the housing project.

(4) Recovery Costs

The cost for all capital items for which the salvage cost is higher than the recovery cost of disconnecting, cleaning, and painting the items and loading them on a truck for removal from the site. This cost does not include transportation away from the site, because this cost cannot be evaluated in an analysis of this type.

(5) Salvage Cost

This (for all capital items for which the salvage cost is higher than the recovery cost) is the value which a capital item will have to HUD for further use. This cost does not represent market value. It is calculated by assuming straight line depreciation over the estimated useful life of the item.

b. Interest

No interest is used in the analysis.

c. Write-Off

All costs (except O&M) are written off over the period the system is used.

d. Comparison

A daily, total cost is derived by dividing each cost (except O&M) by the number of days of deployment and adding them according to the formula:

$$\text{Total} = \frac{\text{Capital} + \text{Installation} + \text{Recovery} - \text{Salvage}}{\text{Days of Development}} + \text{Operation and Maintenance}$$

A <u>cost per dwelling unit</u> is derived by dividing the total cost by the number of dwelling units. Five different system sizes are investigated: those which can serve 25, 50, 100, 150 and 200 units. For water supply and sewage disposal, a <u>cost per 1,000 gallons</u> is derived by dividing the total cost by the total supply or disposal for each system size.

C. PORTABLE WATER SUPPLY SYSTEMS

This section compares portable water supply systems on the basis of requirements, characteristics, and cost-effectiveness.

1. DESCRIPTION AND SELECTION OF ALTERNATIVE SYSTEMS

Recommended systems include: gravity central treatment to pipeline distribution, truck transport to pipeline distribution, and truck transport to individual storage tanks.

These recommendations acknowledge differences in size of site, deployment periods, and rate of consumption. They are intended as a guide. Final decisions must be based on the availability of recommended systems and local conditions.

a. Central Treatment to Pipeline Distribution

This system uses an on-site or nearby raw water source. Raw water is processed through a central treatment plant and stored in an on-site water tank. From there it is distributed to individual units through an underground pressurized pipeline.

This is a cost-effective alternative for all sites except short-term ones which incorporate water conservation devices. For these sites, truck distribution to individual storage tanks is superior.

b. Truck Transport to Pipeline Distribution

In this system, trucks haul potable water to an on-site storage tank to be distributed to individual units through an underground pressurized pipeline.

This is never a cost-effective alternative, even with water conservation programs. It should be used only as a temporary measure until an on-site treatment plant can be installed.

c. Truck Transport to Individual Storage Tanks

In this system, potable water is distributed by truck directly to 500-gallon storage tanks at individual mobile home sites.

The costs of trucking water are highly sensitive to water consumption; therefore, programs for water consumption reduction are recommended if this system is used.

This system is cost-effective only for short-term sites of less than 50 units, for short-term sites of more than 50 units if water consumption reduction is incorporated, or under special conditions.

2. COST SUMMARY FOR PORTABLE WATER SUPPLY SYSTEMS

Table 18 summarizes the cost-effectiveness of alternative water distribution systems. Full water consumption (0% water reduction) is equivalent to 280 gallons/dwelling unit/day: a 50% reduction is equivalent to 140 gallons/dwelling unit/day.

3. COST-EFFECTIVE SYSTEMS ACCORDING TO SIZE OF SITE, DEPLOYMENT PERIOD, AND WATER CONSUMPTION RATE

Figures 13 and 14 indicate which system is recommended under what circumstances. The tables are intended as a guide. Local conditions may make it necessary to select systems other than those recommended.

TABLE 18

COST SUMMARY FOR EACH ALTERNATIVE PORTABLE WATER DISTRIBUTION SYSTEM

($/Day/Dwelling Unit)

DURATION	3 MONTH DEPLOYMENT										12 MONTH DEPLOYMENT									
NO. OF UNITS	25		50		100		150		200		25		50		100		150		200	
% WATER REDUCTION	0	50%	0	50%	0	50%	0	50%	0	50%	0	50%	0	50%	0	50%	0	50%	0	50%
WATER DISTRIBUION SYSTEMS																				
Central Treatment	17	17	10	10	7.7	7.4	6.9	6.5	6.4	6.0	5.6	5.5	3.2	3.2	2.3	2.2	2.0	1.9	1.8	1.7
Truck to Pipeline Distribution	16	12	15	11	15	10	14	10	14	10	11	7.3	11	6.9	11	6.7	11	6.7	11	6.7
Truck to Individual Storage	12	6.0	12	6.0	12	6.0	12	6.0	12	6.0	12	6.0	12	6.0	12	6.0	12	6.0	12	6.0

FIGURE 13

RECOMMENDED COST-EFFECTIVE PORTABLE WATER SUPPLY ALTERNATIVES
(No Water Saving)

GROUP SITE SIZE: 100 - OVER	50 - 100	25 - 50	- 24	
				WATER SUPPLY - THREE MONTH DEPLOYMENT
●	●	●		CENTRAL TREATMENT
				TRUCK TO PIPELINE DISTRIBUTION
		●	●	TRUCK TO INDIVIDUAL STORAGE TANKS
				WATER SUPPLY - TWELVE MONTH DEPLOYMENT
●	●	●	●	CENTRAL TREATMENT
				TRUCK TO PIPELINE DISTRIBUTION
				TRUCK TO INDIVIDUAL STORAGE TANKS

● recommended cost-effective alternatives

FIGURE 14

RECOMMENDED COST-EFFECTIVE PORTABLE WATER SUPPLY ALTERNATIVES
(50% Water Saving)

GROUP SITE SIZE: 100 - OVER	50 - 100	25 - 50	- 24	
				WATER SUPPLY - THREE MONTH DEPLOYMENT
●				CENTRAL TREATMENT
				TRUCK TO PIPELINE DISTRIBUTION
●	●	●	●	TRUCK TO INDIVIDUAL STORAGE TANKS
				WATER SUPPLY - TWELVE MONTH DEPLOYMENT
●	●	●	●	CENTRAL TREATMENT
				TRUCK TO PIPELINE DISTRIBUTION
				TRUCK TO INDIVIDUAL STORAGE TANKS

● recommended cost-effective alternatives

4. REQUIREMENTS FOR AND CHARACTERISTICS OF ALTERNATIVE WATER SUPPLY SYSTEMS

Tables 19-30 provide supplementary data on each alternative system. Shown are performance specifications, system requirements, and costs of installation, operation, maintenance, recovery and salvage. Abbreviations used in the tables are explained in the Glossary.

Tables on requirements summarize such information as the number of units necessary for a particular system. Tables on characteristics summarize the overall costs of each system.

Table 19, which presents the requirements for trucking water to individual storage, requires the minimum number of units. Only delivery trucks and one 500-gallon tank for each household are required. It was assumed that a 5,000-gallon delivery truck would be used. As for all systems, requirements for a three-month period and a twelve-month period are the same.

Table 20 presents the requirements for trucking water to pipeline distribution. The requirements are more complex because it is necessary to provide a central storage tank, pressurizers, and household connections. The size of the storage tank depends on what size tank is available. Therefore the size for 50 units is the same as for 100 units. The size of pressurizers depends on the flow. Requirements for distribution pipe and connection are directly proportional to the number of housing units. For the development under consideration, 4" distribution pipe is practical. Connections of 3/4" in diameter are standard for single-family homes.

Table 21 presents the requirements for a package water treatment plan (central treatment) which supplies water through a pipeline distribution system. The requirements are the same as for trucking water to central storage, except for these additional requirements: an intake pipe from a raw water source, a small pump to bring raw water to the plant, and the plant itself. The size of the plant depend on what size is available from manufacuturers.

Table 22 shows the characteristics of trucking water to individual storage. One can see the low capital and

TABLE 19

REQUIREMENTS FOR SUPPORT SYSTEMS: WATER--TRUCKING TO INDIVIDUAL STORAGE (NO WATER SAVING)

Duration		3 Months						12 Months					
No. of Units		1	25	50	100	150	200	1	25	50	100	150	200
Performance Requirements	Units												
Average Flow	GPD GPM	280 (.2)	7000 (5)	14000 (10	28000 (20)	42000 (30)	56000 (40)	280(.2)	7000 (5)	14000 (10)	28000 (20)	42000 (30)	56000 (40)
Peak Flow	GPM	1.5	38	75	150	225	300	1.5	38	75	150	225	300
Truck	G Trips/Day	5000- .55	5000- 2	5000- 3	5000- 6	5000- 9	5000- 12	5000- 0.1	5000- 2	5000- 3	5000- 6	5000- 9	5000- 12
Individual Storage	G-#	500-1	500-25	500-50	500-100	500-150	500-200	500-1	500-25	500-50	500-100	500-150	500-200

TABLE 20

REQUIREMENTS FOR SUPPORT SYSTEMS: WATER--TRUCKING TO PIPELINE DISTRIBUTION (NO WATER SAVING)

Duration		3 Months						12 Months					
No. of Units		1	25	50	100	150	200	1	25	50	100	150	200
Performance Requirements	Units												
Average Flow	GPD GPM	280 (.2)	7000 (5)	14000 (10)	28000 (20)	42000 (30)	56000 (40)	280 (.2)	7000 (5)	14000 (10)	28000 (20)	42000 (30)	56000 (40)
Peak Flow	GPM	1.5	38	75	150	225	300	1.5	38	75	150	225	300
Truck	G Trips/Day	5000- .55	5000- 2	5000- 3	5000- 6	5000- 9	5000- 12	5000- 0.1	5000- 2	5000- 3	5000- 6	5000- 9	5000- 12
Central Storage	G	50	2335	5161	10939	15443	20612	50	2535	5161	10939	15449	20612
Pressurizer	GPM-G PSI (Range)	1.5-200 30-60	1.5-500 30-60	75-100 30-60	150-2000 30-60	225-3000 30-60	300-4000 30-60	1.5-200 30-60	1.5-500 30-60	75-1000 30-60	150-2000 30-60	225-3000 30-60	300-4000 30-60
Distribution Pipe	ϕ-LF	-	4"-500	4"-1000	4"-2000	4"-3000	4"-4000	3/4"-2000	4"-500	4"-1000	4"-2000	4"-3000	4"-4000
Connection	ϕ-LF	-	3/4"-1000	3/4"-2000	3/4"-4000	3/4"-6000	3/4"-8000	-	3/4"-1000	3/4"-2000	3/4"-4000	3/4"-6000	3/4"-8000

TABLE 21

REQUIREMENTS FOR SUPPORT SYSTEMS: WATER--CENTRAL TREATMENT (NO WATER SAVING)

Duration		3 Months						12 Months					
No. of Units		1	25	50	100	150	200	1	25	50	100	150	200
Performance Requirements	Units												
Average Flow	GPD GPM	280 (.2)	7000 (5)	14000 (10)	28000 (20)	42000 (30)	56000 (40)	280 (-2)	7000 (5)	14000 (10)	28000 (20)	42000 (30)	56000 (40)
Peak Flow	GPM	1.5	38	75	150	225	300	1.5	38	75	150	225	300
Intake Pipe	ϕ-LF	4"-50	4"-50	4"-50	4"-50	4"-50	4"-50	4"-50	4"50	4"-50	4"-50	4"-50	4"-50
Intake Pump	HP Head	1-2 HP-100	1-2 HP-100	1-2 HP-100	1-2 HP-100	1-2 HP-100	1-2 HP-100	1-2 HP-100	1-2 HP-100	1-2 HP-100	1-2 HP-100	1-2 HP-100	1-2 HP-100
Treatment Waterboy Helifloc	GPM GPM	10(10)	10(10)	10(10)	20(25)	60(50)	60(50)	10(10)	10(10)	10(10)	20(25)	60(50)	60(50)
Central Storage	G	50	2535	5161	10939	15449	20612	50	2535	5161	10939	15449	20612
Pressurizer	GPM-G	1.5-200	1.5-500	75-100	150-2000	225-3000	300-4000	1.5-200	1.5-200	75-1000	150-2000	225-3000	300-4000
	PSI (Range)	30-60	30-60	30-60	30-60	30-60	30-60	30-60	30-60	30-60	30-60	30-60	30-60
Dist. Pipe Conn.	ϕ-LF	-	4"-500	4"-1000	4"-2000	4"-3000	4"-4000	3/4"-2000	4"-500	4"-1000	4"-2000	4"-3000	4"-4000

TABLE 22

CHARACTERISTICS OF EACH ALTERNATIVE SYSTEM: WATER--TRUCKING TO INDIVIDUAL STORAGE (NO WATER SAVING)

Duration		3 Months					12 Months				
No. of Units		25	50	100	150	200	25	50	100	150	200
Costs (in dollars)											
Capital	Total	$ 125000	$ 25000	$ 50000	$ 75000	$ 100000	$12500	$ 25000	$ 50000	$ 75000	$ 100000
	Daily	138	275	550	825	1100	35	69	137	205	274
Installation	Total	400	800	1600	2400	3200	400	800	1600	2400	3200
	Daily	4.5	9	17	26	35	1	2	4	7	9
O&M	Daily	300	600	1200	1800	2400	300	600	1200	1800	2400
Recovery	Total	400	800	1600	2400	3200	400	800	1600	2400	3200
	Daily	4.5	9	17	26	35	1	2	4	7	9
Salvage	Total	12300	24600	49000	73400	98200	11650	23300	46600	69900	93200
	Daily	135	270	540	810	1080	63	65	128	192	254
Total	Daily	312	623	1254	1867	2490	305	609	1217	1827	2438
Cost/Unit	Daily	12	12	12	12	12	12	12	12	12	12
Cost/1000 Gal.	Daily	44	44	44	44	44	44	44	44	44	44

TABLE 23

CHARACTERISTICS OF EACH ALTERNATIVE SYSTEM: WATER--TRUCKING TO PIPELINE DISTRIBUTION (NO WATER SAVING)

Duration		3 Months					12 Months				
No. of Units		25	50	100	150	200	25	50	100	150	200
Costs (in dollars)											
Capital	Total	$ 10900	$ 145000	$ 22500	$ 30700	$ 40200	$ 10900	$ 14500	$ 22500	$ 30700	$ 40200
	Daily	120	160	240	330	440	30	40	62	84	110
Installation	Total	10000	16900	30400	43800	57300	10200	16900	30400	43800	57300
	Daily	110	180	330	480	630	28	46	83	120	156
O&M	Daily	240	480	960	1440	1920	240	480	960	1440	1920
Recovery	Total	500	500	500	500	500	500	500	500	500	500
	Daily	5	5	5	5	5	1	1	1	1	1
Salvage	Total	6400	6700	6900	8500	10300	5900	6200	6400	8000	9600
	Daily	70	73	80	90	110	16	17	22	20	30
Total	Daily	400	760	1460	2160	2880	280	560	1090	1620	2160
Cost/Unit	Daily	16	15	15	14	14	11	11	11	11	11
Cost/1000 Gal.	Daily	57	54	52	51	51	40	40	39	39	39

TABLE 24

CHARACTERISTICS OF EACH ALTERNATIVE SYSTEM: WATER--CENTRAL TREATMENT (NO WATER SAVING)

Duration		3 Months					12 Months				
No. of Units		25	50	100	150	200	25	50	100	150	200
Costs (in dollars)											
Capital	Total	$ 46800	$ 50000	$ 68000	$ 109000	$ 127000	$ 46800	$ 50000	$ 68000	$ 10900	$ 12700
	Daily	510	550	750	1200	1400	130	140	190	300	350
Installation	Total	21000	27000	40000	54000	67000	21000	27000	40000	54000	67000
	Daily	230	300	440	590	740	60	70	110	150	180
O&M	Daily	37	37	39	40	42	37	37	39	40	42
Recovery	Total	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
	Daily	20	20	20	20	20	5	5	5	5	5
Salvage	Total	35000	36000	44000	74000	83000	32000	32000	41000	69000	77000
	Daily	380	400	480	810	910	90	90	110	190	210
Total	Daily	420	510	770	1040	1290	140	160	230	300	370
Cost/Unit	Daily	17	10	7.70	6.90	6.40	5.60	3.20	2.30	2	1.80
Cost/1000 Gal.	Daily	60	36	28	25	23	20	11	8.20	7.10	6.60

TABLE 25

REQUIREMENTS FOR SUPPORT SYSTEMS: WATER--TRUCKING TO INDIVIDUAL STORAGE (50% WATER SAVINGS)

Duration		3 Months						12 Months					
No. of Units		1	25	50	100	150	200	1	25	50	100	150	200
Performance Requirements	Units												
Average Flow	GPD GPM	140 .1	3500 2.5	7000 5	14000 10	21000 15	28000 20	140 .1	3500 2.5	7000 5	14000 10	21000 15	28000 20
Peak Flow	GPM	1	25	50	100	150	200	1	25	50	100	150	200
Truck	G Trips/ Day	5000 0.28	5000 1	5000 2	5000 3	5000 5	5000 6	5000 0.28	5000 1	5000 2	5000 3	5000 5	5000 6
Individual Storage	G-#	500-1	500-25	500-50	500-100	500-150	500-200	500-1	500-25	500-50	500-100	500-150	500-200

TABLE 26

REQUIREMENTS FOR SUPPORT SYSTEMS: WATER--TRUCKING TO PIPELINE DISTRIBUTION (50% WATER SAVING)

Duration		3 Months						12 Months					
No. of Units		1	25	50	100	150	200	1	25	50	100	150	200
Performance Requirements	Units												
Average Flow	GPD GPM	140 .1	3500 2.5	7000 5	14000 10	21000 15	28000 20	140 .1	3500 2.5	7000 5	14000 10	21000 15	28000 20
Peak Flow	GPM	1	25	50	100	150	200	1	25	50	100	150	200
Truck	G Trips/Day	5000 0.28	5000 1	5000 2	5000 3	5000 5	5000 6	5000 0.28	5000 1	5000 2	5000 3	5000 5	5000 6
Central Storage	G	500	5532	5532	5532	11350	11350	500	5532	5532	5532	11350	11350
Pressurizer	GPM-G PSI (Range)	1-200 30-60	25-340 30-60	50-670 30-60	100-1300 30-60	150-2000 30-60	200-2600 30-60	1-200 30-60	25-340 30-60	50-670 30-60	100-1300 30-60	150-2000 30-60	200-2600 30-60
Distribution Pipe	ϕ-LF		4"-500	4"-1000	4"-2000	4"-3000	4"-4000	-	4"500	4"-1000	4"-2000	4"-3000	4"-4000
Connection	ϕ-LF	3/4"-40	3/4"-1000	3/4"-2000	3/4"-4000	3/4"-6000	3/4"-8000	3/4"-40	3/4"-1000	3/4"-2000	3/4"-4000	3/4"-6000	3/4"-8000

TABLE 27

REQUIREMENTS FOR SUPPORT SYSTEMS: WATER-CENTRAL TREATMENT (50% WATER SAVING)

Duration		3 Months						12 Months					
No. of Units		1	25	50	100	150	200	1	25	50	100	150	200
Performance Requirements	Units												
Average Flow	GPD GPM	140 .1	3500 2.5	7000 5	14000 10	21000 15	28000 20	140 .1	3500 2.5	7000 5	14000 10	21000 15	28000 20
Peak Flow	GPM	1	25	50	100	150	200	1	25	50	100	150	200
Intake Pipe	ϕ-LF	4"-50'	4"-50'	4"-50'	4"-50'	4"-50'	4"-50'	4"-50'	4"-50'	4"-50'	4"-50'	4"-50'	4"-50'
Intake Pump	HP Head	1-2 HP 100'	1-2 HP 100'	1-2 HP 100'	1-2 HP 100'	1-2 HP 100'	1-2 HP 100'	1-2 HP 100'	1-2 HP 100'	1-2 HP 100'	1-2 HP 100'	1-2 HP 100'	1-2 HP 100'
Treatment Waterboy Helifloc	 GPM GPM	 10 10	 10 10	 10 10	 10 10	 20 25	 20 25	 10 10	 10 10	 10 10	 10 10	 20 25	 20 25
Central Storage	G	500	1191	2788	5532	7966	9658	500	1191	2788	5532	7966	9658
Pressurizer	GPM PST (Range)	1-200 30-60	25-340 30-60	50-670 30-60	100-1300 30-60	150-2000 30-60	200-260 30-60	1-200 30-60	25-340 30-60	50-670 30-60	100-1300 30-60	150-2000 30-60	200-2600 30-60
Distribution Pipe	ϕ-LF	-	4"-500'	4"-1000'	4"-2000'	4"-3000'	4"-4000'	-	4"-500'	4"-1000'	4"-2000'	4"-3000'	4"-4000'
Connection	ϕ-LF	3/4"-40	3/4"-1000	3/4"-2000	3/4"-4000	3/4"-6000	3/4"-8000	3/4"-40	3/4"-1000	3/4"-2000	3/4"-4000	3/4"-6000	3/4"-8000

TABLE 28

CHARACTERISTICS OF EACH ALTERNATIVE SYSTEM: WATER--TRUCKING TO INDIVIDUAL STORAGE (50% WATER SAVING)

Duration		3 Months					12 Months				
No. of Units		25	50	100	150	200	25	50	100	150	200
Costs (in dollars)											
Capital	Total	$ 1250	$ 2500	$ 50000	$ 75000	$ 100000	$1250	$ 25000	$ 50000	$ 75000	$ 100000
	Daily	140	275	550	825	1100	35	69	137	205	274
Installation	Total	400	800	1600	2400	3200	400	800	1600	2400	3200
	Daily	4	9	17	26	35	1	2	4	7	9
O&M	Daily	140	280	560	840	1120	140	280	560	840	1120
Recovery	Total	400	800	1600	2400	3200	400	800	1600	2400	3200
	Daily	4	9	17	26	35	1	2	4	7	9
Salvage	Total	12300	24600	49000	73400	98200	11650	23300	46600	69900	93200
	Daily	135	270	540	810	1080	32	65	128	192	254
Total	Daily	153	303	604	907	1210	145	288	577	867	1158
Cost/Unit	Daily	6	6	6	6	6	5.8	5.8	5.8	5.8	5.8
Cost/1000 Gal.	Daily	43	43	43	43	43	41	41	41	41	41

TABLE 29

CHARACTERISTICS OF EACH ALTERNATIVE SYSTEM: WATER--TRUCKING TO PIPELINE DISTRIBUTION (50% WATER SAVING)

Duration		3 Months					12 Months				
No. of Units		25	50	100	150	200	25	50	100	150	200
Costs (in dollars)											
Capital	Total	$ 10752	$ 14375	$ 21160	$ 29095	$ 36570	$ 10752	$ 14375	$ 21160	$ 29095	$ 36570
	Daily	118	157	232	319	401	29	39	57	79	100
Installation	Total	10177	14700	26400	38100	49800	10177	14700	26400	38100	49800
	Daily	111	160	290	420	550	27	40	70	100	140
O&M	Daily	140	280	560	840	1120	140	280	560	840	1120
Recovery	Total	500	500	500	500	500	500	500	500	500	500
	Daily	5	5	5	5	5	1	1	1	1	1
Salvage	Total	6054	6347	6542	7640	8420	5717	5987	6167	7213	7933
	Daily	66	69	71	83	92	15	16	17	19	21
Total	Daily	308	533	1016	1501	1984	182	344	671	1001	1340
Cost/Unit	Daily	12	11	10	10	10	7.30	6.90	6.70	6.70	6.70
Cost/1000 Gal.	Daily	88	76	73	71	71	52	49	48	48	48

TABLE 30

CHARACTERISTICS OF EACH ALTERNATIVE SYSTEM: WATER--CENTRAL TREATMENT (50% WATER SAVING)

Duration		3 Months					12 Months				
No. of Units		25	50	100	150	200	25	50	100	150	200
Costs (in dollars)											
Capital	Total	$ 47400	$ 50100	$ 57100	$ 73900	$ 81600	$ 47400	$ 50100	$ 57100	$ 73900	$ 81600
	Daily	520	550	627	812	896	129	137	156	202	223
Installation	Total	19900	27000	40000	54000	67000	19900	27000	40000	54000	67000
	Daily	218	300	440	590	740	54	70	110	150	180
O&M	Daily	36	37	37	38	39	36	37	37	38	39
Recovery	Total	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
	Daily	20	20	20	20	20	5	5	5	5	5
Salvage	Total	34400	34800	35200	43900	44800	31800	32300	32600	40600	41500
	Daily	378	382	386	482	492	87	88	89	111	113
Total	Daily	416	525	738	978	1203	137	161	219	284	334
Cost/Unit	Daily	17	10	7.4	6.5	6.0	5.5	3.2	2.2	1.9	1.7
Cost/1000 Gal.	Daily	118	75	53	47	43	39	23	16	14	12

installation costs and high operating costs for this system. The cost per unit is slightly less for a twelve month period than for a three-month period because installation and recovery costs are written off over a longer period.

The other tables on characteristics of systems show the effect of different variables, such as number of units, and the relative importance of fixed cost and operating costs. The item labeled "cost/unit" is presented in the summary table. However, the tables on characteristics are useful because they show the significance of the different variables in determining what is cost-effective.

D. PORTABLE SEWAGE DISPOSAL SYSTEMS

This section compares portable sewage disposal systems on the basis of requirements, characteristics, and cost-effectiveness.

1. DESCRIPTION AND SELECTION OF ALTERNATIVE SYSTEMS

Recommended systems include: gravity collection to activated sludge treatment, pressurized collection to activated sludge treatment, truck collection to an existing sewage collection system and septic tanks.

These recommendations are intended as a guide. Final decisions must be based on the availability of recommended systems and local conditions.

a. Gravity Collection to Activated Sludge Treatment

This system is comprised of an underground pipeline network for the collection of sewage by gravity flow. Sewage is deposited at an activated sludge treatment plant on the site or nearby. The cost of this system depends upon topography and sub-surface conditions. There must be enough of a slope to reduce excavation costs, and sub-surface conditions must present no conflict. The ideal topography provides a slope so that special construction methods are unnecessary and the trench depth is kept to a minimum. However, for level sites with under 200 units, the lack of slope will not result in significantly higher costs. This sys- is recommended for large or long-term sites when all the above criteria are met.

b. Pressurized Collection to Activated Sludge Treatment

In this system, underground pipes are pressurized to collect sewage and carry it to an activated sludge treatment plant. The functioning of this system does not depend on gravity flow or topography.

Table 31 shows that the per-unit cost of this system is lower than that of the gravity system. However, the pressurized system is less reliable than the gravity system, and therefore should not be used if the savings are marginal. The pressurizing pump required in this system is not yet a common item in the United States and would have to be stockpiled to achieve the level of cost-effectiveness indicated. Nonetheless, this system is a cost-effective alternative.

c. Truck Collection to an Existing Sewage Collection System

In this system, 500-gallon sewage storage tanks are located above or below ground at each mobile home site. Sewage is trucked to an existing sewage collection system. This alternative is advantageous when water must be conserved. But it is a minimal solution, appropriate only for sites of 100 units or less, for short periods, and under extraordinary circumstances.

d. Septic Tanks

Underground septic tanks for individual sites are cost-effective only for long-term sites. This system is recommended for all size sites where water conservation devices are present; it should not be used for sites larger than 100 units without water conservation devices or where soil conditions are poor.

