AFFORDABLE HOUSING

U.S. Department of Housing and Urban Development
Office of Policy Development and Research

Challenge and Response – Volume I

Affordable Residential Land Development

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Developers

Joint Venture for Affordable Housing

THE SECRETARY OF HOUSING AND URBAN DEVELOPMENT
WASHINGTON, D.C. 20410

One of my highest priorities when I came to HUD in 1981 was to make housing affordable again. As part of this effort, in January 1982 I announced the formation of the Joint Venture for Affordable Housing as a public-private partnership to find ways to overcome the cost impact of outdated and unnecessary building and land use regulations.

Over the past five years, we at HUD have worked with builders and local government officials in more than 30 communities across the nation in a successful effort to demonstrate that regulatory reform can reduce housing costs both in new subdivisions and for new homes in established neighborhoods. The Affordable Housing Demonstration projects proved that this approach works; the Joint Venture concept of a cooperative effort to reduce housing costs is now an operating program of the Department.

The lessons learned in the demonstration projects, originally reported in a series of individual case studies, have now been combined in two final reports with the general title, Affordable Housing: Challenge and Response.

Volume I, "Affordable Residential Land Development: A Guide for Local Government and Developers," describes the land use, site development, and administrative and procedural changes used in the Affordable Housing Demonstrations. Volume II, "Affordable Residential Construction: A Guide for Home Builders," addresses the changes in building design, materials, construction systems, and marketing methods which proved successful in the demonstration projects.

I believe that the information in these reports will help bring about the changes necessary to reach the goal of affordable housing for everyone.

Very sincerely yours,

Samuel R. Pierce, Jr.

AFFORDABLE HOUSING CHALLENGE AND RESPONSE

Volume I

Affordable Residential Land Development: A Guide for Local Government and Developers

Prepared for:
U.S. Department of Housing and Urban Development, Innovating Technology and Special Projects Division

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July 1987

Foreword

For years the U.S. Department of Housing and Urban Development (HUD), the National Association of Home Builders (NAHB), and the NAHB National Research Center (formerly the NAHB Research Foundation, Inc.) have been searching for solutions to the rising cost of housing.

The Joint Venture for Affordable Housing (JVAH) program has been a significant step toward lowering housing costs. This manual contains a compilation of proven cost-reduction methods of land planning and development, as well as actions local governments can take to encourage more affordable housing. All the techniques may not be applicable in every situation, but most builders will find many ways to lower housing costs. Volume II, the companion manual, contains proven cost-saving construction techniques.

Acknowledgements

This manual is the result of material obtained from the Joint Venture for Affordable Housing Demonstration builders and from other sources. It was prepared for the Department of Housing and Urban Development by the NAHB National Research Center. The demonstration program was directed by the Office of Policy Development and Research.

The principal author was Carol Baker Schaake, with assistance from E. Lee Fisher, Mark S. Nowak, Ralph Lee Smith and others who provided years of residential research effort and documentation. Most importantly, we wish to thank the builders of the JVAH demonstrations and the communities who took the risks and put their resources on the line to prove that affordable housing for all Americans can be a reality.

The work that provided the basis of this publication was supported by funding under a contract with the U.S. Department of Housing and Urban Development. The substance and findings of that work are dedicated to the public. The authors are solely responsible for the accuracy of the statements and interpretations contained in this publication. Such interpretations do not necessarily reflect the views of the Government.

TABLE OF CONTENTS

Introduction

AFFORDABLE HOUSING - CHALLENGE AND RESPONSE

In the nearly three decades since the national policy of "a decent home and a suitable living environment" was established in the Housing Act of 1949, millions of families have been able to reach the goal of home ownership. In recent years, however, this goal has proved elusive for others, particularly young families seeking to buy their first home.

Background

The fundamental problem is that housing prices and mortgage interest rates rose faster than family incomes, particularly in the 1970's. The median house price rose approximately 115 percent while incomes were increasing only about 105 percent. Even worse, during this period mortgage interest rates more than doubled, from below 9 percent to over 18 percent in many areas.

These figures are not precise, nor need they be to demonstrate the scope of the problem facing the nation in the early 1980's. The fact is, many families were prevented from buying homes due to the increasing price of housing and cost of money.

Controlling mortgage interest rates is not something the housing industry can do independently; these rates reflect larger national economic issues. As a result of changes in the economic marketplace, by 1987 mortgage interest rates had dropped to about 10 percent, helping to make housing more affordable.

But housing prices have continued to rise; the median price of a house in 1986 was approximately 33 percent higher than it was in 1982. This increase was due to a number of factors, such as a trend to larger homes on larger lots, increasing amenities such as air conditioning and more bathrooms, higher material prices and labor costs, and sharply higher land costs around many of the nation's major cities.

As will be seen in the ensuing chapters, the cost of land is often the largest single variable in the price of a house. Since land is a fixed quantity, the amount of land available for housing is constantly decreasing as new homes are built; utilizing land more efficiently is one of the best ways to make housing more affordable.

Studies by the President's Commission on Housing in 1981, confirming earlier studies of the housing industry, also showed that excessive regulatory requirements and outmoded building practices also contribute to higher housing prices. In many instances, these studies pointed out that local officials and builders often were unaware of steps each could take to reduce housing costs.

The Joint Venture for Affordable Housing

The Joint Venture for Affordable Housing (JVAH) was initiated by Samuel R. Pierce, Jr., Secretary of Housing and Urban Development, in January 1982 to bring about changes in the way housing is controlled, designed, and built. Recognizing that many of these changes could only be made at the local level, Secretary Pierce organized the Joint Venture as a working partnership among the following organizations and groups:

- American Planning Association
- Council of State Community Affairs Agencies
- International City Management Association
- National Association of Counties
- National Conference of State Legislators
- National Governors' Association
- Urban Land Institute
- National Association of Home Builders (NAHB)
- NAHB National Research Center
- U.S. Department of Housing and Urban Development

The Affordable Housing Demonstration

In the Affordable Housing Demonstrations, actual housing developments were built in 27 cities and communities in 24 states throughout the United States, with local public officials and the designated builder cooperating to reduce the cost of the completed homes. All the developments built in the program were subject to the ultimate test of the marketplace when the homes were completed and sold. Costs and savings in each demonstration project were carefully monitored, and each project was described and analyzed in a Case Study prepared by the NAHB National Research Center and published by HUD. A list of the projects appears in Appendix I.

The central theme of the demonstrations was that builders and local officials can, together, identify ways to reduce the cost of housing and to modify or interpret local building codes and site development regulations to promote efficiency and affordability. No Federal funds were provided either to the builder or to the community to support the projects. In each case, HUD asked for a formal commitment from the highest elected official that the local government would give its strong support.

The experience of the Joint Venture for Affordable Housing demonstrates that the answer to the question, "***Can affordable housing be built on a substantial scale through widely-replicable procedures?***", is ***YES. Thousands of dollars can be shaved off the cost of new homes*** -- enough to broaden the audience of buyers, to reverse the ominous economic and social trends described above, and to place America once more on the path toward increasing fulfillment of the overwhelming wishes of its citizens. The two keys are knowledge and commitment.

The Joint Venture for Affordable Housing has greatly increased our understanding of how it can be done. Knowledge gained from the Demonstration Projects has been distilled in this two-volume report.

AFFORDABLE HOUSING AND LOCAL GOVERNMENT

The Affordable Housing Demonstrations show that active participation by local government is essential in encouraging the production of housing at prices opening the market to those needing housing. In establishing a climate supporting the production of affordable housing, local government must:

- Support the concept and specific activities at the highest levels, including elected officials and the principal executives of the participating agencies. Only their active advocacy of the program concepts and their direction to subordinate staff will assure that the message gets to the people who actually administer the various affected programs.
- Reach out to the local home building community, and respond to any overtures from these builders to develop the mutual trust and activities needed to identify old problems, and resolve them.
- Establish contacts with the opinion makers of the community to keep them informed of the goals of affordable housing and the steps being taken to encourage its development.
- Commit itself for the long haul, and assure that there is continuity of interest and action, even through administration changes. Affordable housing must be a community effort, not just a current "buzz word" to be discarded when fashions change.
- Be willing to evaluate the results of housing projects using affordable housing principles, and to make changes in codes, regulations, and procedures which are suggested by successful projects.

This Chapter will focus on two areas of local government involvement -- zoning and subdivision ordinance requirements, and administrative procedures. Details of local government participation in such areas as site planning, streets and rights-of-way, utilities, and stormwater systems are provided in ensuing sections.