TABLE 31

COST SUMMARY FOR EACH ALTERNATIVE PORTABLE SEWAGE DISPOSAL SYSTEM

($/Day/Dwelling Unit)

DURATION	3 MONTH DEPLOYMENT										12 MONTH DEPLOYMENT									
NO. OF UNITS	25		50		100		150		200		25		50		100		150		200	
% WATER REDUCTION	0	50%	0	50%	0	50%	0	50%	0	50%	0	50%	0	50%	0	50%	0	50%	0	50%
<u>SEWAGE COLLECTION SYSTEMS</u>																				
Gravity Collection to Activated Sludge	38	38	26	26	19	20	18	18	17	17	11	11	7.2	7.2	5.3	5.2	4.9	4.7	4.6	4.4
Pressure Collection to Activated Sludge	19	18	18	18	10	10	9.7	9.3	9.1	9.0	6.4	6.1	4.2	5.1	3.2	3.1	2.9	2.8	2.8	2.6
Truck	10	7	10	7	10	7	10	7	10	7	8	5	8	5	8	5	8	5 8	8	5
Septic Tank																				
Good Soil	11	8.3	11	8.3	11	8.3	11	8.3	11	8.3	2.6	2.0	2.6	2.0	2.6	1.0	2.6	2.0	2.6	2.0
Fair Soil	15	10	15	10	15	10	15	10	15	10	3.6	2.6	3.6	2.6	3.6	2.6	3.6	2.6	3.6	2.6
Poor Soil	23	14	23	14	23	14	23	14	23	14	5.6	3.6	5.6	3.6	5.6	3.6	5.6	3.6	5.6	3.6

2. COST SUMMARY FOR PORTABLE SEWAGE DISPOSAL SYSTEMS

Table 31 summarizes the cost-effectiveness of alternative sewage disposal systems. Full water consumption (0% water reduction) is equivalent to 280 gallons/dwelling unit/day; a 50% reduction is equivalent to 140 gallons/dwelling unit/day.

3. COST-EFFECTIVE SYSTEMS ACCORDING TO GROUP SITE SIZE, DEPLOYMENT PERIOD AND WATER CONSUMPTION RATE

Figures 15 and 16 indicate which system is recommended under what conditions. The tables are intended as a guide. Local conditions may make it necessary to select systems other than those recommended.

4. REQUIREMENTS FOR AND CHARACTERISTICS OF ALTERNATIVE SEWAGE DISPOSAL SYSTEMS

Tables 32-47 provide supplementary data on each alternative system. Shown are performance specifications, system requirements, and costs of installation, operation, maintenance, recovery, and salvage. Abbreviations used in the tables are explained in the Glossary.

Tables on requirements summarize such information as number of units necessary for a particular system. Tables on characteristics summarize the overall costs of each system.

Table 32 shows the requirements for storing sewage in individual tanks and collecting it by truck. The size of truck requirement used depends on the size available.

Tables 33 and 34 show the requirements for treating sewage at the housing project after it has been collected by gravity lines or pressure lines. The treatment requirements are the same. Flows and sewage characteristics are typical of domestic sewage. The size of the treatment plant is based on the Metpro system standard sizes. An aerobic digestor is a tank whose size depends on the number of units served. The requirements for gravity collection (Table 33) include 8" pipes for collection with manholes at minimum distances.

III
FIGURE 15

RECOMMENDED COST-EFFECTIVE PORTABLE SEWAGE
DISPOSAL ALTERNATIVES
(No Water Saving)

GROUP SITE SIZE: 100 - OVER	50 - 100	25 - 50	- 24	
				SEWAGE DISPOSAL - THREE MONTH DEPLOYMENT
●	●			GRAVITY COLLECTION TO ACTIVATED SLUDGE TREATMENT
●	●			PRESSURIZED COLLECTION TO ACTIVATED SLUDGE TREATMENT
	●	●	●	TRUCK COLLECTION TO ACTIVATED SLUDGE TREATMENT
				SEPTIC TANK (if soil is good or fair)
				SEWAGE DISPOSAL - TWELVE MONTH DEPLOYMENT
●	●	●	●	GRAVITY COLLECTION TO ACTIVATED SLUDGE TREATMENT
●	●	●	●	PRESSURIZED COLLECTION TO ACTIVATED SLUDGE PREATMENT
				TRUCK COLLECTION TO ACTIVATED SLUDGE TREATMENT
		●	●	SEPTIC TANK (if soil is good or fair)

● recommended cost-effective alternatives

FIGURE 16

RECOMMENDED COST-EFFECTIVE PORTABLE SEWAGE DISPOSAL ALTERNATIVES
(50% Water Saving)

GROUP SITE SIZE: 100 - OVER	50 - 100	25 - 50	- 24	
				SEWAGE DISPOSAL - THREE MONTH DEPLOYMENT
●				GRAVITY COLLECTION TO ACTIVATED SLUDGE TREATMENT
●				PRESSURIZED COLLECTION TO ACTIVATED SLUDGE TREATMENT
●	●	●	●	TRUCK COLLECTION TO ACTIVATED SLUDGE TREATMENT
				SEPTIC TANK (if soil is good or fair)
				SEWAGE DISPOSAL - TWELVE MONTH DEPLOYMENT
●	●	●		GRAVITY COLLECTION TO ACTIVATED SLUDGE TREATMENT
●	●			PRESSURIZED COLLECTION TO ACTIVATED SLUDGE TREATMENT
		●	●	TRUCK COLLECTION TO ACTIVATED SLUDGE TREATMENT
●	●	●	●	SEPTIC TANK (if soil is good or fair)

● recommended cost-effective alternatives

TABLE 32

REQUIREMENTS FOR SUPPORT SYSTEMS: SEWAGE--TRUCKING (NO WATER SAVING)

Duration		3 Months						12 Months					
No. of Units		1	25	50	100	150	200	1	25	50	100	150	200
Performance Requirements	Units												
Average Flow	GPD	250	6300	12600	25200	37800	50400	250	6300	12600	25200	37800	50400
Storage Tank	#-G/ Tank	1-500	25-500	50-500	100-500	150-500	200-500	1-500	25-500	50-500	100-500	150-500	200-500
Vacuum Truck	G-trips/ day	2500-1	2500-3	2500-5	2500-10	2500-15	2500-20	2500-1	2500-3	2500-5	2500-10	2500-15	2500-20

TABLE 33

REQUIREMENTS FOR SUPPORT SYSTEMS: SEWAGE--GRAVITY

COLLECTION TO ACTIVATED SLUDGE TREATMENT (NO WATER SAVING)

Duration		3 Months						12 Months					
No. of Units		1	25	50	100	150	200	1	25	50	100	150	200
Performance Requirements	Units												
Average Flow	GPD (GPM)	250 (.18)	6300 (4.5)	12600 (9)	25200 (18)	37800 (27)	50400 (36)	250 (.18)	6300 (4.5)	12600 (9)	25200 (18)	37800 (27)	50400 (3)
Peak Flow	GPM	1.4	34	68	135	200	270	1.4	34	68	135	200	270
Sewage Strength	mg/1SS-mg/1COD	300-740	300-740	300-740	300-740	300-740	300-740	300-740	300-740	300-740	300-740	300-740	300-740
Treatment (METPRO)	Level GPD HP	secondary 5000 8	secondary 10000 9	secondary 15000 10	secondary 25000 14	secondary 50000 19	secondary 50000 19	secondary 5000 8	secondary 1000 9	secondary 15000 10	secondary 25000 14	secondary 50000 19	secondary 50000 19
Pump Station	GPM	5	30	50	100	150	200	5	30	50	100	150	200
Aerobic Digestor	G	1000	1500	3000	6000	9000	15000	1000	1500	3000	6000	9000	15000
Pipe	ø-LF	4"-1000	8"-1500	8"-2000	8"-3000	8"-4000	8"-5000	4"-1000	8"-1500	8"-2000	8"-3000	8"-4000	8"-5000
Manhole	#	4	7	9	14	20	25	4	7	9	14	20	25
House Connections	ø-LF	-	4"-1000	4"-2000	4"-4000	4"-6000	4"-8000	-	4"-1000	4"-2000	4"-4000	4"-6000	4"-8000

TABLE 34

REQUIREMENTS FOR SUPPORT SYSTEMS:

SEWAGE--PRESSURE COLLECTION TO ACTIVATED SLUDGE TREATMENT (NO WATER SAVING)

Duration		3 Months						12 Months					
No. of Units		1	25	50	100	150	200	1	25	50	100	150	200
Performance Requirements	Units												
Average Flow	GPD (GPM)	250 (.18)	6300 (9)	12600 (9)	25200 (18)	37800 (27)	50400 (27)	250 (.18)	6300 (9)	12600 (9)	25200 (18)	37800 (27)	50400 (36)
Peak Flow	GPM	1.4	34										
Sewage Strength	mg/1SS- mg/1COD	300-740	300-740	68	135	200	270	1.4	34	68	135	200	270
Treatment (METPRO)	Level GPD HP	secondary 5000 8	secondary 1000 9	secondary 15000 10	secondary 25000 14	secondary 50000 19	secondary 50000 19	secondary 5000 8	secondary 1000 9	secondary 15000 10	secondary 25000 14	secondary 5000 19	secondary 50000 19
House Connections	ø-LF	-	1000	2000	4000	6000	8000	-	1000	2000	4000	6000	8000
Pressure Pumps and Ginders	#	1	25	50	100	150	200	1	25	50	100	150	200
Pressure Main	ø-LF	1 ½"- 1000	1 ½"- 1500	2 ½"- 2000	3 ½"-	4"-4000	4"-5000	1 ½"- 1000	1 ½"- 1500	2 ½"- 2000	3 ½"- 3000	4"-4000	4"-5000

TABLE 35

REQUIREMENTS FOR SUPPORT SYSTEMS: SEWAGE--SEPTIC TANKS (NO WATER SAVING)

Duration		3 MONTHS						12 MONTHS					
No. of Units		1	25	50	100	150	200	1	25	50	100	150	200
Performance Requirements	Units												
Average Flow	GPD	250	6300	12600	25200	37800	50400	250	6300	12600	25200	37800	50400
Connections	#	1	25	50	100	150	200	1	25	50	100	150	200
Septic Tanks	#	1	13	25	50	75	100	1	13	25	50	75	100
Percolation Rates - Good	min/in.	10-550	10-12750	10-27500	10-55000	10-82500	10-110000	10-550	10-12750	10-27500	10-55000	10-82500	10-110000
Fair	"	30-1050	30-26250	30-52500	30-105000	30-167500	30-210000	30-1050	30-26250	30-52500	30-105000	30-167500	30-210000
Poor	"	60-2050	60-51250	60-102500	60-205000	60-307500	60-410000	60-2050	60-51250	60-102500	60-205000	60-307500	60-410000

TABLE 36

CHARACTERISTICS OF EACH ALTERNATIVE SYSTEM: SEWAGE--TRUCKING--INDIVIDUAL STORAGE (NO WATER SAVING)

Duration		3 Months					12 Months				
No. of Units		25	50	100	150	200	25	50	100	150	200
Costs (in dollars)											
Capital	Total	$ 10000	$ 20000	$ 40000	$ 60000	$ 80000	$ 10000	$ 20000	$ 40000	$ 60000	$ 80000
	Daily	110	220	440	660	880	27	55	110	160	220
Installation	Total	2500	5000	10000	15000	20000	2500	5000	10000	15000	20000
	Daily	25	50	110	160	220	7	14	30	40	50
O&M	Daily	190	380	760	1130	1510	190	380	760	1130	1510
Recovery	Total	2500	5000	10000	15000	20000	2500	5000	10000	15000	20000
	Daily	25	50	110	160	220	7	14	30	40	50
Salvage	Total	10000	2000	39000	59000	79000	9500	19000	37000	56000	75000
	Daily	110	220	430	650	870	26	52	100	150	210
Total	Daily	240	480	990	1460	1960	205	410	830	1220	1620
Cost/Unit	Daily	10	10	10	10	10	8	8	8	8	8
Cost/1000 Gal.	Daily	38	38	38	38	38	32	32	32	32	32

TABLE 37

CHARACTERISTICS OF EACH ALTERNATIVE SYSTEM: SEWAGE-GRAVITY COLLECTION TO ACTIVATED SLUDGE TREATMENT (NO WATER SAVING)

Duration		3 Months					12 Months				
No. of Units		25	50	100	150	200	25	50	100	150	200
Costs (in dollars)											
Capital	Total	$60000	$69000	$92000	$125000	$157000	$60000	$69000	$92000	$125000	$157000
	Daily	660	758	1011	1374	1725	164	189	252	342	430
Installation	Total	62700	87000	136000	185000	233000	62000	87000	136000	185000	233000
	Daily	690	956	1495	2033	2560	170	238	373	507	638
O&M	Daily	35	36	37	38	39	35	36	37	38	39
Recovery	Total	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
	Daily	17	17	17	17	17	4	4	4	4	4
Salvage	Total	41000	44000	52000	63000	79000	38000	40000	48000	58000	73000
	Daily	450	480	570	690	870	104	109	132	159	200
Total	Daily	950	1290	1940	2730	3450	282	358	534	732	911
Cost/Unit	Daily	38	26	19	18	17	11	7.20	5.30	4.90	4.60
Cost/1000 Gal.	Daily	150	104	78	74	69	45	30	21	20	18

TABLE 38

CHARACTERISTICS OF EACH ALTERNATIVE SYSTEM: SEWAGE--PRESSURE COLLECTION TO ACTIVATED SLUDGE TREATMENT (NO WATER SAVING)

Duration		3 Months					12 Months				
No. of Units		25	50	100	150	200	25	50	100	150	200
Costs (in dollars)											
Capital	Total	$70000	$104000	$173000	$248000	$325000	$70000	$104000	$173000	$248000	$325000
	Daily	769	1140	1900	2730	3570	191	285	474	679	890
Installation	Total	23000	31000	48000	65000	81000	23000	31000	48000	65000	81000
	Daily	253	340	530	710	890	63	85	130	180	220
O&M	Daily	38	41	47	53	59	38	41	47	53	59
Recovery	Total	1800	2500	4000	5500	7000	1800	2500	4000	5500	7000
	Daily	20	30	40	60	80	5	7	11	15	19
Salvage	Total	54000	80000	134000	191000	252000	50000	74000	123000	176000	232000
	Daily	593	880	1470	2100	2770	137	203	337	482	636
Total	Daily	487	670	1050	1450	1830	160	210	320	440	550
Cost/Unit	Daily	19	18	10	9.70	9.10	6.4	4.20	3.20	2.90	2.80
Cost/1000 Gal.	Daily	77	52	41	38	36	25	17	13	12	11

TABLE 39

CHARACTERISTICS OF EACH ALTERNATIVE SYSTEM: SEWAGE-SEPTIC TANKS (NO WATER SAVING)

Duration			3 Months					12 Months				
No. of Units			25	50	100	150	200	25	50	100	150	200
Costs (in dollars)												
Capital		Total	$ 6900	$ 13700	$ 27500	$ 41200	$ 55000	$ 6900	$ 13700	$ 27500	$ 41200	$ 5500
		Daily	75	150	300	450	600	18	37	75	112	150
Installation	Soil											
	Good	Total	16500	33000	66000	99000	132000	16500	33000	66000	99000	132000
		Daily	180	360	720	1080	1440	45	90	180	270	360
	Fair	Total	26000	52000	104000	156000	208000	26000	52000	104000	156000	208000
		Daily	290	580	1060	1640	2120	70	140	240	380	480
	Poor	Total	44000	88000	176000	260000	352000	44000	88000	176000	260000	352000
		Daily	490	970	1940	2910	3880	120	240	480	720	960
O&M		Total	...	...	...	...	...	...	...	...	...	...
		Daily	...	...	...	...	...	...	...	...	...	...
Recovery		Total	0	0	0	0	0	0	0	0	0	0
		Daily	0	0	0	0	0	0	0	0	0	0
Salvage		Total	0	0	0	0	0	0	0	0	0	0
		Daily	0	0	0	0	0	0	0	0	0	0
Total	Soil											
	Good	Daily	270	520	1020	1530	2040	63	127	255	392	516
	Fair	Daily	380	680	1360	2280	2720	88	177	355	554	716
	Poor	Daily	580	1120	2240	3360	4480	138	277	555	842	1116
Cost/Unit	Soil											
	Good	Daily	10	10	10	10	10	2.6	2.6	2.6	2.6	2.6
	Fair	Daily	14	14	14	14	14	3.6	3.6	3.6	3.6	3.6
	Poor	Daily	22	22	22	22	22	5.6	5.6	5.6	5.6	5.6
Cost/1000 Gal.	Soil											
	Good	Daily	39	39	39	39	39	11	11	11	11	11
	Fair	Daily	54	54	54	54	54	15	15	15	15	15
	Poor	Daily	83	83	83	83	83	22	22	22	22	22

TABLE 40

REQUIREMENTS FOR SUPPORT SYSTEMS: SEWAGE--TRUCKING (50% WATER SAVING)

Duration		3 MONTHS						12 MONTHS					
No. of Units		1	25	50	100	150	200	1	25	50	100	150	200
Performance Requirements	Units												
Average Flow	GPD	125	3125	6250	12500	18750	25000	125	3125	6250	12500	18750	25000
Storage Tank	# G/Tank	1 500	25 500	50 500	100 500	150 500	200 500	1 500	25 500	50 500	100 500	150 500	200 500
Vacuum Truck	G Trips/ Day	2500 1	2500 2	2500 3	2500 5	2500 8	2500 10	2500 1	2500 2	2500 3	2500 5	2500 8	2500 10

TABLE 41

REQUIREMENTS FOR SUPPORT SYSTEMS:

SEWAGE--GRAVITY COLLECTION TO ACTIVATED SLUDGE TREATMENT (50% WATER SAVING)

Duration		3 Months						12 Months					
No. of Units		1	25	50	100	150	200	1	25	50	100	150	200
Performance Requirements	Units												
Average Flow	GPD GPM	125 .09	3125 2.3	6250 4.5	12500 9	18750 13.5	25000 18	125 .09	3125 2.3	6250 4.5	12500 9	18750 13.3	25000 18
Peak Flow	GPM	0.93	24	47	93	140	186	0.93	24	47	93	140	186
Sewage Strength	mg/l SS mg/l COD	600 1400	600 1400	600 1400	600 1400	600 1400	600 1400	600 1400	600 1400	600 1400	600 1400	600 1400	600 1400
Treatment (METPRO)	Level GPD HF	secondary 5000 8	secondary 5000 8	secondary 10000 9	secondary 15000 10	secondary 15000 10	secondary 20000 14	secondary 5000 8	secondary 5000 8	secondary 10000 9	secondary 15000 10	secondary 15000 10	secondary 20000 14
Aerobic Digester	G	1000	1500	3000	6000	9000	15000	1000	1500	3000	6000	9000	15000
House Connections	Ø-LF	-	4"-1000	4"-2000	4"-4000	4"-6000	4"-8000	-	4"-1000	4"-2000	4"-4000	4"-6000	4"-8000
Pipe	Ø-LF	4"-1000	8"-5000	8"-2000	8"-3000	8"-4000	8"-5000	4"-1000	8"-1500	8"-2000	8"-3000	8"-4000	8"-5000
Manholes	#	4	7	9	14	20	25	4	7	9	14	20	25
Pump Station	GPM	1	20	40	80	100	150	1	20	40	80	100	150

TABLE 42

REQUIREMENTS FOR SUPPORT SYSTEMS:

SEWAGE--PRESSURE COLLECTION TO ACTIVATED SLUDGE TREATMENT (50% WATER SAVING)

Duration		3 MONTHS						12 MONTHS					
No. of Units		1	25	50	100	150	200	1	25	50	100	150	200
Performance Requirements	Units												
Average Flow	GPD GPM	125 .009	3125 2.3	6250 4.5	12500 9	18750 13.5	25000 18	125 0.09	3125 2.3	6250 4.5	12500 9	187500 13.3	25000 18
Peak Flow	GPM	0.93	24	47	93	140	186	0.93	24	47	93	140	186
Sewage Strength	mg/l SS mg/l COD	600 1400	600 1400	600 1400	600 1400	600 1400	600 1400	600 1400	600 1400	600 1400	600 1400	600 1400	600 1400
Treatment (METPRO)	Level GPD HP	secondary 5000 8	secondary 5000 8	secondary 10000 9	secondary 15000 10	secondary 15000 10	secondary 20000 14	secondary 5000 8	secondary 5000 8	secondary 10000 9	secondary 15000 10	secondary 15000 10	secondary 20000 14
Aerobic Digester	G	1000	1500	3000	6000	9000	15000	1000	1500	3000	6000	9000	15000
House Connections	Ø-LF		1250	2500	5000	7500	10000		1250	2500	5000	7500	10000
Pressure Pumps & Grinders	#	1	25	50	100	150	200	1	25	50	100	150	200
Pressure Main	Ø-LF	1½"-1000	1½"-1500	1½"-2000	2"-3000	2"-4000	2"-5000	1½"-1000	1½"-1500	1½"-2000	1½"-3000	2"-4000	2"-5000

TABLE 43

REQUIREMENTS FOR SUPPORT SYSTEMS:

SEWAGE--SEPTIC TANKS (50% WATER SAVING)

Duration		3 MONTHS						12 MONTHS					
No. of Units		1	25	50	100	150	200	1	25	50	100	150	200
Performance Requirements	Units												
Average Flow	GPD	125	3125	6250	12500	18750	25000	125	3125	6250	12500	18750	250000
Connections	#	1	25	50	100	150	200	1	25	50	100	150	200
Septic Tanks	#	1	13	25	50	75	100	1	13	25	50	75	100
Percolation Rates - Good	Min/inch Ø	10 225	10 5625	10 11250	10 22500	10 33750	10 45000	10 225	10 5625	10 11250	10 22500	10 33750	10 450
Fair	Min/inch Ø	30 525	30 13125	30 26250	30 52500	30 78750	30 105000	30 525	30 13125	30 26250	30 52500	30 78750	30 105000
Poor	Min/inch Ø	60 1025	60 25625	60 51250	60 102500	60 153750	60 205000	60 1025	60 25625	60 51250	60 102500	60 153750	60 205000

TABLE 44

CHARACTERISTICS OF EACH ALTERNATIVE SYSTEM: SEWAGE--TRUCKING--INDIVIDUAL STORAGE (50% WATER SAVING)

Duration		3 Months					12 Months				
No. of Units		25	50	100	150	200	25	50	100	150	200
Costs (in dollars)											
Capital	Total	$ 10000	$ 20000	$ 40000	$ 60000	$ 80000	$ 10000	$ 20000	$ 40000	$ 60000	$ 80000
	Daily	110	220	440	660	880	27	55	110	160	220
Installation	Total	2500	5000	10000	15000	20000	2500	5000	10000	15000	20000
	Daily	25	50	110	160	220	7	14	30	40	50
O&M	Daily	120	240	490	730	970	120	240	490	730	970
Recovery	Total	2500	5000	10000	15000	20000	2500	5000	10000	15000	20000
	Daily	25	50	110	160	220	7	14	30	40	50
Salvage	Total	10000	20000	39000	59000	79000	10000	19000	37000	56000	75000
	Daily	100	210	430	650	870	27	52	100	150	210
Total	Daily	170	350	720	1060	1420	134	271	560	820	1080
Cost/Unit	Daily	7	7	7	7	7	5	5	5	5	5
Cost/1000 Gal.	Daily	57	57	57	57	57	43	43	43	43	43

TABLE 45

CHARACTERISTICS OF EACH ALTERNATIVE SYSTEM: SEWAGE--GRAVITY COLLECTION TO ACTIVATED SLUDGE (50% WATER SAVING)

Duration		3 Months					12 Months				
No. of Units		25	50	100	150	200	25	50	100	150	200
Costs (in dollars)											
Capital	Total	$ 60000	$ 68000	$ 85300	$ 100300	$ 119800	$ 60000	$ 68000	$ 85300	$ 100300	$ 119800
	Daily	659	750	940	1100	1320	164	186	233	274	328
Installation	Total	62700	88800	135700	184600	233400	62700	88800	135700	184600	233400
	Daily	690	980	1490	2030	2560	172	243	372	506	639
O&M	Daily	33	34	35	36	37	33	34	35	36	37
Recovery	Total	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
	Daily	17	17	17	17	17	4	4	4	4	4
Salvage	Total	40500	42400	44300	44300	51200	37600	38500	42100	43000	47500
	Daily	447	470	500	510	570	98	105	115	117	130
Total	Daily	950	1300	1980	2670	3360	270	360	520	700	870
Cost/Unit	Daily	38	26	20	18	17	11	7.2	5.2	4.7	4.4
Cost/1000 Gal.	Daily	300	210	160	140	130	86	58	42	37	35

TABLE 46

CHARACTERISTICS OF EACH ALTERNATIVE SYSTEM: SEWAGE--PRESSURE COLLECTION TO ACTIVATED SLUDGE (50% WATER SAVING)

Duration		3 Months					12 Months				
No. of Units		25	50	100	150	200	25	50	100	150	200
Costs (in dollars)											
Capital	Total	$ 68700	$ 102700	$ 167800	$ 231700	$ 296700	$ 68700	$ 102700	$ 167800	$ 231700	$ 296600
	Daily	740	1120	1850	2550	3270	190	280	460	634	812
Installation	Total	23300	31600	48300	65000	81600	23300	31600	48300	65000	81600
	Daily	260	350	530	710	900	64	87	132	178	223
O&M	Daily	36	39	45	51	56	36	39	45	51	56
Recovery	Total	1750	2500	4000	5500	7000	1750	2500	4000	5500	7000
	Daily	19	30	40	60	80	5	7	11	15	19
Salvage	Total	53100	59000	129200	177900	227600	49300	54700	119500	164500	110400
	Daily	590	650	1440	1960	2500	135	149	327	450	576
Total	Daily	459	883	1020	1400	1790	153	257	314	422	529
Cost/Unit	Daily	18	18	10	9.3	8.0	6.1	5.1	3.1	2.8	2.6
Cost/1000 Gal.	Daily	150	140	82	75	72	50	41	25	22	21

TABLE 47

CHARACTERISTICS OF EACH ALTERNATIVE SYSTEM:

SEWAGE--SEPTIC TANKS (50% WATER SAVING)

Duration			3 Months					12 Months				
No. of Units			25	50	100	150	200	25	50	100	150	200
Costs (in dollars)												
Capital		Total	$8000	$16000	$32000	$48000	$64000	$8000	$16000	$32000	$48000	$64000
		Daily	90	180	360	540	720	22	44	88	132	176
Installation	Soil											
	Good	Total	11000	21500	43000	44500	86000	11000	21500	43000	44500	86000
		Daily	120	236	472	489	945	30	60	117	121	235
	Fair	Total	16000	31500	63000	94500	126000	16000	31500	63000	95500	12600
		Daily	175	346	692	1038	1384	43	86	172	261	345
	Poor	Total	25000	49000	98000	147000	196000	25000	49000	98000	147000	196000
		Daily	274	538	1076	1615	2153	68	134	268	402	536
O&M		Total	...	...	...	...	...	...	...	...	...	...
		Daily	...	...	...	...	...	...	...	...	...	...
Recovery		Total	0	0	0	0	0	0	0	0	0	0
		Daily	0	0	0	0	0	0	0	0	0	0
Salvage		Total	0	0	0	0	0	0	0	0	0	0
		Daily	0	0	0	0	0	0	0	0	0	0
Total	Soil											
	Good	Daily	210	416	832	1248	1664	52	104	205	253	410
	Fair	Daily	265	526	1052	1578	2104	65	130	260	393	520
	Poor	Daily	364	718	1436	2154	2872	90	178	356	534	712
Cost/Unit	Soil											
	Good	Daily	8.3	8.3	8.3	8.3	8.3	2.0	2.0	2.0	2.0	2.0
	Fair	Daily	10	10	10	10	10	2.6	2.6	2.6	2.6	2.6
	Poor	Daily	14	14	14	14	14	3.6	3.6	3.6	3.6	3.6
Cost/1000 Gal.	Soil											
	Good	Daily	67	67	67	67	67	16	16	16	16	16
	Fair	Daily	84	84	84	84	84	21	21	21	21	21
	Poor	Daily	115	115	115	115	115	28	28	28	28	28

A lift station is necessary to pump the sewage to the treatment plant. Requirements for pressure collection (Table 34) are one pump and grinder for each dwelling unit and a thin pipe to carry sewage to the treatment plant. In both systems, the length of pipe needed is is equal to the distance from the treatment plant to the housing development, plus the distance needed to pass each unit. (See section discussing system configurations).