ZONING AND SUBDIVISION ORDINANCE HIGHLIGHTS

Land use is regulated through zoning and subdivision ordinances. In general, zoning ordinances create the broad outlines of such regulation, while more detailed matters are dealt with through subdivision ordinances. Exceptions to zoning ordinances usually require substantial formal procedures, including a public hearing process. By contrast, variances in

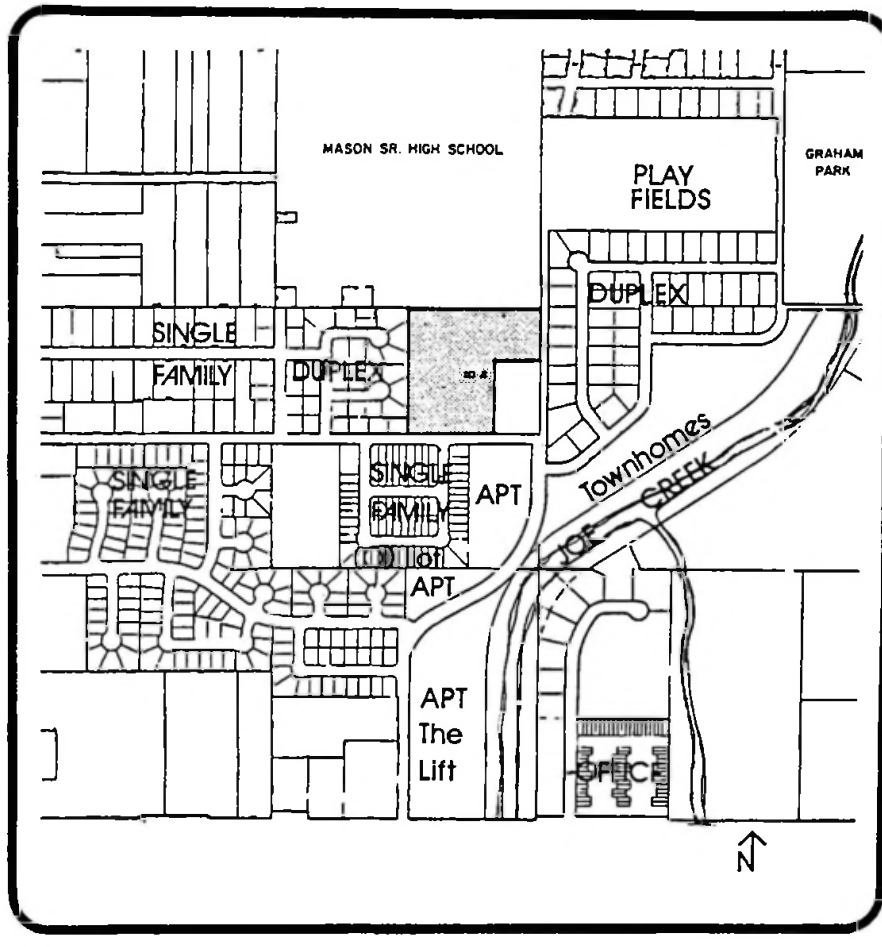
subdivision ordinances are often granted by less formal administrative procedures. The actual coverage of the two types of regulation varies from community to community, so that a matter covered in one community by its zoning ordinance may be consigned in another community to subdivision regulation.

Land values are a central component of housing cost. The relationship of zoning to land value and to housing cost is direct. A recent Urban Land Institute study of the relationship between zoning restrictions and average lot prices showed that in the ten cities rated most restrictive by the Institute in their zoning requirements, the average lot price in 1980 was $24,037. In the ten cities rated least restrictive, the average lot price in 1980 was $14,688.

The reason for this relationship is clear. Restrictive zoning and/or subdivision practices reduce the total supply of land available for housing. When buildable land becomes scarce, one must pay inflated prices for it. Increasingly, persons of moderate means can no longer afford to buy at all.

A key finding that emerged from virtually every project in the JVAH program is that improved zoning and subdivision procedures promote affordable housing. The projects demonstrated conclusively that review and revision of zoning and/or subdivision ordinance requirements to make more effective use of land can bring the cost of housing down. Local governments should:

- Consider the ***Planned Unit Development (PUD)*** approach to residential zoning and/or subdivision regulation described below. Identify specific sites throughout the jurisdiction for this designation.



- Revise zoning codes and/or subdivision regulations to *reduce the land area requirements for Planned Unit Developments*, thereby fostering their use.

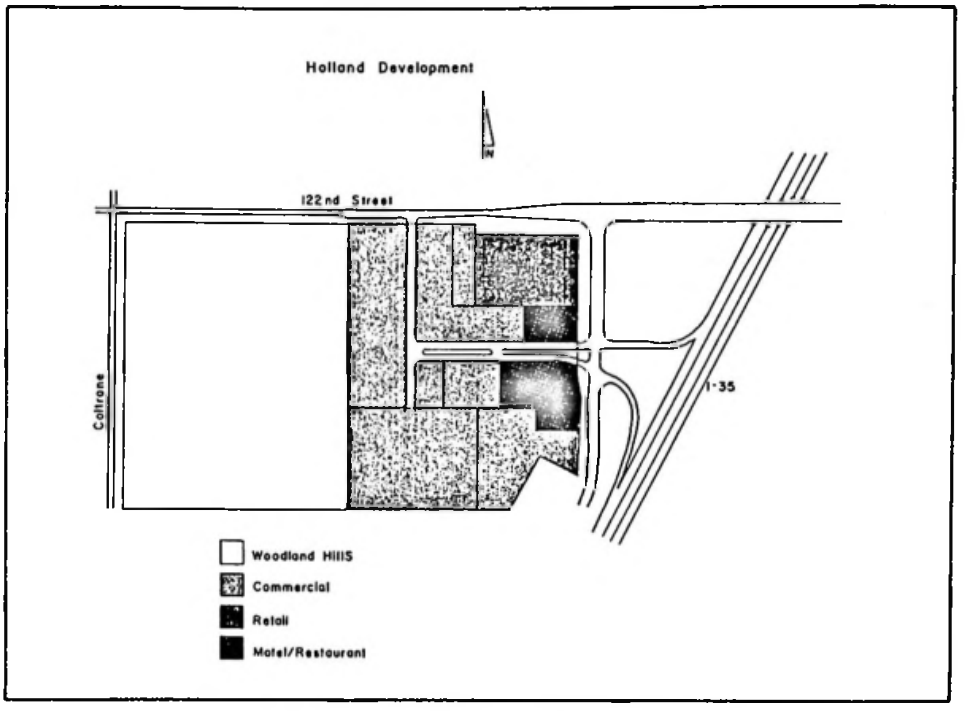
- *Conduct a broad general review of zoning and/or subdivision requirements, particularly those that have been in effect for a substantial period of time.* Consider revisions that will allow for moderate increases in residential density to accommodate contemporary market conditions. Such modifications can be directed toward *the provision of as much land as possible in various density categories, to minimize the impact of land shortage on land prices.*

- When and where possible, employ *performance standards* rather than uniform or arbitrary measurements, as the criteria for zoning and/or subdivision requirements. Performance standards are directed toward matching zoning with the best possible use of the site and its particular features, and employ flexible criteria to achieve this goal.

"The use of performance zoning, or a negotiated approach to land development, allows the most effective balancing of environmental quality against affordable residential construction," according to state and local planners surveyed by the National Institute of Building Sciences (NIBS).

- Adopt zoning and/or subdivision regulations that provide an *allowance for increased density in exchange for a developer's commitment to provide open space, landscaping, and other amenities* on the proposed development site.

- Increase zoning and/or subdivision flexibility for *mixed use development*, thereby allowing various types of housing, various densities, and in some instances a mixture of residential and light commercial use in areas now covered by less flexible criteria.



Oklahoma City demonstration project. Woodland Hills, part of mixed use development

- Allow construction with *little or no setback from property lines.* Often called zero-lot-line zoning, this type of construction is described in an ensuing section on site planning. It allows the construction of houses on or very close to the property line on one or two sides of small lots, making the available land on such lots more attractive and usable.

- Give favorable consideration to *density transfers*, particularly on neighboring or contiguous parcels of land in which developers are allowed to exchange lower density rights on one tract for higher density rights on the other tract.

- Allow zoning and/or subdivision variances to *build on lots that are currently below the specified minimum size* for their locales, and to *divide large lots that currently have excess space.*

- Consider offering *bonus points for affordability* to builders who price quality homes below a specified cost that reflects median local prices of comparable housing. The bonus points could be applied to items such as higher density, elimination of sidewalks, reductions of setbacks, and other changes that will reduce the builders' cost.

Planned Unit Development

In the late 1950s and 1960s home builders and public officials began to use an approach to zoning and subdivision regulation called Planned Unit Development (PUD), also called Planned Residential Development (PRD), Comprehensive Residential Development (CRD), or Community Unit Plan (CUP). Projects developed under this concept usually incorporate a variety of housing types and land uses, higher density, and open space and common land managed by a community association.

PUD land use is characterized by flexibility, and encourages both public and private innovation to a greater extent than is true of more traditional zoning and subdivision controls. On one hand, this flexibility makes it possible for the developer to change long-term development plans to meet current market demands. On the other hand, it gives local authorities the latitude to negotiate with the developer, trading concessions on density, mixed use, and requirements for streets and utilities, for desired amenities, open space, and recreational facilities, for example.