Table 35 shows the requirements for septic tanks. The number of tanks depends on the number of housing units. The leaching field requirements depend on soil types and the number of units. With a single soil type, however, the requirement per house is the same for each size of development.

The other tables on characteristics of systems show the effect of different variables, such as the number of units, and the relative importance of fixed costs and operating costs. The item labeled "cost/unit" is presented in the summary table. However, the tables on characteristics are useful because they show the significance of different variables in determining what is cost-effective.

E. GAS AND ELECTRIC SYSTEMS

This section discusses the utilities needed to provide electricity and heat. It indicates what systems should be used in particular situations, considering the number of units and the amount of time the site will be used.

1. DESCRIPTION AND SELECTION CRITERIA

Two systems are analyzed:

All-Electric, in which electricity supplies all the energy for heat, light, and other needs.

Partial-Electric, in which electricity supplies the energy for all uses except heating.

In the partial-electric system, heating energy must come from burning fuel in the home: propane, natural gas, and oil are the three main options. Natural gas is not recommended, because there is no guarantee that a supply of natural gas will be located near the site. Propane is readily available throughout the United States and is the fuel used most often in mobile homes. It is superior to oil because it is cleaner to burn, safer to store, and can supply all fuel requirements. If oil were used for space heating, propane or electricity would still be needed for hot water heating and cooking. Therefore, propane is the only fuel considered.

Within the two basic systems, two sets of costs must be considered:

- On-site electricity generators versus connection to an existing grid;

- All-electric versus partial-electric schemes.

If an existing grid is used, requirements include the connection to the grid, transformation of the voltage, poles, powerlines, the distribution system to the housing units, transformation to house voltage, and primary and secondary feeders.

With on-site generation, the requirements are the same, except that a generator takes the place of the connection to the grid.

To compare the cost of the two systems, it is necessary to compare the cost of on-site generation to the cost of the connection to a grid. For simplicity, this comparison is done for the all-electric system only.

The electrical systems in the all-electric and the partial-electric arrangements are nearly identical. The only differences are the type of service supplied (150 amp for all-electric versus 100 amp for partial-electric) and the amount of electricity consumed.

To provide enough propane for hot water and cooking, a pair of 100-pound tanks with automatic switchover valves per household would be sufficient. Supply trucks would arrive periodically and fill the tanks.

To meet the heating and cooking needs in the Wilkes-Barre winter climate, at least one 420-pound tank would be needed. HUD has used 250-pound tanks, so a pair of tanks this size with automatic switchover valves would suffice.

State laws concerning propane storage vary. Generally, 100-pound tanks can be stored against the dwelling unit. Larger tanks usually have to be at least 10 feet away.

2. COMPARATIVE ANALYSIS OF ON-SITE GENERATION VS PURCHASED POWER

The housing site should be located so an existing power grid can be used. It is likely that power will be available nearby. However, since power may not be available, the use of an on-site generator will be discussed. The cost of an on-site generator and the cost of purchased power have been compared. The cost of purchased power depends on the local utility, and costs after a disaster might differ from costs under normal conditions. To make the comparison, the following assumptions have been made:

- HUD would install and pay for all power lines, poles, transformers, and other related equipment within the sice, since a utility would be reluctant to install such equipment for a short period.

- HUD will be eligible for Industrial and Commercial Classification rates and therefore able to purchase power in bulk.

The convenience and reliability involved in purchasing outside power should be considered in deciding which source to use. Small short-term sites should be close to an existing power grid to make the system economical. In the following analyses, it is assumed that power exists at the site, that power is purchased at bulk rates (except for the single housing unit, for which normal residential rates apply), and that HUD installs the power distribution system within the site.

3. COMPARATIVE ANALYSIS OF AN ALL-ELECTRIC VS. A PARTIAL ELECTRIC SYSTEM

Table 48 shows the cost of the all-electric system, including the cost of the on-site distribution system. Table 49 shows the cost of the partial-electric system, broken down to show the separate costs of electricity and propane.

A comparison of the costs of the two systems show the following:

- For a three-month period, the two systems are nearly identical in cost. Since the all-electric system is much simpler, it is preferable for short-term sites occupied in summer.

- For the twelve-month period, the all-electric system costs about 20% more than the partial-electric system, or approximately $220 per unit. In selecting a system, the impact of the difference in cost would have to be assessed.

- Power rates prevailing in May 1975 in Rockland County, New York, have been used. These rates are higher than those in most other sections of the country, which means that the analysis probably is slanted against the alternative of purchased power. Table 50 presents the power rate schedule used.

- The on-site generator would be mounted on a trailer. Thus, the cost of installing it at the site would be nominal.

- The only operating costs for the on-site generator would be labor and fuel. Labor costs have been estimated for each size unit with a maximum of four workers for the largest unit (1,500 kw). Fuel has been assumed to cost $.30 per gallon. At nine gallons consumed per 100 kwh, the fuel cost is 2.7¢/kwh. All-electric systems would be used.

The results of this analysis are shown on Table 51. This table is similar to those analyzing water and sewer systems, except:

- Costs given are not total system costs, because the cost of the distribution systems within the housing site is not included;

- The cost of purchased power is given as a single number, since no capital costs are involved;

- The bottom two lines show the difference between the two systems -- both in total cost, and as to the maximum distance to an existing power grid with which the cost of the two systems would be equal.

4. CHARACTERISTICS OF EACH ALTERNATIVE SYSTEM

Tables 48-54 provide supplementary data on the requirements for and characteristics of each alternative system. Shown are performance specifications, system requirements, and costs of installation, operation, maintenance, recovery and salvage.

TABLE 48

CHARACTERISTICS OF EACH ALTERNATIVE SYSTEM: ELECTRICAL SYSTEM--ALL ELECTRIC

Duration		3 Months						12 Months					
No. of Units		1	25	50	100	150	200	1	25	50	100	150	200
Costs (in dollars)													
Material	Total	$750.00	$7500.00	$14,500.00	$28,500.00	$42,500.00	$56,500.00	$780.00	$7500.00	$14,500.00	$28,500.00	$42,500.00	$56,500.00
	Daily	8.56	82.20	158.92	312.32	465.76	619.16	2.14	20.55	39.73	78.08	116.44	154.79
Installation	Total	780.00	7,500.00	14,500.00	28,500.00	42,500.00	56,500.00	780.00	7,500.00	14,500.00	28,500.00	42,500.00	56,500.00
	Daily	8.56	82.20	158.92	312.32	465.76	619.16	2.14	20.55	39.73	78.08	116.44	154.79
Consumption	Daily	1.40	38.00	62.00	117.00	173.00	222.00	2.90	73.00	137.00	266.00	384.00	510.00
Recovery	Total	390.00	3,750.00	7,250.00	14,250.00	21,250.00	28,250.00	390.00	3,750.00	7,250.00	14,250.00	21,250.00	28,250.00
	Daily	4.28	41.10	79.45	156.16	232.88	309.59	1.07	10.27	19.86	39.04	58.22	77.40
Salvage	Total	234.00	2,250.00	4,350.00	8,550.00	12,750.00	16,950.00	234.00	2,250.00	4,350.00	8,550.00	12,750.00	16,950.00
	Daily	2.56	37.75	47.68	93.68	139.72	185.76	.64	6.16	11.92	23.42	34.93	46.44
Total	Daily	18.52	202.40	379.84	741.64	1,104.52	1,460.32	7.18	114.10	216.46	422.16	616.88	819.58
Cost/Unit	Daily	18.52	8.10	7.60	7.40	7.35	7.30	7.18	4.65	4.30	4.20	4.10	4.10

TABLE 49

CHARACTERISTICS OF EACH ALTERNATIVE SYSTEM: ELECTRICAL SYSTEM--PARTIAL ELECTRIC

Duration		3 Months						12 Months					
No. of Units		1	25	50	100	150	200	1	25	50	100	150	200
A. Electrical													
Costs (in dollars)													
Material	Total	$780.00	$7500.00	$14,500.00	$28,500.00	$42,500.00	$56,500.00	$780.00	$7500.00	$14,500.00	$28,500.00	$42,500.00	$56,500.00
	Daily	8.56	82.20	158.92	312.32	465.76	619.16	2.14	20.55	39.73	78.08	116.44	154.79
Installation	Total	780.00	7500.00	14,500.00	28,500.00	42,500.00	56,500.00	780.00	7500.00	14,500.00	28,500.00	42,500.00	56,500.00
	Daily	8.56	82.20	158.92	312.32	465.76	619.16	2.14	20.55	39.73	78.08	116.44	154.79
Consumption	Daily	.67	16.00	28.70	46.50	67.00	86.00	.67	16.00	28.70	49.50	67.00	86.00
Recovery	Total	390.00	3750.00	7,250.00	14,250.00	21,250.00	28,250.00	390.00	3750.00	7,250.00	14,250.00	21,250.00	28,250.00
	Daily	4.28	41.10	79.45	156.16	232.88	309.59	1.07	10.27	19.86	39.04	58.22	77.40
Salvage	Total	234.00	2250.00	4,350.00	8,550.00	12,750.00	16,950.00	234.00	2250.00	4,350.00	8,550.00	12,750.00	16,950.00
	Daily	2.56	37.95	47.68	93.68	139.72	185.76	.64	6.16	11.92	23.42	34.93	46.44
Total	Daily	17.79	180.40	346.54	674.14	998.52	1,324.32	4.95	57.10	105.16	205.65	299.38	395.58
Cost/Unit	Daily	17.79	7.20	6.90	6.75	6.70	6.70	4.95	2.30	2.10	2.05	2.00	1.95
B. Propane													
Costs (in dollars)													
Capital	Total		0	0	0	0	0		0	0	0	0	0
	Daily		0	0	0	0	0		0	0	0	0	0
Installation	Total		500	1000	2000	3000	4000		625	1250	2500	3750	5000
	Daily		5	11	22	33	44		2	3	7	10	14
O&M	Daily		9	18	27	45	54		36	72	144	216	288
Recovery	Total		0	0	0	0	0		0	0	0	0	0
	Daily		0	0	0	0	0		0	0	0	0	0
Salvage	Total		0	0	0	0	0		0	0	0	0	0
	Daily		0	0	0	0	0		0	0	0	0	0
Total	Daily		14	29	49	78	98		38	75	151	226	302
Cost/Unit	Daily		0.49	0.49	0.49	0.49	0.49		1.5	1.5	1.5	1.5	1.5
C. Total													
Cost/Unit	Daily		7.69	7.39	7.24	7.19	7.19		3.80	3.60	3.55	3.55	3.45

TABLE 50

ELECTRIC POWER RATE SCHEDULE

Rate (Per Month)

Demand Charge:	
First 5 kw	no charge
Next 4,295 kw, per kw	\$ 3.50
Over 4,300 kw, per kw	2.90
Energy Charge:	
First 13 kwh or less	\$ 3.45
Next 287 kwh, per kwh	6.60¢
Next 720 kwh, per kwh	4.50¢
Next 3,900 kwh, per kwh	4.00¢
Over 4,920 kwh, per kwh	2.80¢

TABLE 51

ELECTRIC: COMPARISON OF ON-SITE GENERATION COSTS TO PURCHASED POWER COSTS--ALL ELECTRIC (POWER DISTRIBUTION COSTS NOT INCLUDED)

Duration		3 Months					12 Months				
No. of Units		25	50	100	150	200	25	50	100	150	200
A. On-Site Generation											
Capital	Total	$ 45000	$ 70000	$ 115000	$ 115000	$ 170000	$ 80000	$ 125000	$ 190000	$ 210000	$ 225000
Installation	Total	2000	2500	3000	3500	4000	3000	3500	4000	4500	5000
O&M	Daily	63	102	176	244	313	116	194	356	504	670
	Total	5700	9200	15800	22000	28000	42500	71000	130000	184000	244000
Recovery	Total	2000	2500	3000	3500	41000	3000	3500	4000	4500	5000
Salvage	Total	44000	68000	112000	141000	166000	78000	122000	185000	205000	219000
Total		10700	16200	24800	33000	40000	50500	81000	143000	198000	260000
B. Total Purchased Power Cost		3400	5600	10500	15600	20000	26800	50000	97000	140000	185000
Difference in Cost		7300	10600	14300	17400	20000	23700	31000	46000	58000	75000
Equiv. Miles @ 25,000/Mile		.3	.4	.6	.7	.8	1	1.2	1.8	2.3	3.0

TABLE 52

POWER REQUIREMENTS
(All Electric)

NO. UNITS	PEAK DEMAND	DIVERSITY FACTOR	TOTAL PEAK DEMAND	GEN. SIZE
1	30 KVA	100%	30KVA	25KW
25	15	50%	375KVA	300KW
50	12	40	600KVA	500KW
100	10.5	35	1050KVA	900KW
150	9.6	32	144KVA	1200KW
200	9.0	30	1800KVA	1500KW

TABLE 53

ON-SITE GENERATOR COST

SIZE	$/KW.	TOTAL COST	UNIT COST	NO. OF UNITS
25KW	300.	$ 7,500.	$ 7,500.	1
300KW	270.	81,000.	3,240.	25
500KW	250.	125,000.	2,500.	50
900	215	193,500	1,935	100
1200KW	175	210,000.	1,400.	150
1500KW	150.	225,000.	1,125.	200

TABLE 54

COST OF ELECTRICAL POWER INSTALLATION
(All Electric or Partial Electric)

A - Assume Primary Service Connection Cost = $1,000
B - Distribution System

Assume 1 - 75 KVA Transformer for 5 units.

		Labor	Materials
Installed Cost	- $900	150	750
Pole	- $200	100	100
150' Prim Fdr.	- $500	300	200
300' Sec. Fdr.	- 1200	800	400
	$2,800	1350	1450

No. Units	TOTAL "A"	UNIT "B"	TOTAL "B"	TOTAL "A"+"B"	UNIT
1	$1000	$560	$ 560	$ 1,560	$1,560
25	1000		14,000	15,000	600
50	1000		28,000	29,000	580
100	1000		56,000	57,000	570
150	1000		84,000	85,000	567
200	1000		112,000	113,000	565
	Connect to utility grid		Distribution + Transforming to house voltage		

III

TECHNICAL ABBREVIATIONS

Abbreviation	Meaning
$	dollars
GPD	gallons per day
GPM	gallons per minute
ϕ	inside diameter
LF	linear feet
HP	housepower
G	gallons
gal.	gallons
psi	pounds per square inch
#	number
mg/l	milligrams per liter
SS	suspended solids
COD	chemical oxygen demand
min./inch	minutes per inch
⌷	square feet
O&M	operation and maintenance

Part IV

Disaster Group Housing Site Selection, Design and Development

IV.

A. INTRODUCTION

This section contains guidelines to help federal, state, and local officials select, design, and develop group housing sites for disaster victims.

Section 404(a) of Disaster Relief Act Amendments of 1974 (Public Law 93-288) says: "Any mobile home (provided by the federal government) shall be placed on a (group housing) site complete with utilities provided either by the state or local government." This is repeated in the FDAA Handbook for Applicants.*

Immediately after a disaster, state and local officials must:

- Determine whether group sites are needed for federally-provided mobile homes;
- Select enough acceptable sites;
- Design the sites efficiently for short-term occupancy;
- Develop the site as quickly as possible.

*"The local government must help the state find and establish adequate site locations for (temporary) housing, complete with utility line installation for housing connections. This requirement should be made part of the local disaster plan."

At present there are no guidelines or regulations to assist state or local officials with site selection, design, and development. Because of the emergency conditions, development must take place as quickly as possible so victims can be rehoused efficiently and properly.

These guidelines focus on two areas: site selection and site design.

For site selection, all criteria needed to determine whether a site is appropriate is explained. A Site Selection Checklist is provided. For site design, recommendations are given for planning, design, and life support systems, supplemented by illustrations and tables.

Since HUD administers the operation of group sites, such services as garbage collection, snow removal, and police and fire protection must be negotiated by HUD with the local municipalities.

The total cost of developing a site includes relocation of families, vacating the sites, and recovery of mobile homes for re-use later.

B. SITE SELECTION

To accommodate all displaced families the planner selecting sites should:

- Compile a list of vacant sites near the disaster area;
- Determine whether temporary use of the sites can be negotiated with their owners;
- Evaluate whether available sites can accommodate the number of units required (this is determined by multiplying the acreage of a site by six--the recommended number of units per acre);
- Evaluate potential sites on the basis of site selection criteria, determine the most appropriate sites;
- Select one or more sites based on the above analysis.

Sites of 25 dwelling units represent an identifiable neighborhood group. They are easier to develop than larger sites and more efficient than smaller ones. Optimum living conditions will best be met on several 25-unit sites rather than on a single large site.

1. OVERALL GOAL AND SUMMARY

Sites should be identified and prepared as quickly as possible after a disaster.

Optimum sites must be located; temporary control must be arranged; and sites must be adapted to mobile home installation as rapidly and inexpensively as possible. Poor planning can cause serious delays during the site evaluation and selection stages. This report provides guidelines to expedite the evaluation and selection process.

During site selection procedure, four points are critical:

- Advance planning is essential for handling post-disaster problems;

- The magnitude of the disaster must be analyzed and a list made of all available sites which would provide enough space at an acceptable cost;

- Criteria for selecting sites must be thoroughly understood;

- The site selection checklist should be used to evaluate potential sites before making a final decision.

2. SITE SELECTION PROCEDURE

The two sections which follow discuss the site selection procedure. The first section deals with selection before a disaster, the second with selection after a disaster.

a. Pre-Disaster Site Selection

To obtain the best site quickly and inexpensively, careful pre-disaster planning is necessary. A State Emergency Plan is the best vehicle for such planning.

The state can compile, with the help of municipalities, a list of suitable sites throughout the state. The list can be updated periodically. This requirement is part of California's emergency plan, which gives the state's Department of Real Estate responsibility for identifying sites. The Department contacts city and county housing authorities and real estate brokers who can best locate sites. Every state should adopt such a plan.

(See Appendix A for a discussion of pre-disaster site selection criteria.)

b. Post-Disaster Site Selection

When a disaster strikes a site must be chosen as quickly as possible, particularly if long-term housing is not available. The following procedure will help officials select suitable sites:

- List all vacant and nearly-vacant sites near the disaster area; if pre-selection has taken place, this list is on file;

- Narrow the list of potential sites on the basis of ownership; the goal is to find available quickly at little or no cost. Planners should focus on the following:

  Development Agreement: Because disaster housing is temporary, a temporary leasing agreement should be sought. The agreement would take effect immediately and last as long as necessary. The agreement should include a guarantee that every effort will be made to return the land in its original condition.

<u>From Whom to Lease</u>: It is easier to obtain publicly held land than privately owned property. Since the site is intended for public use, local officials can quickly agree to its use in an emergency, at no cost to the state or locality. State land is easiest to obtain because the state government is responsible for site selection. Local officials may be reluctant to permit mobile homes because of zoning or other restrictions and acquisition of local properties can be delayed. The red tape involved in obtaining federal land may make it hard to acquire it rapidly. Thus, state land is most preferable to municipal and federal property. In small disasters, public land is usually sufficient. However, in larger disasters, enough public land may not be available. Since speed is important, leases should be obtained from private owners at prevailing rates. In the past, institutional and private owners have made sites available at little or no cost. After Hurricane Agnes in 1972, Pennsylvania had little trouble leasing private land quickly and cheaply.

- Determine the number of people to be assigned to a site, and thus, the number of units be provided; apply the density figure of six units per acre times the number of units to be provided to determine the total acreage needed;

- Evaluate available sites based on the site selection criteria to further narrow the list of potential sites; the essential criteria are:

  -- sites should be close to the disaster area

  -- adequate water and sewer lines should be adjacent to the site;

-- physical problems like slope should be minimal.

- Select one or more sites from the remaining list, based on the above analysis, that are most appropriate; planners should follow site selection criteria more stringently when pre-selection is possible.

3. CRITERIA FOR SITE SELECTION

This section describes the criteria in the Site Selection Checklist shown in Figure 17. Planners should follow these criteria as closely as possible when selecting a site. The checklist, located at the end of this section, should be used by state or local officials in the field as an aid to selection.

The checklist lists each criteria and its requirements and when possible, gives the minimum and maximum range for compliance. Each criteria is assigned a rating. A site must meet all criteria rated essential to be acceptable. However, if a site fails to meet the other criteria, it should not be discarded. Other circumstances may make such a site suitable.

The checklist is a tool which enables the official to quickly ascertain a site's acceptability; it lists all important factors on one sheet.

a. <u>Location</u>

The first type of site planners should consider is an unoccupied mobile home park or other land with existing or available utility connections. Such sites might include open space and park land, housing authority land, industrial park land, undeveloped land being held for speculation, farms, golf courses, parking lots, race tracks, stadiums, airports, and rail yards.

All potential sites should be located near the victim's original neighborhood and within reasonable commuting distance of major concentrations of jobs and community facilities. Sites should be no more than four or five miles away from concentrated service areas containing government offices, Disaster Assistance Units, shopping, medical facilities, schools, and churches. They should be accessible by bus.

(1) Regional Roadway System for Delivering Mobile Homes to Site

An important criterion is the adequacy of the road system for delivery of mobile homes. The intended routes should be examined for height and maneuvering clearances and other factors which may affect transporting the units to the site.

When HUD's temporary housing assistance program started, variations in state highway regulations seriously hampered the delivery of mobile homes for disaster victims. Most of these problems have since been resolved by the national policy statement of the American Association of State Highway and Transportation Officials (AASHTO).

This agreement between the federal government and the states has helped HUD expedite the delivery of temporary housing. But transportation standards are still key factors in the delivery of mobile homes.

(2) Distance to Original Neighborhood

All sites should reflect pre-disaster residential patterns.

The primary goal is to ease the burden of displaced families by locating the site as close as possible to their permanent neighborhood. This makes it easier for victims to reestablish normal living patterns, maintain neighborhood ties, and return easily to their former homes.

(3) Distance to Shopping

In the past, damage to transportation services, loss of automobiles, and the remote locations of many sites made it hard for victims to reach shopping areas. Because site residents cannot travel easily, sites should be located near existing shopping districts.

(4) Distance to Employment

Access to jobs is important. However, because most job locations are relatively concentrated, people will often have to commute a significant distance to reach them. Access to places of employment is less important than access to shopping or medical facilities.

(5) Distance to Schools

If it helps preserve the community fabric, children should be bused to their pre-disaster schools, regardless of the location of the group site.

(6) Distance to Medical Facilities

In the past, victims have had trouble finding medical services. Also, victim populations tended to be disproportionately very young and elderly, both groups requiring more attention than average. At the same time, doctors and dentists who were disaster victims had trouble reestablishing their offices. These two needs might be coordinated, perhaps by helping displaced practitioners establish facilities within group sites. The proximity of medical facilities is an important criterion in site selection.

(7) Distance to Recreation

Recreation facilities should be determined by the population characteristics of the site. Some temporary on-site facilities should be provided.

Optimally, adequate facilities would be a 10-minute walk away, but this is not always possible. In such cases, on-site recreation accessible to all site occupants should be provided.

(8) Distance to Social, Cultural and Community Facilities

Proximity of cultural, religious, and other community facilities is important to combat the disruptive social and psychological effects of a disaster. These facilities minimize damage to community structure. Maintaining the community fabric may sometimes be more important than certain physical conditions.

(9) Distance to Public Transportation

The availability of good public transportation is important. If a site is good but public transportation is poor, special bus service should be set up. Since site residents tend to be poorer than average, a typical family probably would have only one car which one member of the family would use to drive to work. The other members would be dependent on public transportation. Also, many elderly people do not own cars.

The need for public transportation should be determined by the size of the site, the characteristics of the population, the availability of private transportation, and the scope of the disaster.

(10) Adjacent Land Use

Heavy industry or other land uses that causes severe air or noise pollution would be undesirable next to a residential development. Safety hazards should be avoided, too. For instance, a site with many children should not be located next to a railroad.

The urgency of moving people from emergency shelters into temporary housing should not overshadow factors which will eventually become more important. Amenities such as a pleasant environment become critical when a family must live in temporary housing for months, or perhaps years.

Potential social conflicts should be avoided. Such conflicts might occur if the site population is radically different in income level or social strata from the population of the surrounding neighborhood.

(11) Local Codes and Ordinances

Sections dealing with disaster housing should be included in local codes or ordinances.

Costly time delays result when municipalities or states do not understand that local codes and subdivision ordinances, which often prohibit or restrict the use of mobile homes, must be waived or adjusted to meet temporary housing needs after a disaster. Deciding who should build or maintain a site, and how long it should be operated, is often a problem. Delegation of responsibility should be clarified from the beginning.

(12) Site Information

Accurate surveys and other information concerning site characteristics, topography, utility capacities, water pressure, and the like should be available.

b. <u>Physical Site Features</u>

The site should allow the required number of units and the maneuvering of mobile homes. Planners should avoid such site problems as flood plains, swamps, severe slopes, and inadequate soil. The size and number of units depends on the density, the scope of the disaster, availability of land, and capacity of utilities.

(1) Density

Six to eight units per acre is a desirable density range for sites. For example, if 50 units are required, sites of seven to nine acres would be suitable.