EXAMPLES FROM THE DEMONSTRATION PROJECTS

A majority of the projects in the Joint Venture for Affordable Housing (JVAH) were developed under some version of Planned Unit Development zoning or subdivision regulations.

Phoenix, Arizona

Open-space in Cimarron PUD

Knoell Homes, developer of Cimarron, the JVAH Project in Phoenix, saved at least six months by utilizing the PUD approach instead of applying for rezoning under the standard subdivision ordinances. This time saving reduced interest cost by approximately $106,000 or about $415 per unit. The cost reduction was passed on to the home buyers.

Rick Counts, former Phoenix Planning Director, expressed his frustration that PUDs require Home Owners Associations (HOAs). Many builders do not want to involve themselves with HOAs, and avoid using PUDs for that reason.

Tulsa, Oklahoma

Hood Enterprises, developer of Innovare Park, applied for and was granted residential multi-family zoning for the site. The developer then applied for and was granted a supplemental PUD zoning permit. Under this permit, Hood Enterprises negotiated a site plan with city officials that allowed all single-family construction. The density -- 12 units per acre -- exceeded allowable maximums under standard single-family zoning for the area, but reduced the density that would have been allowed in multi-family development. The arrangement satisfied city officials, who stated that the PUD

approach "provides a higher degree of regulation but permits the developer more flexibility in principal and accessory uses and of lot sizes than conventional zoning."

Lacey, Washington

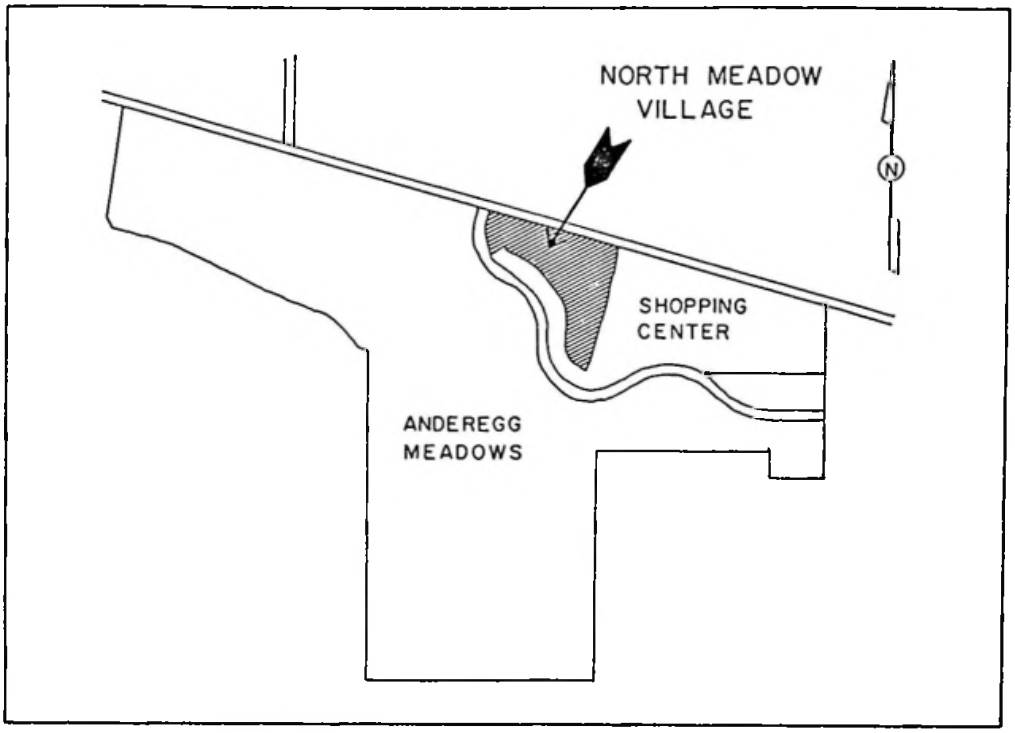
In developing "The Park", an affordable housing demonstration in Lacey, Phillips Homes used a PRD authorization that allowed the developer to construct a mix of townhouses and detached units, and to make his own decisions regarding lot sizes. Phillips added 23 building lots to the 153 that were originally planned, bringing the total to 176.

Birmingham, Alabama

The city of Birmingham rezoned Williamsburg Square, a project built by Malchus Construction Company, as a PRD, enabling Malchus to increase density from 40 to 111 units. The PRD designation also accelerated processing time from the normal 6 to 18 months to five months, saving $9,600 on the subdivision or $86 per unit, with the saving being passed on to the buyers.

Lincoln, Nebraska

The City of Lincoln allowed Empire Homes, Inc., to include its affordable housing project, "The Parkside Village," in an already-approved Community Unit Plan (CUP). This made it possible for the developer to increase the project's density from 32 to 52 units.



Portland, Oregon

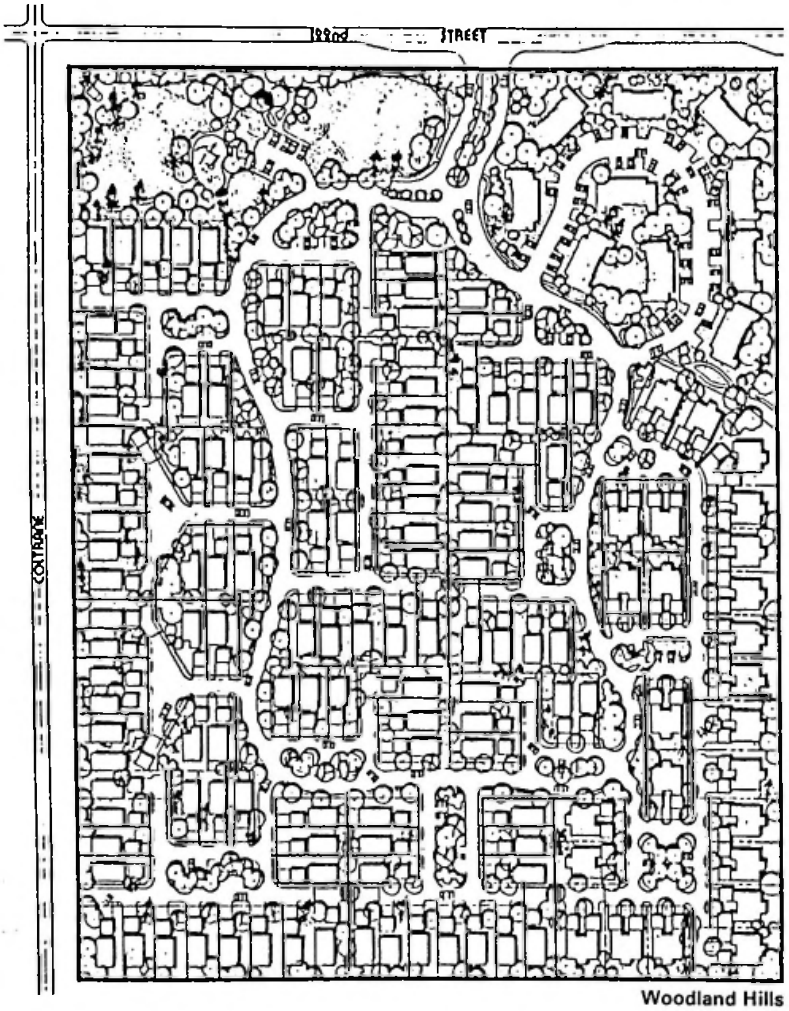
Black Bull Enterprises, Inc., developer of the affordable housing project "North Meadow Village," sought and secured from the city a number of innovative zoning modifications for the land parcel of which North Meadow Village forms one part. The parcel is situated in an area zoned for low-density, single-family construction at four units per acre. Black Bull requested establishment of a multi-family zone (22 units per acre) around a shopping center in the 150-acre tract located on a two-lane state highway, and a medium-density single-family strip (6.28 units per acre) separating the low-density single-family zone from the multi-family zone. In effect, he asked the Planning Bureau to trade higher densities in one portion of the tract for lower water and sewer usage in the commercial and retail area, with no net change in total water and sewer demand. The rezoning was approved by the city.

Valdosta, Georgia

The city added PUD provision to its zoning regulations in 1980. Under this provision, Minchew Homes, developers and builders of "Forestwood II," were able to increase density from 2.9 to 5.8 units per acre.

Oklahoma City, Oklahoma

Under this city's PUD, Holland Land Company was able to cluster homes, increase open spaces, and mix single-family detached units, duplexes, and quadplexes in "Woodland Hills," a subdivision of HUD-code manufactured homes.