An overall density range of five to nine units per acre is acceptable. A density of less than five units per acre is inefficient and economically unfeasible, and a density of 10 or more units per acre is socially and spatially unacceptable.

(2) Size and Number of Units

The size of the site and number of units depends upon the population type, the physical environment, and existing or planned amenities.

In the past, most sites had 25 or fewer units. Occupants preferred sites of this size but in some cases sites had at least 50 units, to ensure efficient and economical development and management.

It may be difficult to find one near the stricken neighborhood large enough to accommodate the required number of units. For example, 50 units would require a site of seven to nine acres; 100 units would require a site of 13 to 17 acres.

Planners should also determine whether the projected number of units is compatible with existing utility lines or requirements.

If the utilities don't provide sufficient capacity and large parcels are not available, several smaller sites should be considered. Smaller sites may be more compatible with existing utilities and easier to locate near original neighborhoods.

A group site for 25 units, requiring an area of four to five acres, is recommended in the site selection checklist.* However, in a specific disaster, sites of varying sizes probably will be developed, based upon available land resources and needs of the stricken community. Minimum or maximum population levels are intended as a guide.

(3) Shape

With 50 or fewer mobile homes, units can be placed most efficiently on square or rectangular sites. The larger the site, the less important the shape.

(4) Slope

The grade should be at least 2% but not more than 8% except for small areas where up to 12% is acceptable. This slope should provide for adequate drainage. In the past, sites were too flat and suffered from ponding and poor drainage in rainy weather, especially if there was a high water table.

(5) Heavily Wooded

Heavily wooded sites should be avoided. Since group sites are occupied for only a short time, the use of a heavily wooded area is costly and

*HUD recommends that a group site have no more than 25 mobile homes.

impractical. However, groves of trees can be part of the on-site recreation and are an asset.

(6) Flood Plain

Only as a last resort, after all other options have been exhausted, should a flood plain site be considered. (See Flood Disaster Prevention Act, PL 93-234.)

(7) Falling Rock Zones, Swampy Areas, or Other Hazards

Such hazardous areas should be avoided due to obvious dangers and development problems. Development plans for a site with hazards should include specific precautions to protect the people who will live there.

(8) Soil Conditions for Bearing Mobile Home

Soil conditions are not critical, if such problems as swampy areas are avoided.

(9) Soil Conditions for Proper Drainage

For natural drainages, sandy soils are most preferable and clay soils are least preferable. But site topography is the determining factor. The steeper the slope, the less important the soil type.

c. Availability and Requirements of Utilities

Availability of utilities is critical. Existing sewer and water lines are essential for economical site development. The cost and time involved in extending existing lines or constructing new systems would be prohibitive. However, electric lines can be extended much more cheaply and easily than water or sewer lines.

Sites with access to existing water and sewage systems aren't always available. The number of planned units may surpass the sewer capacity or amount of water pressure. If so, on-site devices to reduce water consumption or portable systems should be considered.

(1) Water

An existing water line adjacent to the site, with adequate pressure for the number of units planned, is most desirable. Adequate pressure is determined by multiplying the number of units times 280 gallons per unit per day. The local utility company should be contacted to ensure that adequate pressure exists.

Portable or on-site water distribution should be used if no water lines exist or if such lines are inadequate.

(2) Sewer

An existing sewer line adjacent to the site, with an adequate capacity for the number of units planned, is most desirable. Adequate capacity is determined by multiplying the number of units times 250 gallons per unit per day. The local utility company should be contacted to ensure that adequate capacity exists.

Portable or on-site sewage collection should be used if no sewer lines exist or if such lines are inadequate.

(3) Electric

Electric lines do not have to be located adjacent to the site because it is less time-consuming and costly to bring overhead electric lines from a remote location.

A 120/220 volt, single-phase, three-wire, 60-cycle service should be available to each unit.

If electrical service is not immediately available, temporary on-site generators should be used.

(4) Gas

Gas lines are not required. If units require gas for heating or cooking, portable bottled gas tanks should be used.

FIGURE 17

Site Selection Criteria Checklist

Locational Criteria	AT LEAST:	BUT NOT MORE THAN:	DESIRABLE:
1. Required Regional Roadway Clearance for Delivery of Mobile Home	12 ft. wdth. 13½ ft. hgt. 15 ft. turning radius @ right angle turns	14 ft. wdth. 14 ft. hgt. 20 ft. turning radius @ right angle turns	Adequate roadway clearance and turning radius for the transportation and delivery of mobile home units to the site; refer to the National Policy Statement of the American Association of State and Transportation Officials (AASHTO) 5 July 1973.
● 2. DISTANCE TO ORIGINAL NEIGHBORHOOD	NOT APPLICABLE	4-5 MILES	ADJACENT TO OR AS NEAR AS POSSIBLE TO ORIGINAL NEIGHBORHOOD IN EFFORT TO RE-ESTABLISH NORMAL OR ROUTINE LIVING PATTERNS.
3. Distance to Shopping	Within walking distance	4-5 miles	Walking distance of 10 minutes (½ mile) or less; the usual impaired mobility of the disaster victims elevates the importance of locating group sites near shopping facilities.
4. Distance to Employment	Same as pre-disaster	45 minutes	30 minutes or less, or same as pre-disaster.
5. Distance to Schools	Same as pre-disaster	30-min. bus ride to pre-disaster	Pre-disaster schools should be attended in order to avoid further psychological disorientation, preserve the community fabric and re-establish normal daily routine; if necessary, busing children to their pre-disaster schools should be instituted.
6. Distance to Medical Facilities	Access to disaster relief station	4-5 miles	Access to medical services or facility either near or on-site; the need for medical and dental attention will be determined by the scope of the disaster and the characteristics of the dislocated population (children, elderly).
7. Distance to Existing Recreational Facilities	Within walking distance	Walking distance of 15 minutes (3/4 mile)	Walking distance of 10 minutes (½ mile) or less; the need for recreational facilities will be determined by the characteristics of the population (children, elderly) and the intent to provide some temporary on-site facilities.

● essential criteria

FIGURE 17 (cont'd)

	AT LEAST:	BUT NOT MORE THAN:	DESIRABLE:
8. Distance to Social Cultural and Other Amenities	Same as Pre-Disaster	45 minutes	30 minutes or less, or same as Pre-Disaster; proximity to such amenities is not essential but important in combatting the disruptive social and psychological effects of a disaster.
9. Distance to Existing Public Transportation	Within walking distance	Walking distance of 10 minutes (½ mile)	Walking distance of 10 minutes (½ mile) or less to existing public transportation; the need for additional or temporary public transportation will be determined by the group site size, population (low income, elderly), the availability of private transportation and the scope of the disaster.
10. Adjacent Land Use	Not applicable	Not applicable	Heavy industrial, air and/or noise pollution should be avoided where possible.
11. Local Codes and Ordinances	Not applicable	Not applicable	Local restrictions should be waived by local authorities in a disaster situation so as to accommodate temporary group housing design and development.
12. Site Information	Not applicable	Not applicable	Accurate site surveys and existing utility information should be available; the lack of site information will cause delay in design and development.

● essential criteria

FIGURE 17 (cont'd)

Physical Site Features	AT LEAST:	BUT NOT MORE THAN:	DESIRABLE:
● 1. POTENTIAL NET DENSITY	5 UNITS/ACRE	10 UNITS/ACRE	6 - 8 UNITS/ACRE; PAST EXPERIENCE AND SITE DEVELOPMENT STUDIES HAVE SHOWN THAT A 6 - 8 UNIT/ACRE DENSITY IS MOST DESIRABLE FOR EFFICIENT ECONOMICAL DEVELOPMENT
2. Size and Number of Units	Not applicable	Not applicable	25 units on 4-5 acres; potential capacity of any site can be estimated by multiplying the total site acreage by 6, which is the recommended unit density per acre; that is, a 10-acre site can accommodate 60 mobile home units. If physical site and utility constraints prohibit the use of a single site, several smaller sites should be considered which may be in closer proximity to original neighborhood(s).
3. Shape	Not applicable	Not applicable	Square or rectilinear; for 50 units or less, the units are most efficiently placed on a square or rectilinear site; shape is less important for larger sites.
● 4. SLOPE	2% SLOPE	8% SLOPE; 12% SLOPE FOR SHORT RUNS MAY BE ACCEPTABLE	UNIFORM GROUND SURFACE WITH A SITE GRADIENT BETWEEN 2% AND 8%; A TOO-UNIFORM SITE WITH TOO LITTLE SLOPE COULD RESULT IN INADEQUATE SITE DRAINAGE.
5. Heavily Wooded Areas	Not applicable	Not applicable	Should be avoided since the sites are to be vacated in a short period of time and the use of the land is temporary.
6. Flood Plains	Not applicable	Not applicable	Should be avoided unless no alternative is available; refer to the "Flood Disaster Prevention Act," PL.93.234.
7. Falling Rock Zones, Swampy Areas or Other Hazards	Not applicable	Not applicable	Should be avoided due to the potential development difficulties and dangers related to child play.
8. Soil Conditions for Bearing of Mobile Unit	Not applicable	Not applicable	High water table or swampy sites should be avoided. Sandy soils are most preferable.
9. Soil Conditions for Proper Site Drainage	Not applicable	Not applicable	Sandy soils are most preferable and clay soils are least preferable for site drainage.

● essential criteria

FIGURE 17 (cont'd)

Availability and Requirements for Utilities	AT LEAST:	BUT NOT MORE THAN:	DESIRABLE:
● 1. WATER	POTENTIAL FOR PORTABLE WATER SUPPLY SYSTEMS	NOT APPLICABLE	EXISTING LOCAL WATER LINE, ADJACENT TO SITE, WITH AN ADEQUATE PRESSURE TO SERVE THE TOTAL NUMBER OF UNITS REQUIRED; ADEQUATE PRESSURE CAN BE DETERMINED BY MULTIPLYING THE TOTAL NUMBER OF UNITS BY 280 GAL./UNIT/DAY.
● 2. SEWER	POTENTIAL FOR PORTABLE SEWAGE DISPOSAL SYSTEMS	NOT APPLICABLE	EXISTING LOCAL SEWER LINE, ADJACENT TO SITE, WITH AN ADEQUATE CAPACITY TO SERVE THE TOTAL NUMBER OF UNITS REQUIRED; ADEQUATE CAPACITY CAN BE DETERMINED BY MULTIPLYING THE TOTAL NUMBER OF UNITS BY 250 GAL./UNIT/DAY.
3. Electric	An existing electrical power source in a remote location from the site from which electrical lines can be extended. Electric lines are less expensive and more easily extended to a site from a remote location than water or sewer.	Not applicable	Existing electrical utility line which can provide 120/220 volt, single phase, 3-wire, 60 cycle service.
4. Gas	Not applicable	Not applicable	Existing gas lines are not appropriate for Temporary Disaster Housing; bottled gas should be used exclusively, if required; bulk liquid propone may also be used.
5. Other	Not applicable	Not applicable	Other systems need not be considered in the site selection process.

● essential criteria

C. SITE DESIGN

The following recommendations and criteria should be observed in designing the site.

1. OVERALL GOAL AND SUMMARY

A site must be designed and developed as quickly as possible after a disaster.

For most efficient development, the design should be reduced to its basic components and special development or operating costs should be avoided. Development of imaginative layouts and amenities cannot be permitted to delay implementation. For efficient site design, the planner should:

- Understand the mobile home unit to be used.

  The planner should analyze the mobile home unit, how it relates to other units and to open spaces between units.*

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*The 12' x 60' mobile home unit which is currently stockpiled will continue to be used in disasters. Sites shown herein have been designed to accommodate this unit. However, improvements to this design have been extensively studied and published by Abeles, Schwartz and Associates/Beyer-Blinder-Belle in Volume 4 in their study, Cost Effective Housing Systems for Disaster Relief (Washington, D.C., U.S. Dept. of Housing and Urban Development, Sept. 1974)

Two prototypical lots have been developed to meet the criteria of density, privacy, and cost-effectiveness. If the two prototypes are used exclusively, emergency situations can be handled quickly.

- Apply the set of criteria for overall site planning.

- Review the examples of site plans given.

- Provide all appropriate amenities and life support systems.

2. PROTOTYPICAL LOT AND UNIT LAYOUTS

Different types of mobile homes are appropriate for disaster housing sites. This report assumes that a unit of 12' x 60' will be used. However, the report entitled "Cost Effective Housing Systems for Disaster Relief: Evaluation of Applicable Housing Systems Technology " concludes that this unit, which is currently stockpiled by HUD, is not best suited for disasters. The reports suggests that HUD purchase mobile homes with a dimension of 12' x 48' (144 square feet smaller), a different arrangement of interior space, and all-electric service. However, if HUD stockpiles such a unit in the future, lot sizes and site layouts specified here should not be varied. The new smaller unit will conform to all requirements in the layout of the larger unit; there would be no change in density, utility hook-ups, or development techniques.

No matter what size unit is used, a spatial relationship exists between each unit in the design of a site. A 30-foot space between units is efficient and yet creates a sense of privacy. This space acts as a buffer between units and provides appropriate density. The lot prototypes incorporate these elements.

The space just outside a unit is private and semi-private. Private space, the area beneath the bedroom windows, is for passive, undefined activity; the semi-private space, viewed from the unit's entry, living, dining, and kitchen areas, is for specific activities such as parking and recreation.

The planner should know the type and size unit that will be provided so he can design a site plan which will ensure privacy, provide private outdoor yards, and orient units appropriately.

These elements are integral parts of site design, and are illustrated in the prototypical layouts which follow.

a. <u>Lot Prototype A</u>

Lot prototype A in Figure 18 is a simple and efficient layout of lots in which units are parallel to each other on adjacent lots. Each lot is 112' x 42'. The important characteristics of prototype A are:

- Mobile home units are placed parallel to the contours of the site.

- A 25' setback between the unit and the on-site access road provides a private parking space, direct vehicular access to the front door of each unit, and paved access to the lot to position the mobile home. As a result, a larger private yard is provided adjacent to each unit.

- The overall lot depth of 112 feet extends to the center line of the 24'-wide access road. That is, 12 feet of the 24'-wide access road right-of-way is provided in each prototype so the placement of two lots side by side will provide the total required roadway width. (See discussion on roadways in the Criteria for Overall Site Planning.)

- The lot dimensions provide at least 30 feet between units, enough to maintain privacy. If the recommended dimensions are exceeded, the length of roadway and utility lines, plus total development costs, will be increased. Therefore, dimensions should be carefully observed.

- The windows of the private or bedroom areas of each unit face the windowless wall of an adjacent unit. This feature allows units to be placed only 30 feet apart.

The schemes in Figure 19 illustrate efficient arrangements of prototype A. A utility line for essential utilities -- sewer, water, and electric service -- is aligned above or below ground along rear lot lines. The servicing of units on either side, or double-loading the utility line, is the most efficient utility layout.* Gravel access roadways are provided at the perimeter of the grouping to avoid conflicts with the installation and maintenance of utilities.

b. Lot Prototype B

The scheme in Figure 20 illustrates a second lot size, prototype B. Each lot is 80' x 58'. Units are placed at a 45° angle to the access road. Prototype B differs from prototype A in these important respects:

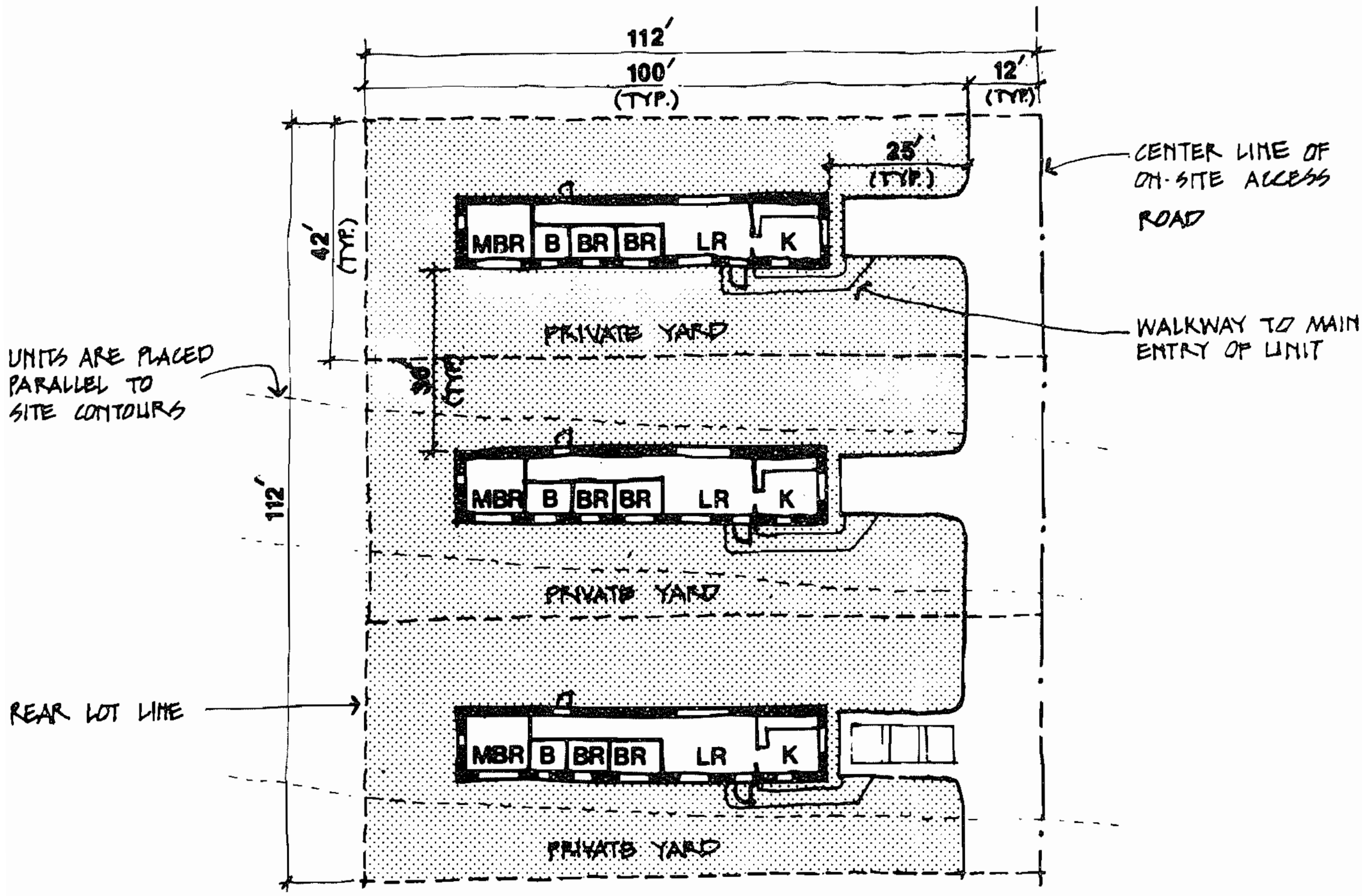
- Prototype B is more appropriate when the lot layout is limited and grading problems can be reduced if units are placed parallel to contour lines. This prototype is also valuable when sun, wind, or natural site features make it desirable to place units on an angle.

- Installation is simplified since a truck delivering a unit need not negotiate a 90° turn to place the unit on its lot.

- Placing units at an angle gives the planner greater flexibility in designing an imaginative layout while maintaining desirable effiency.

The placement of lots at multiples of two or at least two abreast is essential to achieve an efficient utility layout as discussed in the Criteria for Overall Site Planning included in this report.

The variations illustrated in Figure 21 for prototype B contain the same features of the prototype A groupings. Units are placed two abreast, 30 feet apart, and are provided with a double-loaded utility line and a perimeter access road.

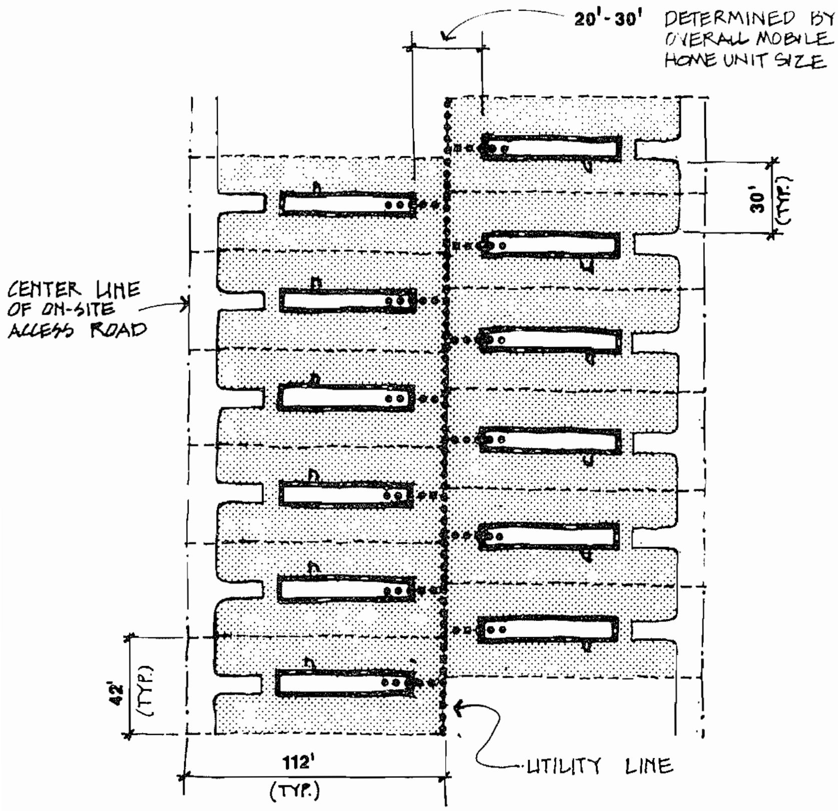


PROTOTYPE 'A' (42 FEET x 112 FEET)

NOTE: THE 12 FOOT x 65 FOOT MOBILE HOME SHOWN ABOVE IS ONE TYPE OF UNIT WHICH MAY BE USED AT TEMPORARY DISASTER GROUP SITES. INTERIOR LAYOUTS AND OVERALL UNIT DIMENSIONS MAY VARY.

FIGURE 18

LOT PROTOTYPE 'A'



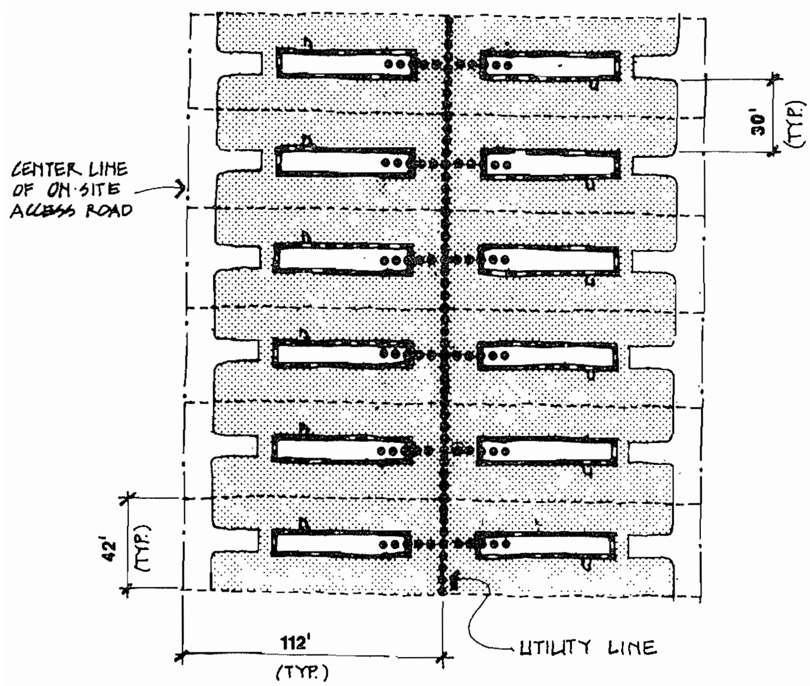
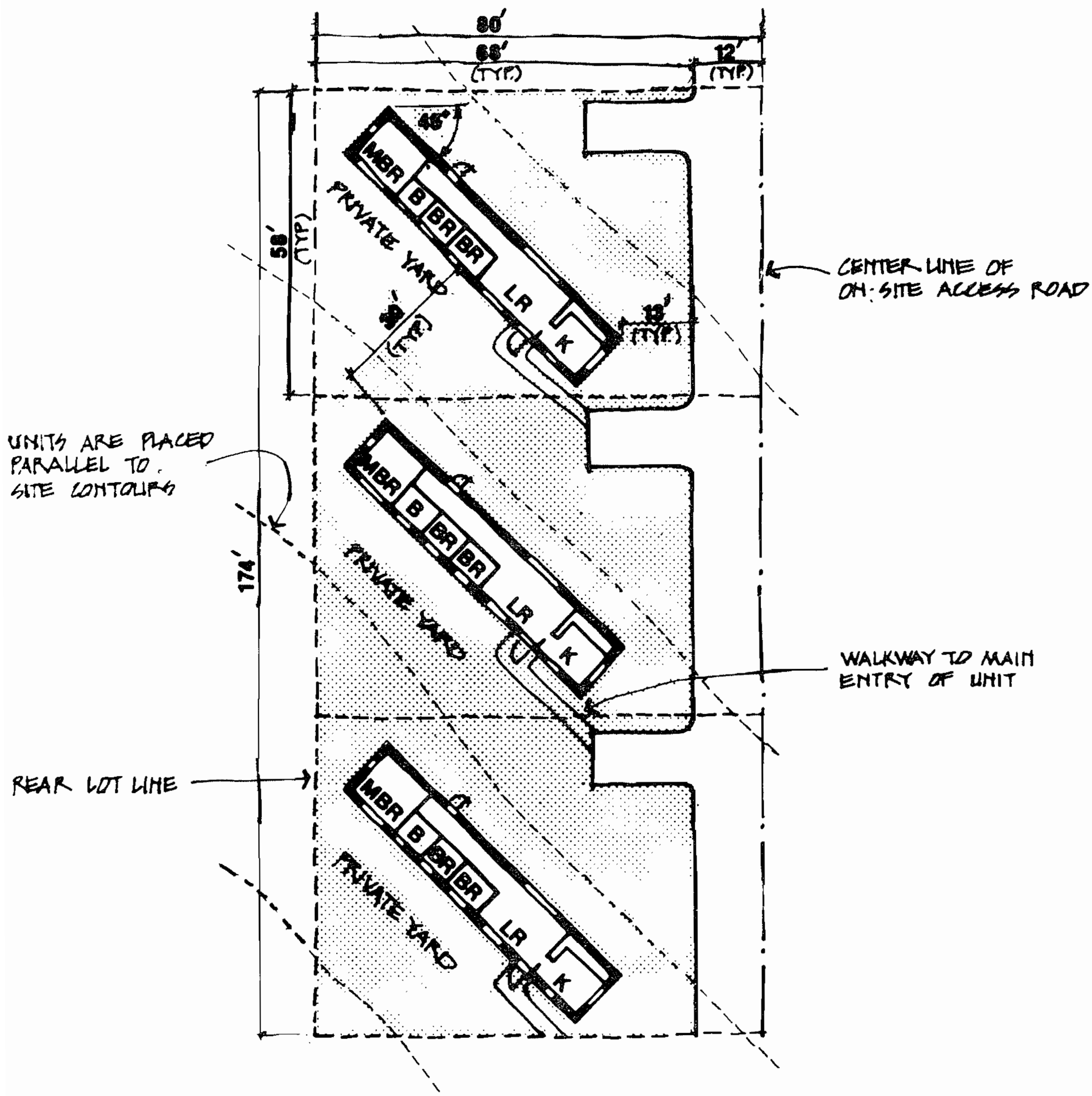


FIGURE 19   LAYOUT VARIATIONS FOR LOT PROTOTYPE 'A'



PROTOTYPE 'B' (58 FEET x 80 FEET)

NOTE: THE 12 FOOT x 65 FOOT MOBILE HOME SHOWN ABOVE IS ONE TYPE OF UNIT WHICH MAY BE USED AT TEMPORARY DISASTER GROUP SITES. INTERIOR LAYOUTS AND OVERALL UNIT DIMENSIONS MAY VARY.