Woodland Hills

Other JVAH demonstration projects developed and built under PUD-type ordinances include: *Elkhart, Indiana*; *Knox County, Tennessee*; and *Charlotte, North Carolina.*

EXPEDITING ADMINISTRATIVE AND PROCESSING PROCEDURES

Housing developments are built on borrowed money on which the developer makes interest payments each month. Developers also incur an overhead cost each month. The more quickly the homes can be built and sold, the more the interest and overhead costs can be reduced. According to a study by the Los Angeles County Land Development Center, every month of delay adds, by conservative estimate, 2 percent to the purchase price of a new home. These savings can be passed on to home buyers. Local *jurisdictions can therefore make a direct contribution to affordable housing by expediting their procedures regulating land use and housing construction.*

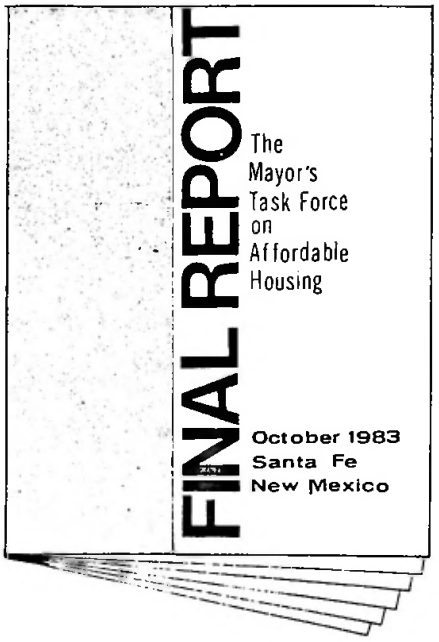
"Most builders don't know the true cost of delay. Everyone assumes that it's only interest, but the true cost includes overhead, material and labor inflation, and the lost opportunity to make a profit."—John Phillips

Housing is governed at the local level by an array of codes, rules, and procedures which have typically grown up over a substantial period of time, and which often do not represent a coordinated system. A basic step that municipalities can take to promote affordable housing is to *review the entire regulatory process from zoning through permitting* as it is actually experienced by developers, to identify procedures that can be simplified, abbreviated, or improved.

"Concurrently with the Affordable Housing Demonstration project," commented Jon Wendt, "Phoenix was pursuing an aggressive regulatory relief campaign under the leadership of Mayor Hance. Cimarron provided tangible evidence of the benefits to citizens of government deregulation. From the start, our primary interest in the project was to field test deregulation ideas to see if they worked, and, if they did, to incorporate them as permanent changes."

Municipalities may wish to implement certain changes immediately. In other instances, changes that appear to be desirable can be used to expedite a specific affordable housing project as a test. The project can be evaluated, the changes modified if necessary, and support gained among agencies and officials who will have to implement them.

Task Force



A *working group* of public officials, builders and developers, representatives of community groups, and consultants should conduct such a review and make recommendations. This can achieve three goals.

1. It gives the task the status of a community effort in which diverse interests and views are represented.
2. It helps to consolidate community support for the recommendations and the action that is taken to implement them.
3. It helps to broaden awareness and understanding of affordable housing and of the municipality's support of it.

Review Areas

Areas recommended by the *National League of Cities* for review include the following:

- *Length of the process from application to approval or issuance of a permit.* A builder/developer should know how much time it will take before a decision is made on his or her proposal. For example, there should be a fixed review period for subdivision plans, at the end of which, if no action has been taken, the plan will be automatically approved.
- *Number of permits*, approvals, hearings, and administrative reviews necessary for construction, and the additional number necessary for occupancy.
- *Number of agencies*, departments, boards, and other groups that must review an application.
- *Types of information* and amount of detail necessary for the kinds of approvals that are required.

Review Techniques

Techniques that can be used in such a review study include:

- *Review of city records* to ascertain the number of applications received and approved, the agency or agencies involved, and the length of time involved.
- *Review of items in process during a specified current period*, to learn how the system works in practice and where problems may exist.

Application Process Review

The study should examine each of the *three principal stages of the application process* and make recommendations for improving procedures at each stage, as follows:

1. *The Pre-application Stage*

   In this stage, the developer should receive an *overview* of all that will be required during the regulatory process, including approvals needed, departments involved, and the best methods for moving through the system efficiently, and should be advised of the *anticipated time frame* for approval.

2. *The Staff Review Stage*

   Procedures can be reviewed for fast-tracking possibilities, ways to offer combined or simultaneous reviews, mandatory deadlines, involvement of expediters or coordinators, elimination of duplication of review among various agencies, concurrent reviews, and use of a management information system to track applications. Some local governments have developed a plan review checklist to guide developers through the review procedures. If all steps on the

checklist are carefully followed, the review can be brief and relatively simple.