FIGURE 20
LOT PROTOTYPE 'B'

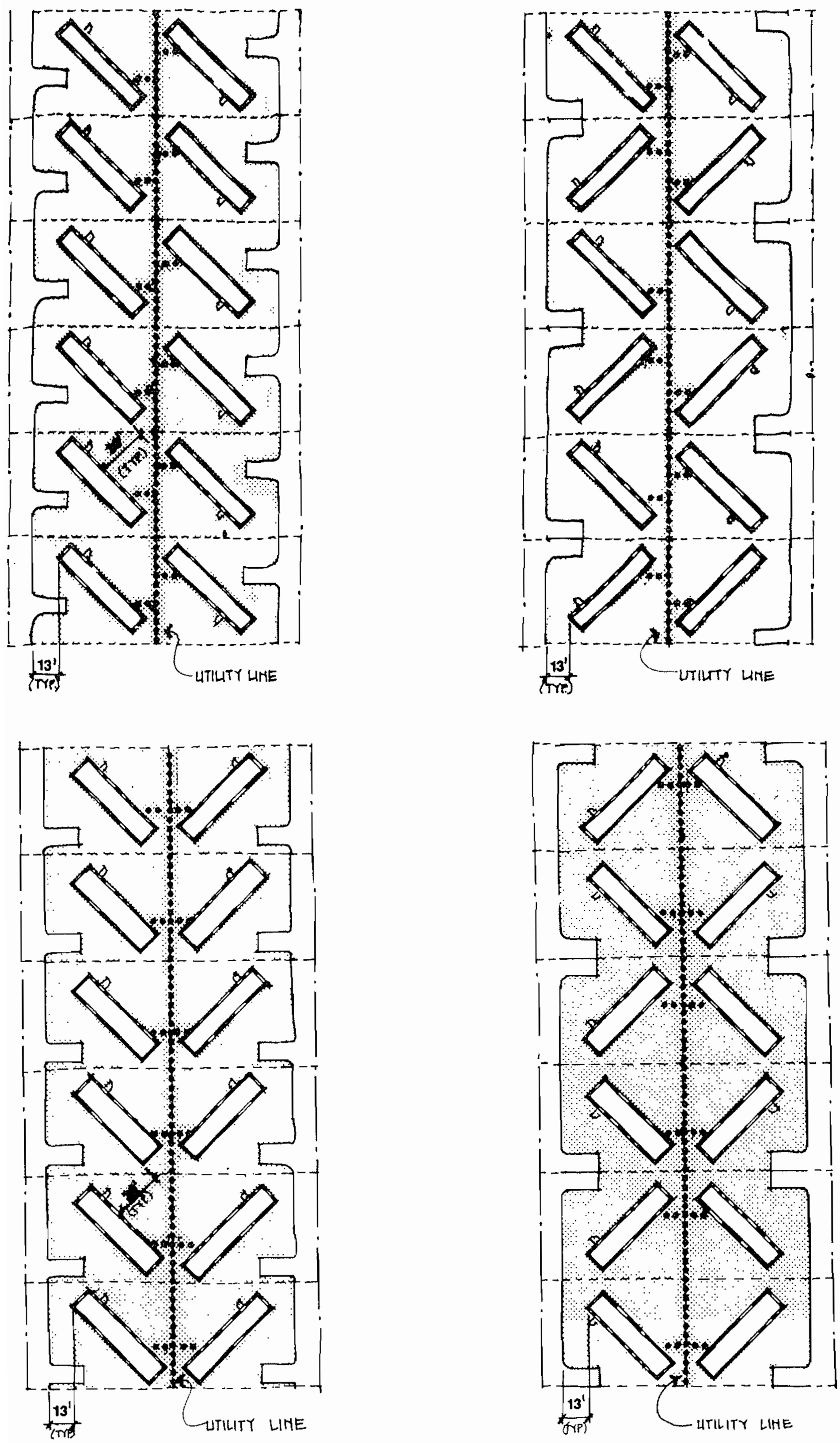


FIGURE 21 LAYOUT VARIATIONS FOR LOT PROTOTYPE 'B'

3. GUIDELINES FOR SITE PLANNING

If the criteria for site selection are observed, difficulties in site planning should be eliminated or reduced. However, the planner should keep in mind the following guidelines.

Sites of 100 units or more are usually more difficult to develop, require more amenities, and demand greater attention to lessen monotony and dreariness.

Small sites, averaging 25 units or four acres, have been used most often, regardless of the size of the disaster.* Such sites are simplest to design. However, in the past, sites selected were sometimes larger than necessary to house the displaced families. In such cases it is tempting to decrease density by placing units farther apart. This should be avoided since it may lead to less efficient and costlier site plans. The criteria for overall site planning, which follow, should be strictly observed to produce the most efficient site plans. Undeveloped area can be used for recreation or to increase setbacks.

In any case, the site plan should be designed so units are grouped in clusters of 25 to achieve an efficient and economical plan and a sense of community.

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* Of all sites required in 1972 after Hurricane Agnes in Pennsylvania, over 70% were in this size range. Larger sites simply were not available near the disaster area. This was especially true in urban and suburban locations.

4. EXAMPLES OF ACCEPTABLE SITE PLANS

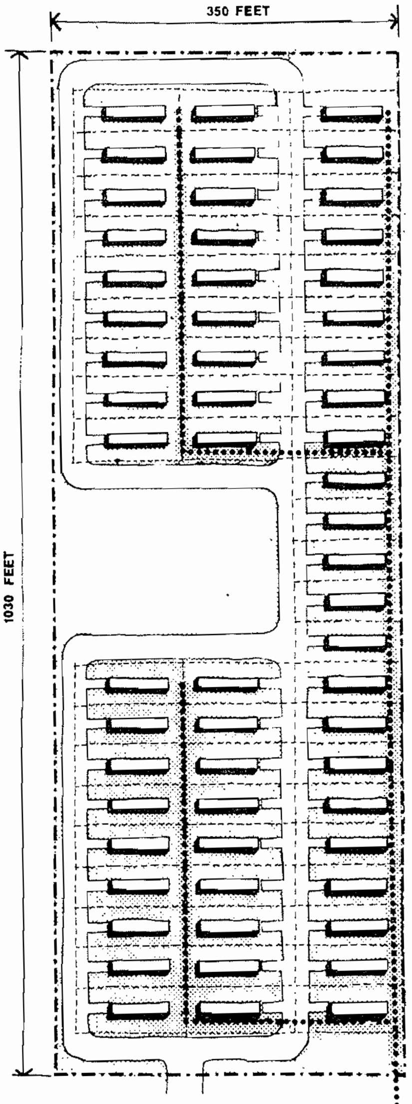
To apply the recommended prototypes to an actual site efficiently the planner should refer to the following layout variations.

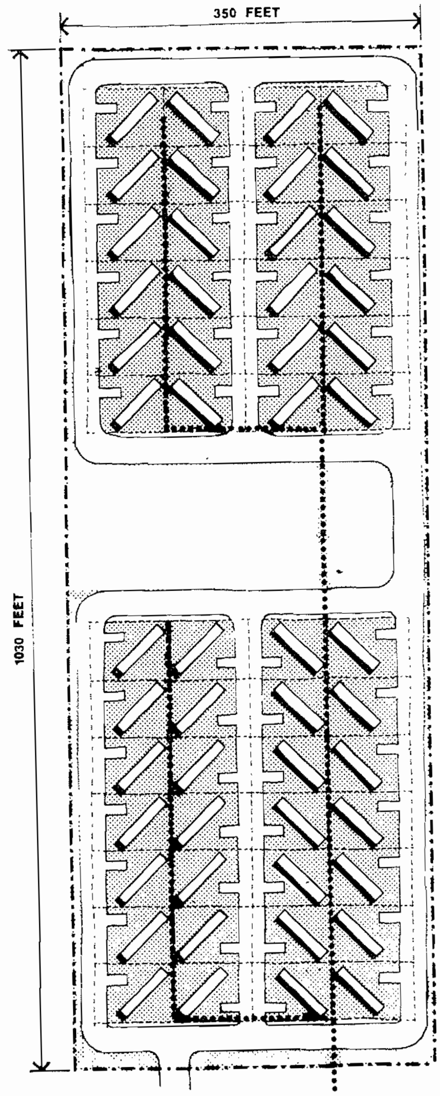
Three site shapes are shown -- a narrow rectangle, a square, and a triangle. Each contains 8.26 acres and can accommodate at least 50 mobile homes. Each site has 2% to 8% slope and no unusual features. Each plan incorporates double-loaded utility lines, perimeter roadways, and centrally located community areas.

A narrow rectangular site may dictate the use of one prototype throughout, as shown in Figures 22 and 23.

Both site plans require the same length of utility and are equally acceptable in terms of density and development costs. However, the site plan in Figure 22 is less expensive to develop since 25% less access roadway is required. This site plan is therefore more desirable in terms of cost-effectiveness.

The site shown in Figure 23, however, provides a larger community space. If necessary, additional mobile homes could be added. This plan also incorporates the use of prototype B, allowing units to be placed at a 45^{o} angle to the access road. In this way, natural site features such as sunlight, trees, and land contours are respected. The use of prototype B also reduces monotony.





	PER UNIT		TOTAL	
LINEAR FT. OF ONSITE ROADS:	45		2680	
LINEAR FT. OF ONSITE UTILITY LINES:	37		2230	
COMMUNAL RECREATION FACILITIES (DEFINED SPACES):	735	SQ. FT.	43380	SQ. FT.
COMMUNAL OPEN AREAS (UNDEFINED SPACES):	650	SQ. FT.	38420	SQ. FT.
INDIVIDUAL LOT AREAS (INCLUDING 50% ROADWAY):	4704	SQ. FT.	277536	SQ. FT.
PARKING SPACES PER UNIT:	1		59	

GROSS SITE AREA: 8.26 ACRES
MOBILE HOMES ON SITE: 59 UNITS
DENSITY: 7.14 UNITS/ACRE

MOBILE HOME UNIT
UTILITIES
SITE BOUNDARY
PARKING

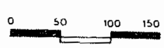


FIGURE 22

	PER UNIT		TOTAL	
LINEAR FT. OF ONSITE ROADS:	73		3810	
LINEAR FT. OF ONSITE UTILITY LINES:	38		2040	
COMMUNAL RECREATION FACILITIES (DEFINED SPACES):	1068	SQ. FT.	55550	SQ. FT.
COMMUNAL OPEN AREAS (UNDEFINED SPACES):	1275	SQ. FT.	66310	SQ. FT.
INDIVIDUAL LOT AREAS (INCLUDING 50% ROADWAY):	4640	SQ. FT.	241280	SQ. FT.
PARKING SPACES PER UNIT:	1		52	

GROSS SITE AREA: 8.26 ACRES
MOBILE HOMES ON SITE: 52 UNITS
DENSITY: 6.3 UNITS/ACRE

MOBILE HOME UNIT
UTILITIES
SITE BOUNDARY
PARKING

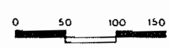


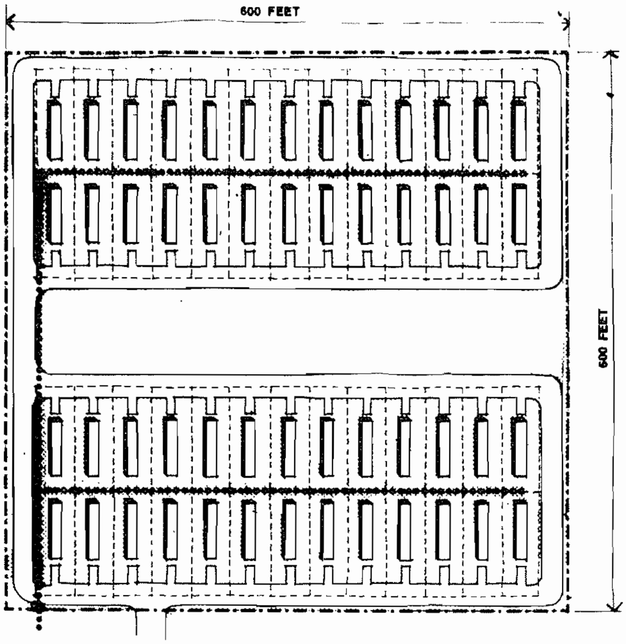
FIGURE 23

SITE PLAN FOR RECTANGULAR SITE

The square sites, shown in Figures 24 and 25, each provide an equal number of units with desirable density and acceptable efficiency. However, the site plan shown in Figure 25, containing lot prototypes A and B, uses the given site area less efficiently and at a higher development cost.

The site plan shown in Figure 25 also requires more utility line and roadway. Furthermore, the plan in Figure 25 provides minimal community space, while the plan in Figure 24 provides a large community space adjacent to half the units.

Although both schemes are acceptable, the site plan in Figure 24 is more desirable in terms of cost-effectiveness due to greater efficiency and lower development costs.



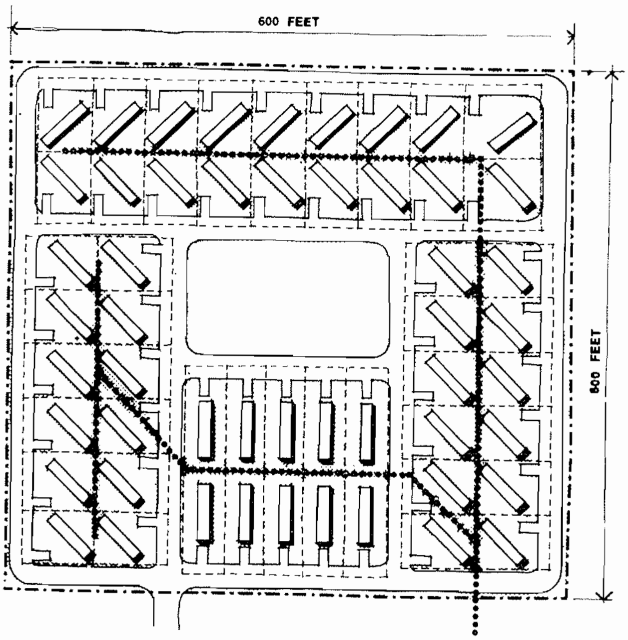
	PER UNIT		TOTAL	
LINEAR FT. OF ONSITE ROADS:	62		3200	
LINEAR FT. OF ONSITE UTILITY LINES:	29		1520	
COMMUNAL RECREATION FACILITIES (DEFINED SPACES):	1033	SQ. FT.	53760	SQ. FT.
COMMUNAL OPEN AREAS (UNDEFINED SPACES):	1162	SQ. FT.	60840	SQ. FT.
INDIVIDUAL LOT AREAS (INCLUDING 50% ROADWAY):	4704	SQ. FT.	244608	SQ. FT.
PARKING SPACES PER UNIT:	1		52	

GROSS SITE AREA: 8.26 ACRES
MOBILE HOMES ON SITE: 52 UNITS
DENSITY: 6.3 UNITS/ACRE

MOBILE HOME UNIT
UTILITIES
SITE BOUNDARY
PARKING

0 50 100 150

FIGURE 24



	PER UNIT		TOTAL	
LINEAR FT OF ONSITE ROADS:	72		3760	
LINEAR FT. OF ONSITE UTILITY LINES:	32		1680	
COMMUNAL RECREATION FACILITIES (DEFINED SPACES):	508	SQ. FT.	26400	SQ. FT.
COMMUNAL OPEN AREAS (UNDEFINED SPACES):	646	SQ. FT.	33600	SQ. FT.
INDIVIDUAL LOT AREAS (INCLUDING 50% ROADWAY):	4640	SQ. FT.	241280	SQ. FT.
PARKING SPACES PER UNIT:	1		52	

GROSS SITE AREA: 8.26 ACRES
MOBILE HOMES ON SITE: 52 UNITS
DENSITY: 6.3 UNITS/ACRE

MOBILE HOME UNIT
UTILITIES
SITE BOUNDARY
PARKING

0 50 100 150

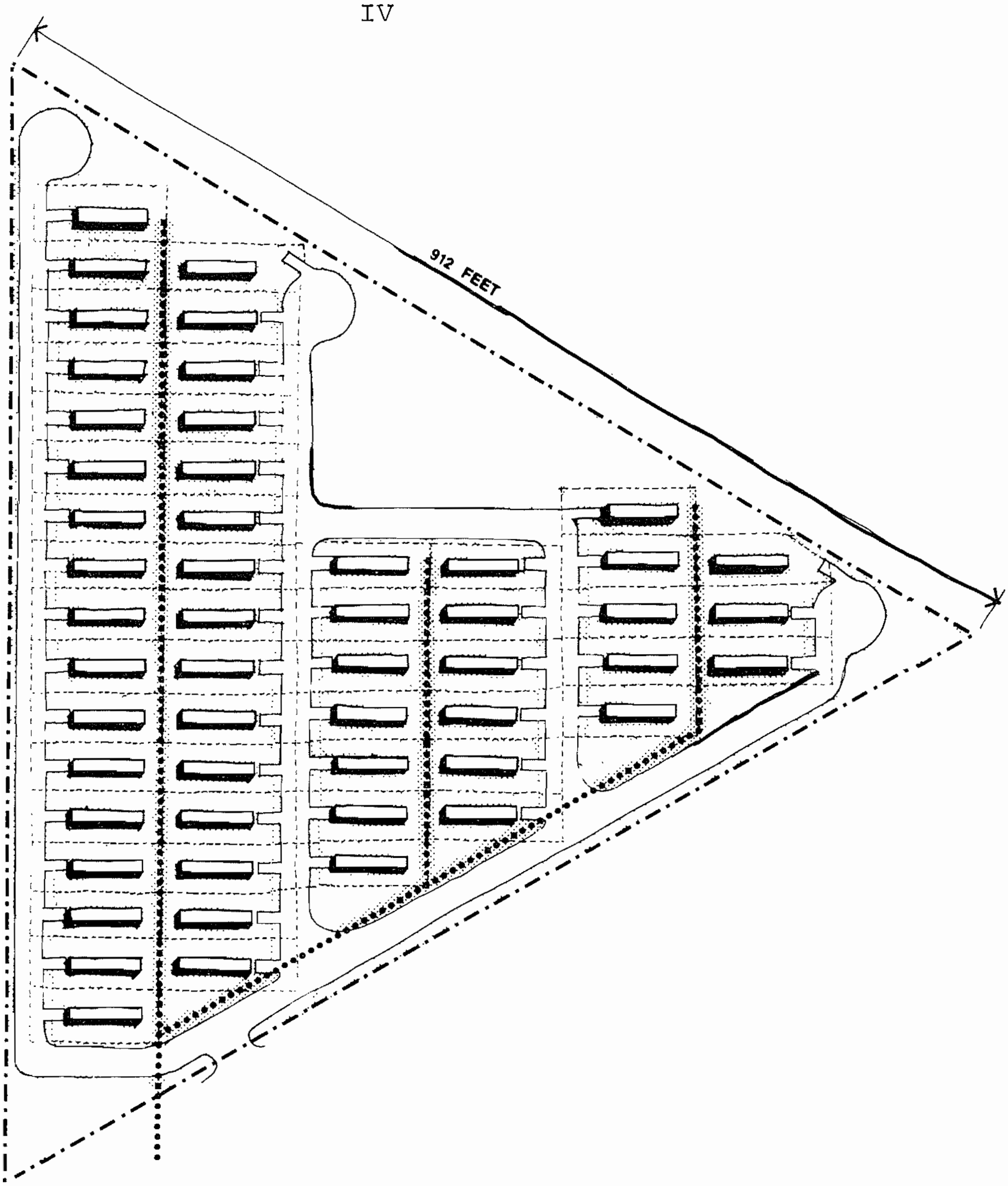
FIGURE 25

SITE PLAN FOR SQUARE SITE

The triangular site shown in Figure 26 is often difficult to develop. The triangular site plan demonstrates that an efficient layout can be achieved, with densities and lengths of roadways and utility lines which compare favorably to rectangular sites.

Cul-de-sacs, or turn-arounds, are provided. Vehicular turn-arounds should be considered whenever unnecessary roadway length can be eliminated or where dead-end streets are called for.

All these plans achieve a desirable level of efficienty. The planner should therefore consider various layouts as guidelines, not as fixed rules.



	PER UNIT		TOTAL	
LINEAR FT. OF ONSITE ROADS:	50		2640	
LINEAR FT. OF ONSITE UTILITY LINES:	26		1380	
COMMUNAL RECREATION FACILITIES (DEFINED SPACES):	580	SQ. FT.	30800	SQ. FT.
COMMUNAL OPEN AREAS (UNDEFINED SPACES):	1040	SQ. FT.	55000	SQ. FT.
INDIVIDUAL LOT AREAS (INCLUDING 50% ROADWAY):	4704	SQ. FT.	249300	SQ. FT.
PARKING SPACES PER UNIT:	1		53	

GROSS SITE AREA: 8.26 ACRES
MOBILE HOMES ON SITE: 53 UNITS
DENSITY: 6.4 UNITS/ACRE

MOBILE HOME UNIT
UTILITIES
SITE BOUNDARY
PARKING

0 50 100 150

FIGURE 26

SITE PLAN FOR TRIANGULAR SITE

5. RECOMMENDATIONS FOR SITE DESIGN

The following sections will help the planner design sites quickly and efficiently. Included are recommendations and criteria. A procedure for overall site planning is recommended, and design criteria and recommendations regarding amenities and life support systems are provided.

a. Criteria for Overall Site Planning

The following criteria illustrated in Figures 27-34 will be helpful in site planning.

(1) Site Selection

Refer to the Site Selection Checklist in Figure 17 to select an appropriate site.

(2) Physical Site Feature Identification

Identify all existing structures, large rock outcroppings, wooded areas, lakes, ponds, and streams which may either be an asset or interfere with the positioning of mobile homes. Direction of sunlight, slope, prevailing breeze, and desirable view should also be noted so units can be oriented appropriately.

(3) Lot Setbacks and Net Site Dimensions

Determine the net area of the site by subtracting 15' setbacks which must be provided at the perimeter property line. Where possible, allow for a 30' setback at the front of the site.

(4) Lot Layout

Lay out the required number of lots within the net site area in an even and simple manner. It is not necessary to provide additional space between lots for access roadways; the roadway width has been provided for within the lot. Natural site features should be taken into consideration so the site plan can maximize their advantages.

Two lot prototypes are recommended -- prototypes A and B. When units are placed in multiples of two, each prototype provides the most efficient arrangement of mobile homes, utility connections, and roadway layout. The two prototypes may be used individually or in combination.

(5) On-Site Utility Layouts

Plot utility line of the <u>shortest</u> possible distance.

Since the installation of new utilities is greater than any other development cost, length of utility lines should always be minimized by aligning utilities at the rear lot line between lots placed two abreast.

This alignment, or double-loading of utilities, is the most efficient and least costly layout.

Single loading, or aligning utilities at the perimeter of the site will increase the length of the utilities and boost the total cost. It should be avoided.

(6) On-Site Roadway Layout

Provide a roadway system which will provide direct access to each lot but will avoid conflict with the installation or maintenance of utilities. The lot depth of each prototype provides for half the required street width of 24 feet; therefore, placing two lots next to each other, provides the total width. Thus, no additional space is needed for roadways. The roadway alignment is determined by the lot and utility layout.

However, if lots have been aligned two abreast along the perimeter of the site only half the required width is provided for an access roadway at the site's perimeter.

In such cases, the remaining street width may be taken from the perimeter setback.

The perimeter roadway scheme will <u>increase</u> the length of roadway, but will <u>decrease</u> the length of utility line required.

(7) Community Space Designation

For sites of more than 25 units, designate at least 8% of the site as community space. Centrally located or hard to develop lots should be used for this purpose.

Natural site features should be included in the community space. But community parking and inaccessible site features such as lakes and ponds should not be.

Community space is not required for sites with fewer than 25 units.

(8) Mobile Home Unit Layout

Lay out mobile homes using the recommended prototypes to achieve acceptable setbacks and privacy. Setback dimensions should be observed, and units should be placed back-to-back.

The orientation of individual units should respect the slope of the site, the direction of sunlight and wind, and such physical features as trees and rocks.

(9) Density Evaluation

To determine density, divide the total number of units by the acreage of the portion of the site being developed. An acceptable density range is six to eight units per acre. Sites should contain no fewer than five units nor more than 10 units to the acre.

(10) General Site Plan Refinements

Provide a 30-foot-wide collector roadway to service all 24-foot-wide access streets at sites of 100 or more units. Provide more than one entrance for sites of 100 units or more. For sites of 50 units, provide buffer roadways between mobile homes and designated community space to distinguish private and community space. Provide open space or collector roadways between cluster mobile home groupings at sites of 50 or more units.

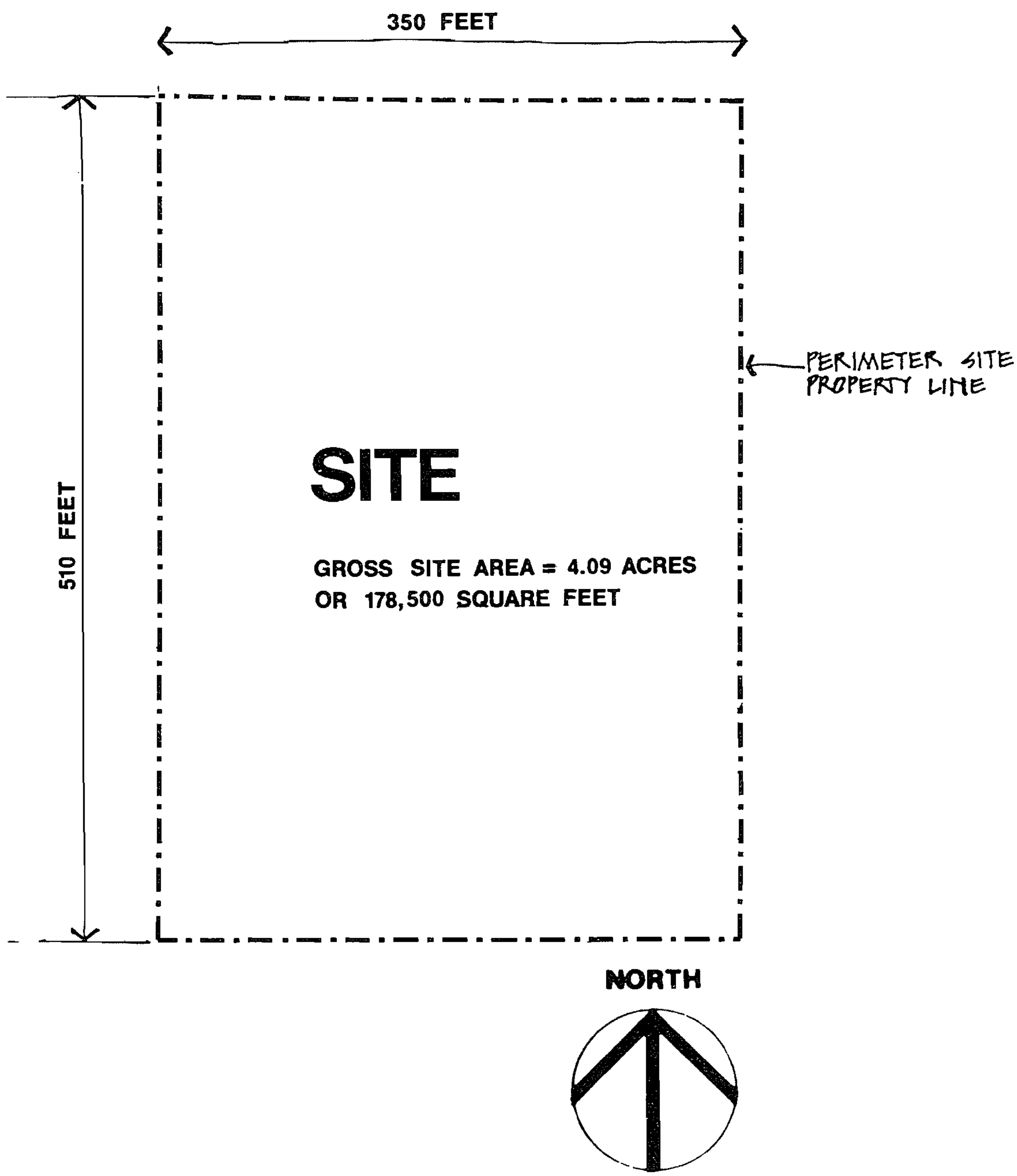


FIGURE 27

SELECT SITE

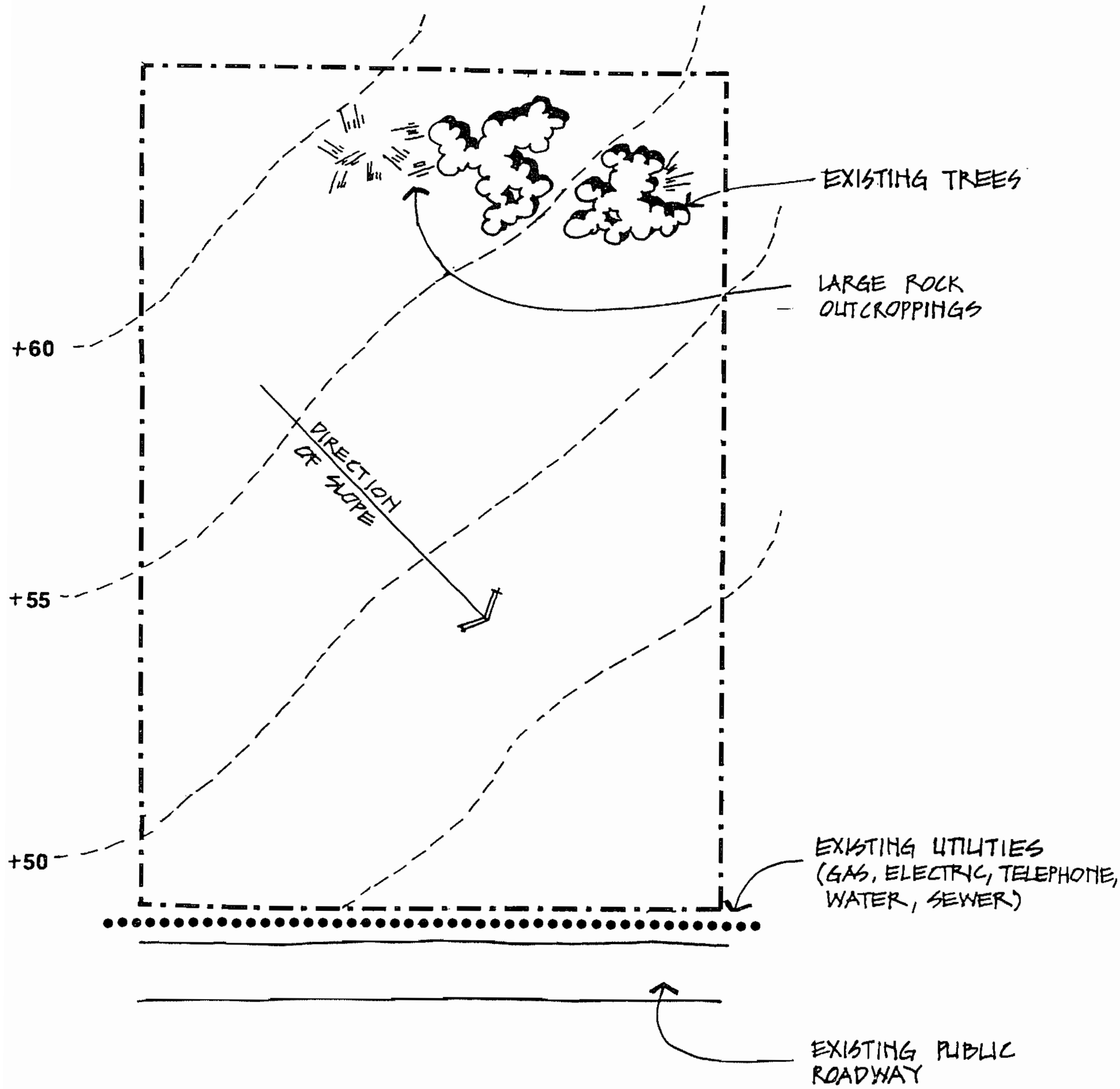


FIGURE 28

IDENTIFY SITE FEATURES

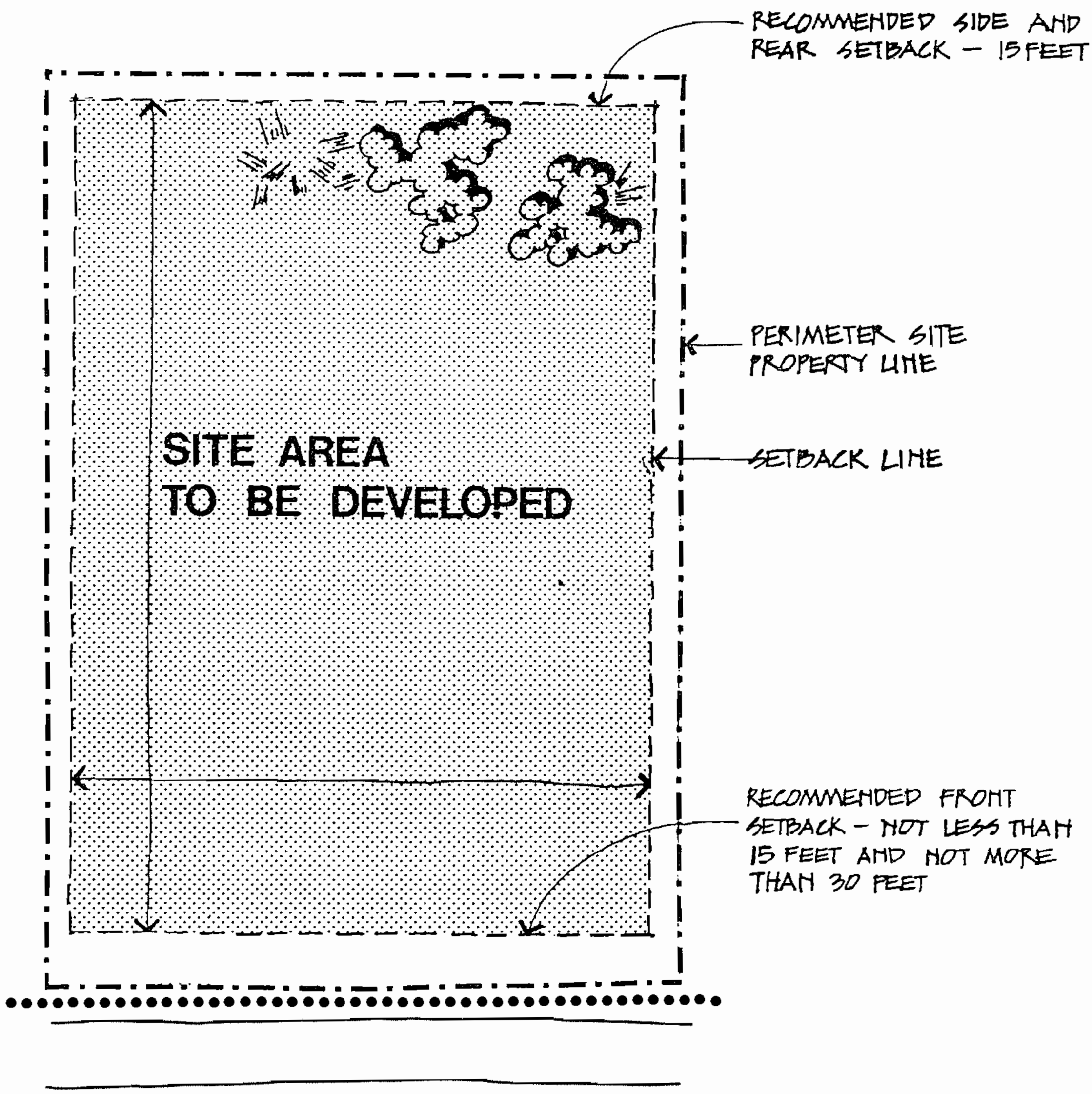
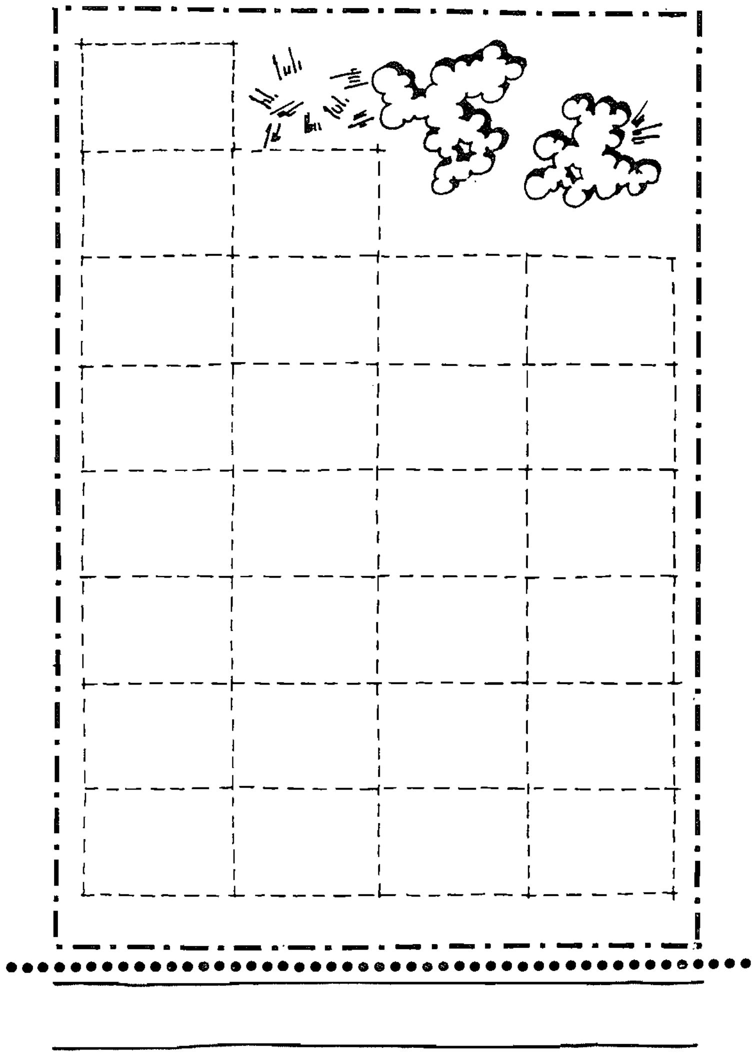


FIGURE 29

ESTABLISH SITE AND SETBACK DIMENSIONS



LOT PROTOTYPE 'B' IS MORE APPROPIATE FOR THIS SITE THAN LOT PROTOTYPE 'A' DUE TO THE 320 FOOT SITE WIDTH.

FIGURE 30

LAYOUT LOTS

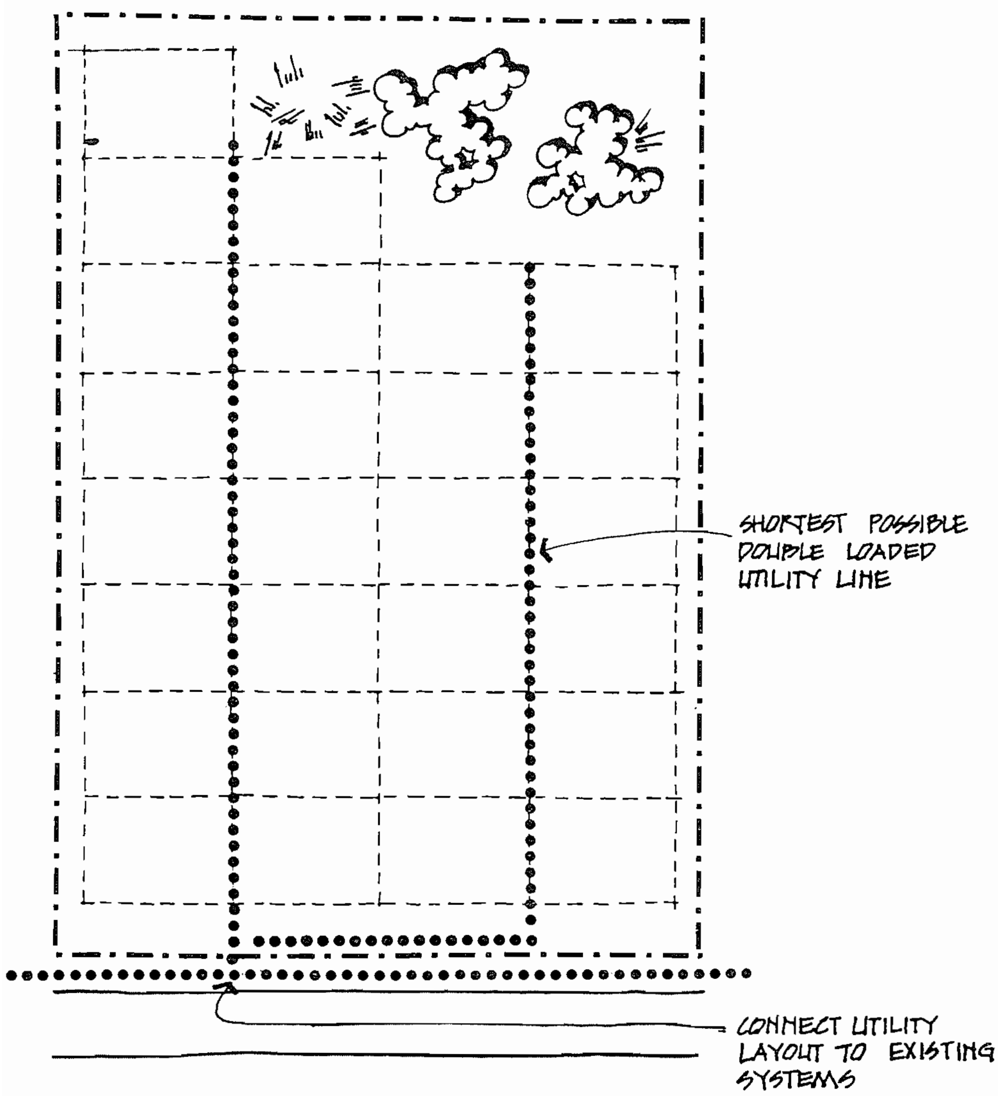


FIGURE 31

LAYOUT ON-SITE UTILITIES

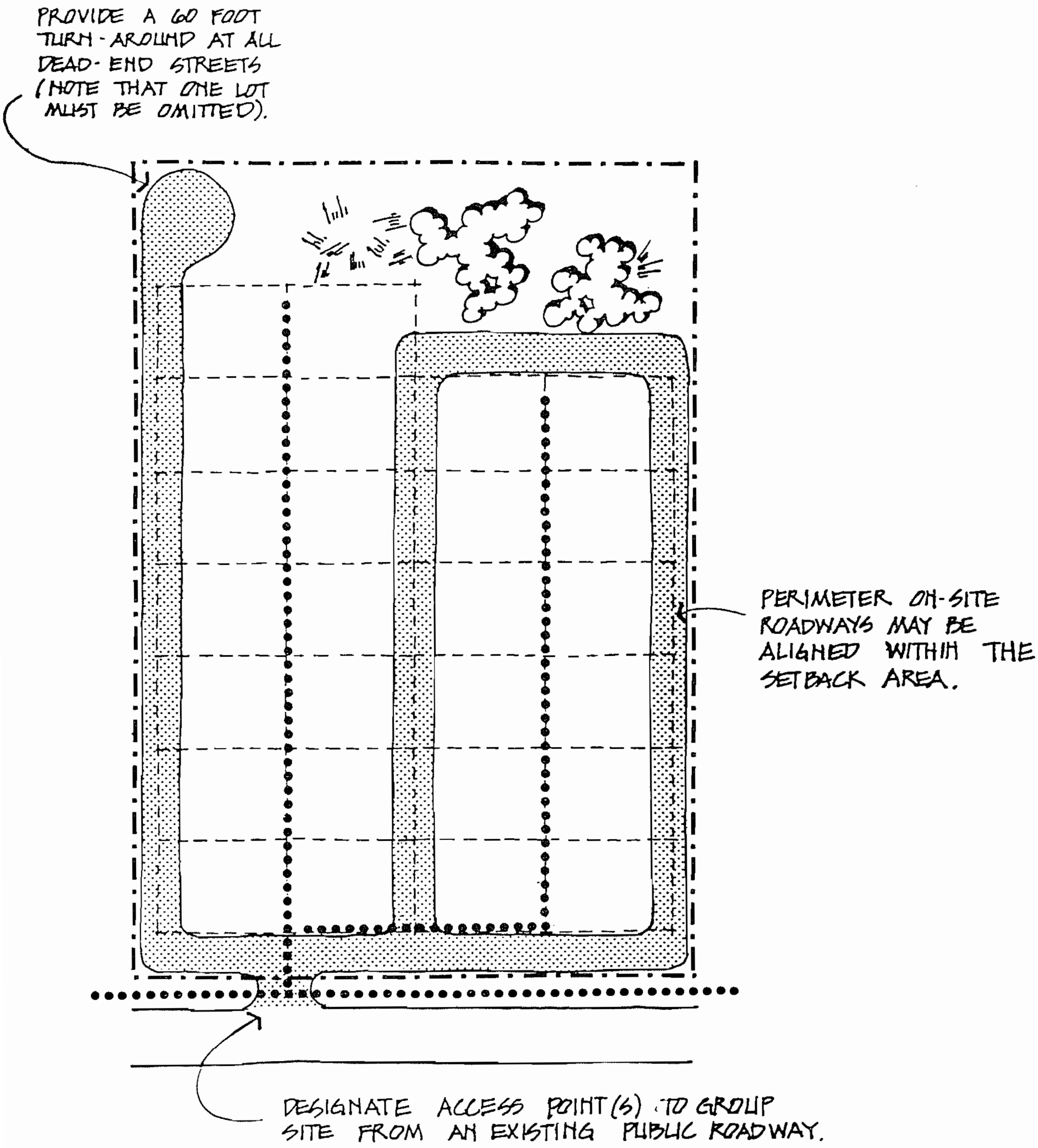


FIGURE 32

LAYOUT ON-SITE ROADWAYS

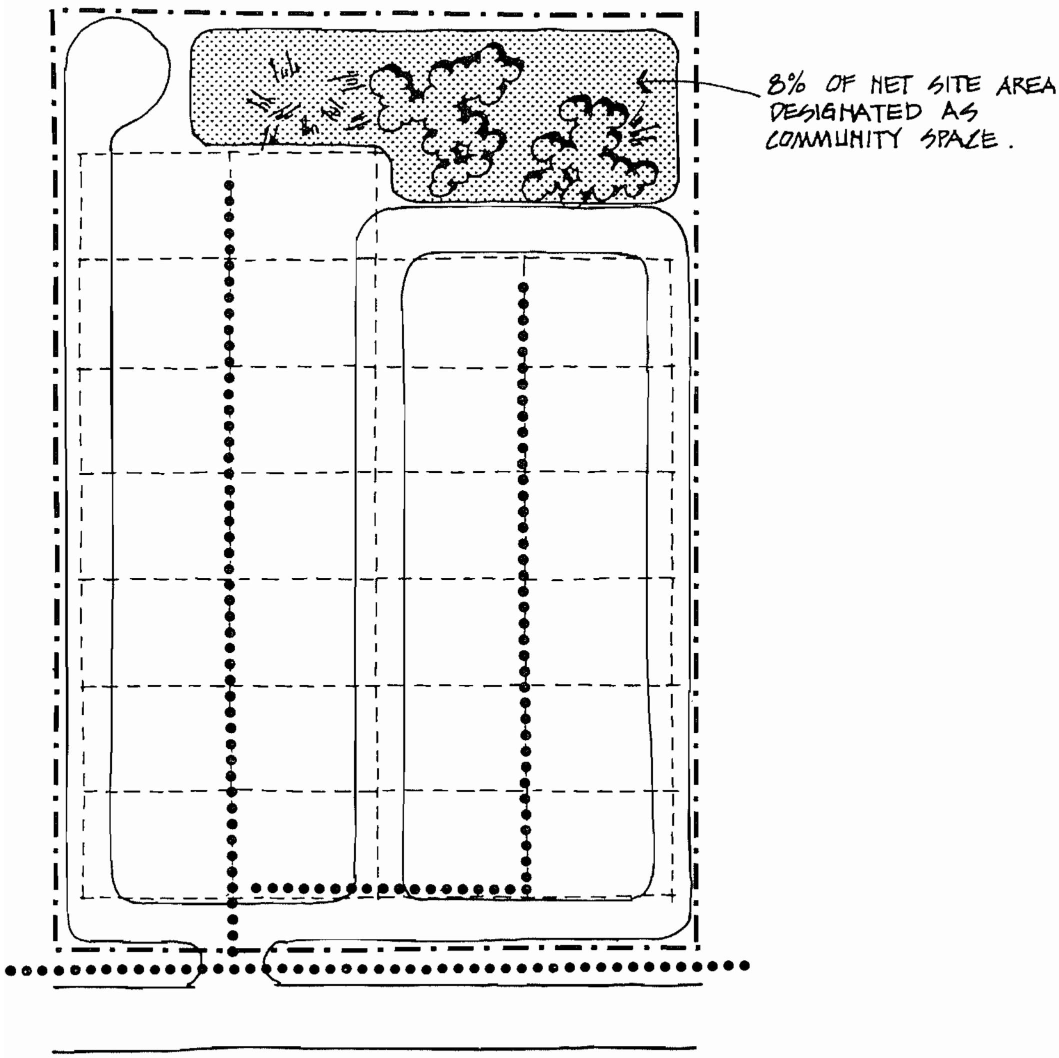


FIGURE 33

DESIGNATE COMMUNITY SPACE

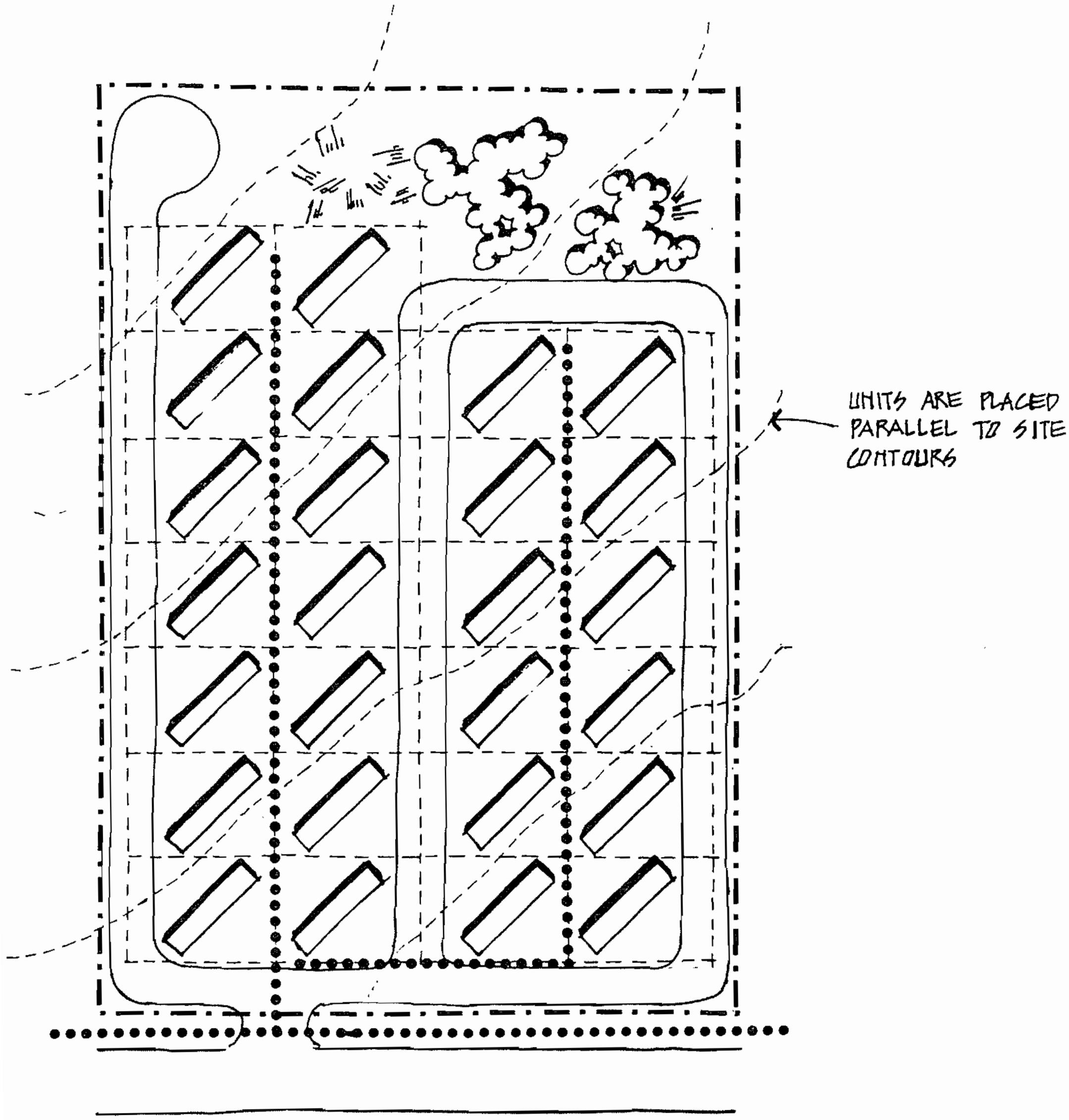


FIGURE 34

LAYOUT MOBILE HOME UNITS

b. Recommended Amenities for Site Design

Some amenities should be provided. They will make it easier for displaced families to resume their daily routine and readjust psychologically after the disaster.

Figure 35 should be referred to as a guide during the design process to include appropriate amenities.

For detailed specifications concerning site design, the planner should refer to this section and the Army Corps of Engineers specification in the Appendices.

FIGURE 35

RECOMMENDED AMENITIES FOR SITE DESIGN
ACCORDING TO GROUP SITE SIZE

100 - OVER	50 - 100	25 - 50	- 24	GROUP SITE SIZE
●				MORE THAN ONE SITE ENTRY
●	●	●	●	ON-SITE GRAVEL ROADWAY
●	●	●	●	PRIVATE PARKING (INDIVIDUAL PARKING SPACE AT EACH UNIT)
●	●	○		COMMUNITY PARKING
●	●	●	●	PRIVATE WALKWAY
●	○	○		COMMON WALKWAY
●	●	●		COMMUNITY SPACE (8% GROSS SITE AREA)
	●	●		COMMUNITY MEETING SPACE (MANAGEMENT TRAILER)
●	○			COMMUNITY MEETING SPACE (SEPARATE STRUCTURE)
●	●	●		PLAYGROUND/OPEN SPACE RECREATION (100 S.F./UNIT)
●	●	●	○	ON-SITE COMMUNAL LAUNDRY FACILITY (1 WASHER FOR EVERY 17 UNITS; 1 DRYER FOR EVERY 4 WASHERS)
●	●	●	●	ON-SITE STORAGE
○	○	○	○	OFF-SITE STORAGE
●	●	●		ONE MANAGEMENT TRAILER NEAR GROUP SITE ENTRY
●	●	●	○	IDENTIFICATION GRAPHICS

● recommended

○ as required

*The above table is intended to be a guide for the development of disaster group sites. However, population type (i.e., low income, elderly, etc.), scope of the disaster and other local criteria may prevail.

(1) General Site Preparation

Limit site preparation to minimal grading and excavation required to layout units, roadways, and utilities. Existing top soil and vegetation should be retained. The site plan should not alter natural drainage.

(Refer to the Army Corps of Engineers' Proposed Standard for Emergency Mobile Home Site Development, Sections 0201 and 0202, for proper procedure for clearing, grading, excavating, trenching, and disposal of debris.)

(2) Unit Foundation and Anchoring

Provide two rows of six concrete block piers 12 feet on center on 24"x24"x4" deep concrete foundation pads.

All temporary mobile homes must have wind-resisting tie-downs or anchors. In hurricane zones, tie-downs must be spaced every 12 feet beginning from the mobile home's front wall, corner to corner. Elsewhere every other tie-down can be omitted. Either of two types of anchors may be used: an auger-type anchor which spreads apart in the earth or an anchor buried in block concrete.

(3) Roadway

The roadway material should be compacted gravel or crushed rock consisting of a 2 inch surface course.

Provide a cul-de-sac or vehicular turn-around of at least 60 feet in diameter at all dead-end streets. However, provision of a cul-de-sac may require omitting at least one mobile home. Continuous or circuit roadways may be an alternative. In either case, there should be a 15'-to-20' minimum turning radius at all right angle turns.

(Refer to the Army Corps of Engineers' Proposed

Standard Specification for Emergency Mobile Home Site Development, Section 0203, for proper roadway construction technique.)

(4) Parking

Provide 1.25 parking spaces of 9'x18' each for each unit; all parking areas should have a six-inch-deep compacted gravel base. One or two spaces should be provided adjacent to each unit. No space should exceed 10'x20'.

Provide one additional guest parking space for every four units. Locate guest parking at the site entry adjacent to the management trailer or the community facility. Community parking should not be part of the 8% of the site designated as community space.

(5) Walkway

Provide a four-inch-deep gravel walkway from each private parking space to the main entry of each unit. The private walkway should be at least 1.5 feet and preferably two feet wide. Common walkways should not be wider than 3.5 feet and should be omitted if internal streets are lightly traveled.

Provide wooden steps or ramps with a railing at the front and rear entry of each unit. All wheelchair units should have ramps.

(Refer to the Army Corps of Engineers' Proposed Standard Specification for Emergency Mobile Home Site Development, Section 0203, for proper walkway construction procedure.)

(6) Community Meeting Space

Use the management trailer or a vacant trailer for community meeting space or indoor recreation. Large sites may need a separate permanent or semi-permanent structure.

(7) Playground/Open Recreation Space

For sites of 25 or more units, provide 100 square feet of open recreation space per unit. This area should be part of the 8% of the site set aside for community facilities. Areas not occupied by mobile homes should be used for this purpose.

Provide recreational or play surface and equipment as required by the size and age of the site population. An asphalt surface is necessary for basketball, an asphalt surface next to a concrete block wall for handball or squash, and grass for children's play or athletic fields.

A simple solution for young children would be an adventure playground furnished with discarded materials such as rubber tires, plywood, and concrete pipes.

Small children should be able to reach the playgrounds without crossing major internal roads. The public should not be able to walk through the playground easily.

Playgrounds should not be near major internal streets or public roadways.

Playground areas should be visible from many dwellings.

(8) Laundry Facilities

Provide on-site communal laundry facilities. There should be one washer for every 17 homes and one dryer for every four washers.

(9) On-Site Storage

Provide a corrugated aluminum skirt with an access panel beneath each mobile home for on-site storage. The enclosure provides security for property stored below, insulates the unit, and resists wind. A picket fence may be substituted if necessary.

If the storage space beneath the mobile home is inadequate and mobile homes do not have enough private storage space, one steel storage shed should be provided next to each unit.

(10) Off-Site Storage

If all salvaged property cannot be stored on-site, an off-site storage facility such as a vacant warehouse should be used.

(11) Management Trailer

For sites of 25 or more units, provide one management trailer at the entrance to the site for management purposes.

(12) Identification Graphics

Provide a site identification panel clearly visible from the public roadway at the site entrance.

Provide appropriate traffic and street identification signs within the sites.

Consecutively number all units. Graphics should be clearly visible from the internal roadway.

Provide a directory or schematic map of the site indicating the location and occupant of each unit. The directory should be located at the entrance to the site, near the management trailer.

c. <u>Recommended Systems for Life Support</u>

Sewer, water, and electric utilities -- life support systems -- should be available at the site. However, if these systems have been damaged or are not available, alternative systems or portable life support systems should be used.

Following are criteria for existing and portable systems. A decision on what system to use should be based on what systems are available, and on local conditions. Systems other than those recommended may be used if unusual site features or local conditions require it.

(Refer to the Army Corps of Engineers' Specification in Appendix B and the part entitled "Use of Portable Life Support Systems for Disaster Housing" for a detailed discussion.)

(1) Water

Provide an underground pressurized PVC pipeline water distribution system using an existing water line with adequate pressure to serve the units on the site. The system should be aligned along the double-loaded utility line.

If the existing utility is not able to service the site, or if no service is available, portable systems and water consumption reduction devices should be used.

The average requirement is 280 gallons per unit per day. However, if water conservation devices are installed in individual units, 140 gallons per unit per day is the required average.

The use of portable systems should be determined on the basis of site size, period of use, topography, and local conditions.

Portable water supply systems include trucking water to individual storage tanks, trucking water to an on-site pipeline distribution system, and pressurized pipeline distribution from an on-site water treatment tank.

Truck transport to individual storage tanks involves distributing potable water directly to 500-gallon storage tanks at individual mobile home sites.

The cost of trucking water is highly sensitive to water consumption; therefore, programs for water consumption reduction are recommended if this system is used. Distribution of water by truck to individual tanks should only be considered for short-term sites, or for sites where unusual conditions exist.

This procedure should only be considered for short-term sites of less than 50 units or for short-term sites of more than 50 units if water consumption reduction devices are used.

Trucking water to a pipeline distribution system involves having trucks haul potable water to an on-site tank where it is distributed to individual units through an underground pressurized pipeline.

This alternative is never cost-effective, even with water conservation programs. It should be only a temporary measure until an on-site treatment plant can be installed.

A central treatment system using an on-site or nearby raw water source involves processing raw water through a central treatment plant and storing it in an on-site water tank for distribution to individual units through an underground pressurized pipeline.

Central water treatment is a cost-effective alternative for all sites, except for short-term sites which incorporate water conservation devices. For these sites, truck distribution to individual storage tanks is preferable.

(Refer to the Army Corps of Engineers' Proposed Standard Specification for Emergency Mobile Home Site Development, Section 1501, for proper procedure for installation of water distribution system.)

(2) Sewer

Provide an underground gravity or pressurized PVC pipeline sewage collection system to an existing sewer line with enough capacity to serve all the units on the site. If PVC piping is not available, concrete pipe may be substituted.

The system should be aligned along the double-loaded utility line. If the existing utility is not able to serve the site, or if no service is available, portable on-site systems and water consumption reduction devices should be used.

The average sewer flow at full water consumption is 250 gallons per unit per day. However, if water conservation devices are installed in individual units, 125 gallons per unit per day is the average flow.

The use of portable systems should be determined on the basis of site size, period of use, topography, and local conditions.

Portable sewage disposal systems include trucking sewage, using septic tanks, and gravity or pressurized pipeline collection to an activated sludge treatment plant.

The trucking of sewage involves trucking individual 500-gallon storage tanks from the site to an existing sewage collection system. This alternative is advantageous if water is conserved or consumption restricted. But it is a minimal solution, appropriate only for sites of 100 or fewer units, for short periods and under unusual conditions.

Underground septic tanks for individual sites should not be used for short-term sites. But this alternative is cost-effective for long-term deployment of all site sizes where water conservation devices are present. Septic tanks should not be used for sites larger than 100 units without water conservation devices or if soil conditions are poor.

The gravity system consists of an underground pipeline network dependent on gravity for the collection of sewage to an on-site or nearby activated sludge treatment plant. Gravity systems are the most common method of sewage disposal. Costs of a gravity system are determined by topography and subsurface conditions. There must be a suitable slope to reduce excavation costs, and geological or other subsurface conditions must not interfere.

The gravity system is a recommended cost-effective alternative for large or long-term group sites if all these criteria are met.

The pressurized system also consists of an underground pipeline network; however, the sewage is pumped to an activated sludge treatment plant. The per unit cost of this system is lower than that of the gravity system. However, the pressurized system is not recommended if the savings are marginal. Also, the pressurizing pump required in this system is not a common item in the United States. The pump would therefore have to be stockpiled in advance.

(Refer to the Army Corps of Engineers' Proposed Standard Specification for Emergency Mobile Home Site Development, Section 1502, for proper procedure for installation of the sewer system.)

(3) Electric

Provide an on-site underground PVC conduit electrical layout. The layout should follow the alignment of the utility line so this system can be double-loaded.

Electrical service should be connected to an existing power line or source even if it is not adjacent to the site. On-site power generation should be avoided, or considered only a temporary measure. The amount of electricity required depends upon whether the mobile homes are prepared for all-electric or partial-electric power use. With partial-electric units, bottled gas should be used exclusively, even if existing gas lines are available. The cost of adapting to an existing gas line would be prohibitive.

If an underground electrical layout is inappropriate, standard utility poles with overhead wires should be constructed. In either case, a wood pole or post should be provided next to each mobile home to mount an electrical meter.

(Refer to the Army Corps of Engineers' Proposed Standard Specification for Emergency Mobile Home Site Development, Sections 1601, 1602, 1603, and 1604, for proper electrical system installation procedure.)

(4) Exterior Lighting

Provide spotlights attached to each unit or to street poles. Unit-mounted spotlights light the area near each unit and use unit power. Pole-mounted exterior lighting illuminates the street, but a separate overhead utility wire is required to provide power.

For street lighting, one light pole should be located at each intersection within the site and especially at site entrances.

(Refer to the Army Corps of Engineers' Proposed Standard Specification for Emergency Mobile Home Site Development, Section 1605, for proper installation procedure.)

(5) Storm Drainage

Provide or maintain a minimum 2% slope and a maximum 12% slope for adequate site drainage. Natural site drainage should not be altered. The disturbance of existing top soil and vegetation should be minimized.

(Refer to the Army Corps of Engineers' Proposed Standard Specification for Emergency Mobile Home Site Development, Sections 0201 and 0202 for proper site preparation procedures.)

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PERSONAL INTERVIEWS AND CONTACTS

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Mssrs. Brandon, Crossed, Smith, Wasserstrom

Emergency Preparedness Staff (HUD)

Messrs. Austin, Boazman, Bokel, Breeden, Buskirk, Carlton, Cheltenham, Coile, Davies, Feeney, Gibbons, Hannon, Hughes, Makris, Parker, Rohlic, Snow, Uomoto, Zaferopulos, Ms. Hoffman

Glossary

AASHTO	American Association of State Highway and Transportation Officials
activated sludge treatment	sewage treatment process in which bacteria are used to consume organic matter in waste
central treatment plant	an on-site water treatment package
cluster	group of (approximately 25) housing units
COE	U. S. Army Corps of Engineers
collector roadway	a street which provides access to several less traveled side streets
cost-effective	acceptable or desirable due to the high level of efficiency and economy achieved
cul-de-sac	a street with access at only one end and a turn-around at opposite end
EPS	Emergency Preparedness Staff, DHUD
FDA	Food and Drug Administration
FDAA	Federal Disaster Assistance Administration
FHA	Federal Housing Administration
gross site area	total site area within perimeter property lines
HUD	U. S. Department of Housing and Urban Development

life support system	an essential utility service (i.e., sewer, water, electric)
lot prototype	a lot type of standard area and shape
MHMA	Mobile Home Manufacturers Association (now Manufactured Housing Institute)
NEMA	National Electrical Manufacturers Association
net site dimension	site Dimensions (width and depth) which determine the net site area; determined by deducting the set-back distances from the overall site dimensions
NSF	National Sanitation Foundation
portable life-support system	an alternative to existing utility services (i.e., sewer, water, electric); a system which can be brought to and operated on the site
PVC	poly-vinyl-chloride
raw water source	source from which untreated water is obtained
USPHS	U. S. Public Health Service

Appendices

APPENDIX A

PRE-DISASTER SITE PLANNING

The following information should be used by officials or planners to select group housing sites prior to the disaster.

1. <u>General Location Criteria</u>

   In pre-selecting sites, officials should determine:

   a. The probable location of flooding, hurricanes, earthquakes, etc., based on past occurrences of these disasters;

   b. The availability of sites near concentrations of population where probable disaster locations are less easily determined.

2. <u>Site Evaluation</u>

   Sites should be chosen on the basis of the selection criteria outlined below. Enough sites should be investigated so, in case of a major disaster, all victims can be housed near the disaster area. This investigation and selection is best handled on a statewide level.

   States should update the list of available sites periodically. The list should include information about each site with a rating by state and local officials on its acceptability. Each site should be described according to:

   a. Location

   b. Size

c. Owner

d. Probable cost of temporary leasing

e. Unusual features which would affect development

f. Estimated time and method required for leasing

g. Conditions required by owner

h. Legal or administrative requirements (zoning, etc.)

i. Availability of site survey

Acceptable sites can be determined by rating each site according to the Site Selection Checklist in Figure 17.

3. Leasing Procedure

When a disaster strikes, sites must be obtained quickly at minimal cost. Before a disaster, more time is available to establish site ownership, work out leasing arrangements with cooperating owners, and analyze legal and administrative problems.

In noting all these factors, and keeping information on acceptable sites up-to-date, the best and cheapest land can be obtained quickly when a disaster occurs, and development can begin immediately.

APPENDIX B

PROPOSED
STANDARD SPECIFICATION
FOR

EMERGENCY
MOBILE HOME
SITE DEVELOPMENT

Based on
Hurricane Agnes Flood Experience
In
June 1972

Prepared By
Susquehanna District
U. S. Army Corps of Engineers
Harrisburg, Pennsylvania

INSTRUCTIONS AND GUIDE FOR THE PREPARATION OF DRAWINGS AND SPECIFICATIONS FOR DEVELOPMENT OF MOBILE HOME SITES

Site plans should be adopted to local conditions as required, including but not limited to the following:

a. Grading Plan

Overall site grading plan should be prepared for the required number of mobile homes.

b. Top Soiling and Seeding

(1) Strip and stockpile top soil from areas to be disturbed by excavation and trenching operations. Replace as topping 6" of backfill and grade.
(2) Seeding not included.

c. Sanitary Sewage System

(1) Basic system utilizes hook-up with existing sanitary lines.
(2) Alternate system utilizes package treatment plants.

d. Water System

(1) Basic system utilizes hook-up with existing sanitary lines.
(2) Alternate system utilizes wells, to be drilled.

e. Existing Utility Connection

Water, sewerage and/or electric power connections to existing utility lines should be coordinated with the local authorities.

f. Location of Utility Runs

Utility run locations may be interchanged from that shown on the alternate site plans for maximum economy at the option of the designer.

g. Special Provisions

The contractor shall be personally responsible for the coordination and proper relation of the work on the site and for the work of all trades. The contractor shall visit the site to thoroughly familiarize himself with all details of the work and working conditions.

DIVISION 1

GENERAL REQUIREMENTS

0101 DESCRIPTION OF THE WORK

The project consists of the construction of ___(No.)___ unit temporary mobile home court to be located at ______________

____

____

____

Work includes the clearing and grading of site, construction of roads, parking areas, sidewalks and the construction of water and sewage system and electrical service complete as shown on the drawings and specified herein.

0102 WORK BY OTHERS

The mobile homes will be moved on site and all utilities will be connected by others.

0103 GENERAL SAFETY REQUIREMENTS

1. Head Protection (Hard Hats)

   The entire work area under this contract is designated as a hard hat area. The contractor shall post the area and shall insure that all personnel, vendors and visitors utilize hard hats within the project area.

0104 ENVIRONMENTAL PROTECTION

The contractor shall take all necessary steps to prevent pollution of the environment during or as a result of construction operations. The contractor shall not unnecessarily deface, injure or destroy trees or shrubs, nor remove or cut them, without special authority. The contractor shall obliterate all signs of temporary construction facilities such as work areas, temporary structures or stockpiles of excess or waste materials. No burning shall be conducted on the site of the work.

DIVISION 2

SITEWORK

Section 0201 CLEARING AND DISPOSAL

1. CLEARING

Clearing shall consist of felling, trimming and disposal of all debris, including down timber, snags, brush and rubbish occuring within areas to be cleared. Conduct clearing operations so as to prevent damage by falling trees to trees left standing, existing structures or installations under construction.

Grubbing shall consist of removal and disposal of stumps, roots larger than 3 inches in diameter and matted roots from the designated grubbing areas.

2. DISPOSAL

Logs, stumps, roots, brush, rotten wood and other refuse resulting from the clearing and grubbing operations becomes the property of the contractor.

3. PROTECTION OF EXISTING STRUCTURES, UTILITIES AND TREES:

3.1 Bench Marks: Maintain all bench marks, monuments, and other reference points; if disturbed or destroyed, replace as directed.

3.2 Existing Construction: Protect existing buildings, streets and other structures which are indicated to remain and damage and repair damage caused by this work.

3.3 Utility Lines: Existing utility lines indicated, or locations of which are made known to the contractor prior to excavation, and that are indicated to be retained, as well as utility lines constructed during excavation operations, shall be protected from damage during excavating and backfilling. If any of these lines are damaged, they shall be repaired.

3.4 Trees: Trees indicated or marked to remain, and which are within areas of operation under this contract, shall be protected.

4. SURVEY AND GRADES

The drawings indicate layout of grounds and buildings and existing and final site grades. The contractor shall be responsible for laying out site and setting grade stakes in complete conformity with the drawing.

5. WATER FOR CONSTRUCTION

The furnishing of water used for sprinkling and wetting the materials during construction operations in connection with the compaction of fills and embankments will be considered an obligation of the contractor.

Section 0202 SITE EXCAVATING, TRENCHING, BACKFILLING & EMBANKMENTS

1. WORK

1.1 Provide all labor, material, equipment and incidentals necessary to perform all excavating and trenching for site development, in accordance with the drawings, specifications, and directions of the contract. Remove and dispose of all excess material of whatever nature encountered (including rock) as herein specified. Protect all trees on the site from damage during construction.

1.2 Excavation consists of the removal of all material to establish subgrade elevations; placing and compacting all fill material to establish subgrades; and the disposal of all excess suitable and unsuitable material.

1.3 Trenching consists of the removal of all material to establish subgrade for all utility pipe and conduit lines and structures; all backfilling; and disposal of all excess suitable and unsuitable material.

1.4 Contractor shall furnish any borrow material required to complete backfilling and fill operations.

2. EXCAVATING AND TRENCHING

2.1 Conduct all excavating and trenching operations in a safe and prudent manner to avoid damage to property, utilities, trees, etc., that are to remain within or adjacent to limits of work under this contract.

2.2 Excavate all areas to the required lines and elevations for subgrades, including the preparation of foundations for fills.

2.3 During the grading and excavation operation, all existing trees on the site shall be protected and no trees shall be removed except upon approval.

2.5 Remove and dispose of all unsuitable subgrade material and replace with suitable material. Where unsuitable material has been removed from sub-grades, use replacement material that does not contain stones larger than 4 inches in greatest dimension, sod, roots, or other objectionable material. Place the material in uniform layers, not exceeding 8 inches in thickness, loose measure, thoroughly compacting each layer as herein specified.

2.6 Prepare the foundation for fill by removing all existing unsuitable material. Roll the entire fill foundation area until the underlying soil is thoroughly compacted to the satisfaction of the contractor before any construction on the fill is begun.

2.7 Construct fills of earth material free from sod, roots, stumps, trees, brush and stones or rock over four inches in greatest dimension and any other objectionable material.
objectionable material.

2.8 Place fill material in layers not exceeding 8 inches in thickness and thoroughly compact each layer with approved equipment, equivalent to a roller, weighing at least 10 tons. Add water as necessary to fill material to obtain maximum compacting. If fill material is excessively wet, allow material to dry to proper moisture content before placing and compacting.

2.9 Where rock is encountered at subgrades for roads and seeded areas, remove rocks to a depth of 6 inches below subgrade and backfill with acceptable material.

2.10 Perform trench excavation to the required subgrades for pipe and conduit lines and structures.

2.11 Place special sand bedding for all conduit and pipe lines and all direct burial cable.

2.12 After placing the pipe, selected soil material shall be compacted in uniform lifts of not over four (4) inches placed simultaneously on all sides of the pipe with an approved tamper to a density which prevents lateral displacement of the pipe. This bedding operation shall be continued in four (4) inch lifts to a plane one (1) foot minimum above the top of the pipe.

2.13 Where utility lines are located in the roadway or cross the roadway, backfill above the bedding operation will be compacted in uniform layers to the same density as the adjacent undisturbed earth.

2.14 Where utility lines are located outside the roadway, backfill above the bedding operation shall be placed without special compaction and mounded to allow for settlement

2.15 Provide all labor, equipment materials, pumps, hoses, etc., and any required construction necessary to keep all trenches free from water. Construction will not be permitted in a wet trench.

3. EMBANKMENT

3.1 Embankments shall be constructed where called for on drawings, and as required.

Section 0203 PAVING AND ROADWORK

1. EXCAVATION AND BACKFILL

Excavation and backfill shall be the minimum amount required. Unsuitable material as defined in the field shall be removed and replaced with approved material. Excess material shall be removed from the site by the contractor unless otherwise authorized. Borrow material shall be from approved sources. All work shall be done in a manner to insure adequate drainage.

2. ROAD CONSTRUCTION

2.1 Subgrade For Roads: After rough grading has been completed, the subgrade shall be compacted by means of approved equipment to a density equivalent to that which can be obtained by 2 passes of a 10 ton roller at optimum moisture content. Water shall be added as necessary under dry conditions. During heavy rains or when the subgrade is excessively wet, compaction shall be delayed until conditions are suitable. The subgrade shall be rolled and cross rolled as necessary to provide a smooth uniform surface.
uniform surface.

2.2 Base Course For Roads: The base course shall consist of well-graded crushed rock or pit run gravel, stone or screenings reasonably uniform in density and quality and realtively free from thin elongated pieces. The aggregate shall have a maximum size of 1 inch and shall be within the following limits:

Percent by Weight Passing Sieves		
1-inch	No. 4	No. 200
100	45-60	5-8

The portion of any component or of the completed blend passing the No. 40 sieve shall be either non-plastic or shall have a liquid limit not greater than 25 when tested in accordance with ASTM D 523-66 and a plasticity index not greater than 8 when tested in accordance with ASTM D 424-59.

The base course shall be a thickness in place of not less than 6" and shall be uniformly distributed by a blade grader or truck equipped with a spreader box. The material shall be placed in one layer and compacted with a minimum of 4 coverages by a D-6 bulldozer or equivalent.

2.3 Surface Course: A finish surface course of clean crushed rocks 1/2" minus in size shall be placed over the base course to a minimum depth of 2" and uniformly distributed over the surface for the full width of the roadway, excluding shoulders and individual parking areas.

3. SIDEWALKS

3.1 Construction: Sidewalks shall be constructed with a minimum amount of excavation and backfill. The final graded surface shall be reasonably smooth and uniform and hand graded as necessary to achieve this result. Special compaction is not required, except in fill areas where loose material shall be satisfactorily consolidated.

3.2 Surfacing: Surfacing shall consist of a single layer of crushed gravel, rock or stone to a depth of 4 inches minimum. The surfacing shall be uniformly distributed and shall present a smooth, even appearance.

DIVISION 15

MECHANICAL

Section 1501 POTABLE WATER SYSTEM

1. SCOPE OF WORK

The contractor shall furnish all labor, material and equipment required to connect to an existing water main, install a pressure-reducing station and install a potable water distribution system with fire hydrants and individual risers, complete as shown on the contract drawings. The work required of the contractor shall also include the furnishing and installation of concrete thrust blocks, sterilization and testing of the entire system and the installation of heat tapes on each riser.

2. PERMITS AND FEES

The contractor shall be responsible for obtaining all permits and the payment of all fees required for the execution of this work by any state or local rules, regulations and/or ordinances.

3. MATERIALS

All materials and equipment shall be new and of the standards specified herein. All materials offered under this contract shall be limited to products regularly produced and recommended for service intended and so rated in accordance with engineering data or other comprehensive literature in effect at the time of opening of bids. The contractor may approve optional materials in order to prevent delay of project completion.

4. WATER MAIN CONNECTION

Connection to the existing water main shall be made using cast iron Class 250 mechanical joint or flanged joint pipe and cast iron Class 250 fittings conforming to AWWA Standard C 110. The contractor shall install a gate valve in a cast iron meter box with cover at the main connection.

5. WATER DISTRIBUTING SYSTEM

5.1 The piping for the water mains shall be either polyvinyl chloride plastic (PVC) or asbestos cement type. The laterals shall be copper tubing with solder joint fittings, galvanized schedule 40 steel pipe with malleable iron fittings, or PVC pipe. The risers shall be copper tubing with solder joint fittings or schedule 40 galvanized steel pipe with screwed malleable iron fittings. The contractor shall furnish signed notarized certification that all pipe and fittings proposed for use meet all the requirements of these specifications.

5.2 Pipe and fittings shall be carefully cleaned of all dirt and debris immediately prior to installation. Open ends of pipe and fittings shall be plugged securely at night, during storms and at any time that the pipe is not being worked on, to prevent contamination.

5.3 Pipe joints may be deflected to make gradual bends only to the extent recommended by the manufacturer.

5.4 Concrete reaction backing shall be placed around each fitting or change in direction of 22.5 degrees or more. Enough concrete shall be placed to insure at least 1 square foot of bearing against the outside wall of the trench so as to resist thrust due to surges from either direction.

6. POLYVINYL CHLORIDE PIPE

6.1 Polyvinyl chloride (PVC) pipe material shall conform to ASTM D 1784, Type 1, Grade 1, and be approved for potable water use by the National Sanitation Foundation and bear its seal (NSF).

6.2 PVC pipe joined by means of solvent cementing shall conform to ASTM D 1785, Schedule 40. Fittings shall conform to ASTM D 2466. Pipe fittings shall be joined in accordance with the particular manufacturer's instructions using solvents and other joint materials as recommended and supplied by the manufacturer.

6.3 PVC pipe and fittings joined by means of rubber ring gaskets shall conform to ASTM D 2241 for Standard Dimension Ratio (SDR) 26 pipe. Lubricant used for rings and joints shall be of a non-toxic material specifically manufactured for use in potable water systems. Pipe and fittings shall be joined in accordance with the particular manufacturer's instructions.

7. ASBESTOS CEMENT PIPE

Asbestos cement pressure pipe shall conform to AWWA Standard C 400, Class 150. Rubber rings for sealing the joints shall conform to ASTM D 1869. Asbestos cement piping shall be installed to conform to AWWA Standard C 603.

8. COPPER TUBING

Copper tubing used for laterals, at the option of the contractor, shall conform to ASTM B 88, Type K, Hard Drawn. Fittings shall be solder joint type conforming to ANSI B 16.22. Joints shall be cleaned and soldered using a non-corrosive flux and solder as recommended by the manufacturer of the tubing and/or fittings. Where copper tubing is connected into steel piping or other dissimilar metals, full type insulating unions shall be installed.

9. GATE VALVES AND VALVES BOXES

9.1 Gate valves shall be iron bodied, bronze trimmed, solid wedge, 200 pound non-shock WOG. Valves for buried service shall be inside screw, non-rising stem with square operating nut. Valves for service in pits or above ground where access is available shall be outside screw and yoke, rising stem with handwheel,unless otherwise directed.

9.2 The contractor shall provide two operating keys or wrenches for each different size operating nut for service valves installed under this contract.

9.3 Valve boxes shall be of cast iron or other approved material and shall be three piece screw type, five and one quarter (5 1/4) inch diameter, No. 4 round base for valves up through four (4) inches, and No. 6 round base for valves six (6) to eight (8) inches. Lids or caps shall be permanently marked for identification. Supply shut-off valves shall be marked "water", drains shall be marked "drain". All boxes shall have minimum vertical adjustment capability of 12 inches and be set at approximate midpoint of adjustment. Valve boxes of materials other than cast iron require approval by the contractor.

9.4 Boxes shall not bear on valves or pipe lines. All construction methods and materials shall be in accordance with state and local codes.

10. PRESSURE REDUCING STATIONS

10.1 A pressure reducing station shall be constructed which shall conform to all state and local codes. It shall consist of a pressure reducing valve, shut-off valves, gages, unions or flanges and valved by-pass, as required to provide regulated water pressure not to exceed 50 psi.

10.2 Shop drawings of catalog data for the pressure reducing valve (PRV) with integral strainer shall be submitted for approval.

10.3 All piping within the pressure reducing station pit shall be either cast iron or galvanized steel.

10.4 Pressure gages shall be 3.5 inch diameter, 0-200 psi with 10 psi graduations, and shall be provided with a shut-off valve. Gages shall be located upstream and downstream from the pressure reducing valve, and shall be mounted so as to be easily read.

10.5 A gate valve shall be placed on each side of the PRV to provide isolation and a gate valve by-pass shall be provided around the gage valve-PRV-gate valve combination. PRV shall be flanged or provided with unions and shall be mounted so as to permit removal without disturbing the piping.

11. SERVICE RISERS

Water service risers shall be of copper or galvanized steel.

12. PROTECTION OF WATER SUPPLIES

12.1 There shall be no physical connection between a water supply system and a sewer, or appurtenance thereto which would permit the passage of any sewerage or collected water into the potable water supply.

12.2 Relationship of sewer and water piping.

12.2.1 Horizontal Separation: Sewers shall be laid at least 10 feet, horizontally, from any water main. Should local conditions prevent a lateral separation of 10 feet, a sewer may be laid closer than 10 feet to a water main if:

a) It is laid in a separate trench, or if
b) It is laid in the same trench, with the water main located at one side on a bench of undisturbed earth, and if
c) In either case the elevation of the top (crown) of the sewer is at least 18" below the bottom (invert) of the water main.

12.2.2 Vertical separation: Whenever sewers must cross under water mains, the sewer shall be laid at such an elevation that the top of the sewer is at least 18" below the bottom of the water main. When the elevation of the sewer cannot be varied to meet the above requirement, the water main shall be relocated to provide this separation, with mechanical-joint pipe for a distance of 10 feet extending on each side of the sewer. One full length of water main should be centered over the sewer so that both joints will be as far from the sewer as possible.

12.2.3 When it is impossible to obtain proper horizontal and vertical separation as stipulated above, both the water main and sewer shall be constructed of mechanical-joint cast iron pipe and shall be pressure tested to assure watertightness.

14. HYDROSTATIC TESTS

14.1 Hydrostatic test shall be perfromed on all water lines as soon as practical. Testing should be satisfactorily completed before backfilling trenches. The contractor may, at his option, backfill over the line before performing hydrostatic tests. If the test is unacceptable, the contractor shall excavate as necessary to locate the defect, make necessary corrections and repeat testing.

14.2 The contractor shall provide all labor, water, materials, pumps, equipment, and incidentals necessary to perform the tests.

14.3 All defective pipe, joints, valves and fittings shall be removed and replaced.

14.4 Leakage is the quantity of water necessary to maintain the specified test pressure after the line has been filled with water and air expelled and for the specified length of time.

14.5 Duration of test shall not be less than two hours and test pressure shall not be less than 150 psi.

14.6 Line shall not be accepted if leakage exceeds the quantity shown by the formula:

$$L = \frac{(N)\ (D)\ (P)}{3700}$$

L = Leakage (gallons per hour)
N = Number of joints in line under test
D = Nominal pipe diameter (inches)
P = Average test pressure during test (psi)

14.7 Trenches shall be maintained free of exterior water from construction sources or rain until satisfactory testing is completed.

15. STERILIZATION

15.1 All water lines shall be sterilized after satisfactory construction and hydrostatic testing. Sterilizing shall be in accordance with the requirements of the state and local health authorities and witnessed by the contractor.

15.2 A chlorine solution shall be used for sterilization. The chlorine solution shall be prepared using calcium hypochlorite, HTH, Perchloren, Mexochlor, or other approved equal.

15.3 Chlorine solution shall be introduced at the feed point of the line to be cleaned and flow insured through entire line, connections, valves meters and equipment. Chlorinating agent shall be applied to produce a dosage of 50 ppm of chlorine. Local health authorities will take samples from the line after a 24 hour retention period. If the samples are not approved the lines shall be resterilized and retested. After satisfactory testing, the lines shall be flushed from the normal water supply and protected from contamination or damage until put into service.

16. SYSTEM OPERATION

After testing, backfilling and sterilizing the individual sections of the water system, the entire system shall be checked for proper operation as a unit. All valves, meters and equipment shall operate as intended before acceptance. Deficiencies shall be corrected and rechecked before acceptance.

Section 1502 SANITARY SEWERAGE SYSTEM

1. SCOPE OF WORK

The contractor shall furnish all labor, materials and equipment required to connect to an existing sewerage main and install a sanitary sewerage collection system with individual inlet risers complete as shown on the contract drawings. The work required of the contractor shall also include the furnishing and installation of cleanouts and manholes, complete concrete encasement, as may be required, and testing of the entire system.

2. PERMITS AND FEES

The contractor shall be responsible for obtaining all permits and the payment of all fees required for the execution of this work by any state or local rules, regulations and/or ordinances.

3. MATERIALS

All materials and equipment shall be new and of the standard specified herein. All materials offered under this contract shall be limited to products regularly produced and recommended for service intended and so rated in accordance with engineering data or other comprehensive literature in effect at the time of opening the bids. Optional materials may be approved in order to prevent delay of project completion.

4. MANHOLES

4.1 Concrete shall have a 28-day strength of 3000 psi minimum.

4.2 Metal reinforcement shall be cold drawn wire or welded wire fabric. Metal reinforcement and all accessories shall conform to the requirements of the Concrete Reinforcing Steel Institute.

4.3 Brick shall be Grade H., hard burned common, conforming to ASTM Specification C 62. Mortar for laying brick and for plastering (1/2" thick) the inside and outside of manholes shall be composed of one part Portland Cement to two parts sand, with enough water added to produce the proper consistency for the type of joint.

4.4 All precast concrete manholes shall conform in all respects, including materials, reinforcing, precasting and workmanship to the requirements of ASTM Standard Specification C 478. All manhole bases shall be poured in the field. No precast manhole bases will be permitted. Furnish units as manufactured by Interpace, or approved equal. Joints between precast rings shall be full-embedded in cement mortar or approved gasket.

4.5 The bases of all manholes shall be constructed and reinforced as shown on the contract drawings and shall be sealed water-tight. All ground water shall be excluded from freshly poured concrete and masonry work until set. Any noticeable leakage into or out of the manhole shall be repaired by the contractor. Flow channels in manhole bases shall be as shown on contract drawings, and shall slope uniformly from influent invert to effluent invert. Unless otherwise noted on the plans, the slope from influent to effluent shall be on one (1) inch. Bends in channels shall be of largest possible radius. Channel sides and invert shall be smooth and uniform.

4.6 Steps shall be of heavy cast iron or approved equal, normally spaced on 12 inch centers. Steps shall be ten (10) inches wide with five (5) inch projection from wall and four and one-half (4 1/2) inch projection into wall.

4.7 All manhole covers shall have the words "Sanitary Sewers" cast on the top surface. Frames set on brick courses shall be set in full bed of mortar cast frames into concrete.

5. PIPE AND FITTINGS

5.1 All pipe and fittings shall be carefully inspected before use. Defective material shall not be used and if found shall be removed immediately from the work site. A bedding consisting of sand or other suitable approved material shall be formed to provide a suitable cradle for the bottom quadrant of the pipe. Pipes and fittings shall be laid to proper line and grade with a true surface of invert throughout. Pipe shall be continuously supported throughout its length. Blocks or other noncompressible items are not to be used to raise the pipe to grade. Clean pipe as it is laid and keep clean of all sediment and debris. Close open ends of pipe at night, during storms, and when otherwise directed. Cut ends of pipe entering or leaving structure flush with inside face of structure.

5.2 Polyvinylchloride (PVC) pipe shall be rigid Class 160 unplasticized polyvinyl chloride Type I or Type II with screwed, flanged, or solvent welded joints as required. Fittings shall be injection molded, high impact (Type II) 1120 PVC with screwed, flanged or solvent welded ends as required.

5.2.1 Watertight joints shall be constructed in accordance with the manufacturer's instructions. Copies of manufacturer's instructions shall be furnished before beginning work.

5.3 If it is deemed suitable, in lius of PVC pipe, acrylonitrile-butadiene-styrene (ABS) pipe and fittings conforming to ASTM D2680 may be substituted. Pipe and fittings 6 inches I.D. and smaller shall be solid wall ABS; pipe and fittings larger than 6 inches I.D. shall be compo-- site truss pipe. Provide all adapters, etc., as required.

5.3.1 Construct joints watertight by chemical welding. Thoroughly clean bell and spigot of all dirt, etc., apply primer to outside of spigot and inside of bell; immediately apply cement to same surfaces and make joint by pushing pieces together while rotating one piece one quarter turn. Make up joints in accordance with manufacturer's recommendations.

5.3.2 Construct manhole connections using ABS coupling, and manhole waterstop built into manhole. Connect pipe to manhole coupling using "O" ring gasket, retainer ring for pipe spigot end and joint lubricant. Make joint connection in accordance with the manufacturer's recommendations.

5.4 If it is deemed, suitable, in lieu of PVC or ABS pipe, Asbestos cement pipe, couplings and fittings conforming to ASTM C 428 may be used. Pipe shall be Class 2400.

5.4.2 All fittings shall use the same joint as standard sewer pipe lengths for connection into the line. Other types of fittings, branches,etc., may be used as approved.

5.4.3 The machined ends and inside of the couplings of pipe to be joined as well as the rubber rings shall be wiped clean before applying the joining lubricant. The assembly of the joints shall be as recommended by the manufacturer. After joining, a suitable gage, supplied by the pipe manufacturer, shall be used to make certain that the rubber ring is seated properly in the coupling groove.

5.5 Vitrified Clay Pipe (Option to PVC, ABS or asbestos cement) Provide Class 1 or 2 pipe and fittings.

5.5.1 Pipe joints shall be type III "O" ring joints.

5.6 Wye branches shall be standard pipe fittings, and shall be installed in the pipeline concurrent with pipe installation. No connection shall be made to the pipeline by cutting or breaking into the pipe. Wye branches shall be of the same material or approved equal and shall utilize the same type joint as the pipeline into which they are installed. Wye branches shall be provided with watertight plugs which shall be removed when laterals are installed. Wye branches shall be installed in accordance with manufacturer's instructions. Tees shall not be considered as a substitute for Wye branches.

6. PIPE TESTS

The contractor shall provide all labor, water, material, pumps, equipment and incidentals necessary to perform tests. Tests shall be performed by the contractor before backfilling any trench. In the event of failure, the contractor shall remove and replace all defective material and correct all defects. Tests shall be repeated until results are within specified limits.

6.1 Exfiltration Test (Non-Pressure Lines): Test each section of sewer line between manholes. Plug downstream manhole pipe with watertight plug. In upstream manhole plug all lines except line to be tested. Fill the upstream manhole with water to obtain pressure on the upstream pipe and check for visible leakage or seepage.

6.2 Hydrostatic and leakage tests (pressure lines only): These tests shall conform to the requirements specified in Section 1501, POTABLE WATER SYSTEM.

7. CONCRETE ENCASEMENT

Where indicated and to the dimensions shown on the plans or as required, concrete easement shall be placed around sanitary line piping. Concrete shall consist of one part Portland Cement, 2 1/2 parts sand, and 5 parts gravel with just enough water to produce workable consistency. Minimum thickness of encasement at any point shall be 4 inches.

DIVISION 16

ELECTRICAL

Section 1601 SCOPE

This section covers the electrical service, telephone conduits and street lighting system complete and ready for operation.

1. GENERAL

1.1 The aerial electrical distribution system, to include street lighting, will be installed by the local power company.

1.2 Service eqiupment, including empty telephone conduits shall be installed by the contractor as noted on the plans. The contractor may, in some cases be required to install street lighting units where indicated on the plans.

1.3 Capacities of all equipment shall be not less than those shown on the plans and sketches.

1.4 The installation shall comply with the requirements of the National Electrical Code (NEC) and the local Electrical Code. Metallic materials shall be protected against corrosion.

2. WORKMANSHIP

Materials and eqiupment shall be installed in accordance with the approved recommendations of the manufacturer to confrom with the contract documents. The installation shall be accomplished by workmen skilled in this type of work.

Section 1602 ELECTRICAL SYSTEM

1. CONDUIT AND INSTALLATION

1.1 Unless otherwise indicated or specified, all exposed conduits shall be made of steel with a galvanized or sherardized treatment and given a protective clear enamel coating inside and out. All conduits shall carry the manufacturer's label and the Underwriters' Laboratories label.

1.2 All exposed conduits shall be run in a neat and workmanlike manner parallel with the general building lines. All concealed conduits may be run in as direct a line as possible between outlets. Conduits shall be sealed where they enter or leave an area carried at a lower temperature than that of the major areas of installation. Such seal locations shall be installed as directed. No conduits shall be installed closer than 6" to any hot water or heating lines or other high temperature piping. All conduit runs shall be installed so that the conductors can easily be removed, and during construction all free ends shall be capped to prevent the entrance of foreign matter.

2. PLASTIC CONDUIT

2.1 Electrical plastic conduit shall be Schedule 40, Type 1 for direct burial which shall be composed of High Impact PVC (polyvinyl chloride) and shall conform to industry standards and Commercial Standard CS207-60 and be listed in accordance with Article 347 of the latest National Electrical Code for underground and exposed work. Eash tube shall be straight, tough, sound and of uniform thickness. Tubes shall be furnished in manufacturer's standard lengths.

2.2 All materials shall be of first quality and shall be fabricated with the best modern practice so as to meet the highest standards for electric and physical strength, moisture absorption and uniformity.

2.3 Conduit and fittings shall be produced by the same manufacturer, and the manufacturer having had at least five years experience extruding the above.

3. CAST FITTINGS

Cast fittings shall be made of rust resisting alloy or non-ferrous material. All cast fittings shall be provided with heavy threaded hubs to fit the conduit used. Iron fittings shall be cast malleable iron thoroughly coated with metallic zinc or cadmium inside and outside after all machine work is completed. Cast fittings shall be used on all conduit runs except at locations where it is impractical. At these locations factory elbows can be used. All conduits installed at locations where they will be subject to moisture shall be of the weather-proof type.

4. WIRE AND CABLE

4.1 All conductors shall be copper not smaller than number 12 AWG unless indicated or specified otherwise. Conductors shall be at least as large as those indicated and those larger than number 10AWG shall be stranded.

4.2 Unless otherwise indicated, specified or required for NEC approval, all insulation for use with exterior conduit work and trailer feeders shall be 600 volt, THW thermoplastic jacketed type. All wires and cables shall be continuously marked to indicate the conductor size and type of insulation and its voltage rating.

5. SPLICES

5.1 No joints or splices will be allowed except at outlet and junction boxes. Splices in number 10 and smaller conductors shall be twisted and provided with scotch lock connectors and those in larger conductors shall be made with compression type connectors that do not employ a set screw bearing directly on the conductor. Unless the manufacturer recommends otherwise, all splices shall be insulated with rubber tape.

5.2 All wires and cables shall be color coded in accordance with the requirements of the NEC.

6. PULL AND JUNCTION BOXES

6.1 Pull and junction boxes shall be supplied and installed where required by the construction. In general, boxes shall be installed in accordance with NEC requirements and arranged to limit conduit runs to 100 feet between boxes or so that there is not more than four 90 degree bends, or equivalent thereof, between boxes. Except where standard outlet boxes are used, all pull and junction boxes shall be sized and constructed in compliance with the requirements on the NEC. All back-boxes shall be made of galvanized sheet steel and shall be of either riveted or welded construction. The covers shall also be of galvanized sheet steel finished to match the panels and attached with chrome plated oval head brass machine screws and chrome plated finishing washers.

6.2 All boxes shall be supported independent of the conduit runs and the final locations shall be as approved.

7. WIRING TROUGHS

7.1 Horizontal wiring troughs shall be furnished and installed where noted on the plans, or where required by job conditions. Troughs shall be made of 14 gauge sheet steel with painted finish; have screw or hinged cover and insulated cross brackets to support conductors at 3 foot intervals. Troughs shall be of sufficient size to accommodate feeder conduits and cables and to provide ample room for installation and training the conductors.

7.2 All troughs shall be supported from the building structure independent of all the conduits entering them. Feeders in troughs shall be identified by fireproof tags or other approved methods. Individual conductors of feeder circuits shall be tied together with cabling twine.

8. EQUIPMENT MOUNTING BOARDS

The contractor shall furnish and install, where indicated or specified, mounting boards on which various items of equipment shall be installed. Mounting to wood pole shall be with lag screws. These boards shall consist of a piece of 3/4" weatherproof fir plywood of required size. All surfaces of all components shall be prime coated and finished with two coats of an alkyd gloss gray enamel. The boards shall be of sufficient size to provide at least a 6" border on all sides of the equipment.

9. FUSES

The contractor shall furnish and install all necessary fuses for the project. Fuses shall be in place when the work is accepted and shall be one-time type, renewable cartridge fuse holder fitted with drop out fuse links, dual element, cartridge type plug fuses of the sizes indicated and required. One spare fuse for every fuse in place shall be furnished.

10. DISCONNECTING SAFETY SWITCHES

10.1 The contractor shall furnish and install, unless specifically noted otherwise, fusible safety switches of sizes noted on the drawings. All switches shall be front operated, NEMA Type "A", positive quick-make, quick-break, NEMA Type 3 raintight enclosures for outdoor locations. All enclosures shall be equipped with hinged interlocking front cover having hasp and keeper for padlocking. Each switch shall be equipped with solderless lugs.

10.2 The enclosure shall be provided with openings in the proper location to permit installation of the conduit and wiring system.

10.3 These switches shall be of the proper number of poles, ampere rating and horsepower rating, for all motors served. Fused switches shall be of the quality specified above, but shall contain provisions to accept NEC standard or current limiting fuses, if noted. Switches intended for use with dual element fuses shall be specially designed for use with these fuses and shall contain the

Underwriters' label attesting to the fact that these switches are so rated.

11. GROUNDING

11.1 A grounding system shall be installed in accordance with the requirements of the NEC. The main ground connection shall be made to the ground rod installed at the main distribution board. An independent ground shall also be provided for the enclosure of the power outlet unit and the mobile home frame. This ground shall be independent of and shall <u>NOT</u> be connected into or made a part of the electrical system ground.

11.2 Ground rods shall be of copper weld or equal, consisting of heavy copper exterior with steel inner members having a steel drive point. Rods shall be provided with a combination drive cap and wire clamp, or with a wire clamp, or with a wire of proper size and of a length to provide not less than 6 complete turns around the rod and thoroughly sweated to rod by cadweld process and with a two (2) foot stub of an approved connector.

11.3 Upper portions of the ground rods shall extend six inches below established grade. Ground cable grids, ground-plates, metal mesh arrangements and cables connecting ground rod assemblies and ground equipment shall be installed 2 feet below grade. Grounding conductors shall be installed in such a manner as to allow the shortest and most direct path between equipment and ground.

11.4 All connections to ground conductors shall be made accessible for visual inspection before covering.

11.5 The resistance between the grounding system and absolute earth shall not exceed 10 ohms and shall be measured by the contractor prior to placing equipment in operation.

11.6 Ground bushings shall also be provided on ends of conduit not terminated in cast fittings. Bonding jumpers shall be provided to solidly bond ends of conduit to ground conductor.

12. FEEDER IDENTIFICATION

The service entrance conductors and every feeder originating at the main distribution boards shall have each cable of the feeder provided with a nameplate in every panel and pull box through which the feeder passes, enters or leaves. These nameplates shall indicate the load served by the feeder, the conductor size and the type of insulation. These nameplates shall be 3/4" fiber and shall be drilled and secured to the cables with self-locking ties.

Section 1603 SECONDARY SERVICES

The secondary service for each mobile home site shall be 120/240 volts, single phase, 4 wire, 60 hertz delta and shall be extended underground from the terminal and metering pole to the plug-in device located at each mobile home site.

Section 1604 TEMPORARY POWER FOR CONSTRUCTION

Facilities for temporary power shall be furnished by the contractor. Extensions from these facilities shall be made by each respective trade to serve his own basic electrical requirement. Facilities for temporary power shall be made by the contractor as outlined in the General Conditions of the specifications.

Section 1605 STREET-LIGHTING SYSTEM

Street lighting shall be a 240-volt multiple circuit-mounted system on poles.

1. STREET-LIGHTING UNITS

Each unit shall consist of a bracket and a luminaire as shown.

1.1 Luminaires: Shall be of the multiple enclosed type for mercury-vapor lamps with the IES distribution indicated on the drawings. Mercury-vapor luminaires shall be provided with a high-power factor ballast to suit the lamp and circuit specified, mounted either integrally in the luminaire or separately at the bracket on the pole.

1.2 Luminaire Head: Shall be either metal or porcelain with slip-fitted or pipe-tap mounting. All luminaire heads shall have standard dimensions suitable for interchangeable standard optical assemblies. Heads shall be internally wired or equipped with porcelain bushings for external wiring. Head shall be rated 600 volts.

1.3 Enclosed Luminaire: Shall consist of an alzak-finished aluminum reflector and enclosing glass refractor or globe providing the indicated IES light distribution, with the indicated lamp mounted on a standard luminaire head.

1.4 Individually Controlled Luminaires: Where indicated, luminaires shall be served from the 120/240-volt secondary distribution system and be individually controlled by a photoelectric control element which will be a replaceable, weatherproof, plug-in or twist-lock assembly with adjustable operation range of approximately 0.5 to 5.0 footcandles, operating from 120 volts, 60 cycles, to control the lamp specified. Luminaires shall be multiple, enclosed type as specified above, equipped with weather-proof plug-in or twist-lock receptacle to receive the photo-electric element.

Section 1606 TEST

After the installation is completed, the contractor shall conduct an operating test for approval.

The equipment shall be demonstrated to operate in accordance with the requirements of this section of the specifications.

The contractor shall furnish all instruments and personnel required for the test. The contractor shall submit in writing the measured ground resistance of each ground rod, indicating the location of the rod, and the resistance and the soil conditions at the time the measurements were made.

Section 1607 QUALITY CONTROL

The contractor shall establish and maintain quality control to assure compliance with contract requirements and shall maintain records of his quality control for all construction operations required under this section.

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