3. *The Citizen Review Stage*

   Not all communities have ordinances that provide for citizen review procedures. Where such reviews are required, they target possible improvement in such areas as: convening of informal neighborhood meetings to disseminate information and respond to concerns prior to finalization of designs or the holding of public hearings; improvement of public hearing procedures through adoption of fair and consistent rules on who is heard, when, for how long, and how decisions are made; combining hearings when the approval of more than one governmental body is required; shifting some responsibilities from the planning commission to a hearing official, staff, or other party or entity; and adoption of mediation procedures in lieu of resorting to the courts to resolve difficult cases.

Inspections and Permits

City staff responsible for inspection must respond to builder and developer requests in a timely and scheduled manner. Developers and builders have a responsibility to assure that the work for which inspection is requested has been completed and meets the relevant criteria. Cities are justified in requiring that their time and expertise are efficiently used.

Permit and inspection fees should bear a reasonable relationship to the actual cost of performing the inspections and issuing the permits. It is inappropriate to use them as a form of indirect tax.

EXAMPLES FROM THE DEMONSTRATION PROJECTS

Most of the projects in the Affordable Housing Program received some form of fast-tracking processing. In many instances, the city used the program as a test for the improvement and expediting of procedures, and successful innovations were frequently adopted for general use.

Lacey, Washington

When Phillips Homes joined the Affordable Housing Program, a number of changes to the approved plans for their development, The Park, were recommended. Under existing city procedures, approval of the changes would have required a formal hearing by a hearing examiner, and then approval by the city council, with the two steps requiring about two months to complete.

The city manager proposed and the council accepted an alternate procedure in which a five-member site review committee, whose membership represented various interested groups, worked with Phillips to review the revised plans. When the committee's work was completed, it reported its recommendations directly to the city council. The formal hearing was eliminated. When Phillips appeared before the council with requests for revisions that had already received approval of the site review committee, the council approved the requests. The process saved two months of time, resulting in savings of about $449 per unit in interest and overhead.

City officials remained involved in the development of The Park. The opening was attended by Mayor Brown; Gordon Walker, former HUD Undersecretary for Field Coordination; John Phillips; and Governor John Spellman.

Tulsa, Oklahoma

A Task Force, comprised of seven industry representatives and thirteen department heads working with Chairman Ray Greene, streamlined the Tulsa plan review and construction permitting process from a long process involving nine separate authorizing departments, to a one-stop system completed in days. Additionally, sequential inspections were replaced by concurrent inspections. Local architect J. L. Richardson commented, "This is the first time the Tulsa government and the private sector have gotten together to resolve mutual concerns. The city knows developers prefer to do business in areas with minimal red tape."

City and Federal officials participated in the Innovare grand opening.

Everett, Washington

Boyden Realty, Inc., sought city approval for PUD designation of a plot of land situated in a single-family, low-density area where it would otherwise not be possible to build housing in the affordable range. City officials supported the cost-saving goals of the plan submitted by Boyden, but required the developer to offer clear evidence in a public hearing of positive reaction to the PUD designation on the part of the proposed project's neighbors.

The land planner, Gary Wight, prepared detailed information on the project, including answers to anticipated fears and objections, and devoted substantial time and effort to conducting discussions with the proposed project's neighbors. Using charts, maps, and drawings, the developer demonstrated that the natural features of the site would be maintained and even enhanced, and that the project would have a positive impact on the area. At the hearing, not one neighboring home owner objected to PUD designation.

The designation was approved; the project, "Sunridge," was built; and surveys conducted after completion and occupancy show strong continuing positive reactions by the community.

Phoenix, Arizona

The city of Phoenix used the opportunity provided by Cimarron, the affordable housing project by Knoell Homes, to review and modernize its entire set of regulations and procedures for land use and home construction. Under the revamped procedures, Knoell Homes worked through a city Development Coordinating Office to schedule special staff meetings on various changes requested for the subdivision. The procedure saved three months of time, with interest and overhead savings totalling $2,133 per unit. Features of Phoenix's modernized regulatory arrangements are as follows:

(1) *Assistance to developers prior to application*

A Pre-Development Advisory Team, with members from the Planning, Streets and Traffic, and Engineering Departments, provides information and assistance to developers before formal applications are submitted.

(2) *Expediting of reviews and approvals through a Development Coordination Office*

This office, a Division of the Planning Department, staffed by senior personnel from three city departments, assists developers with zoning matters and site plan review.

(3) *Use of administrative hearings in lieu of city council hearings*

Many matters relating to development now come before a hearing

officer, leaving the city council free to deal with issues that involve policy. Administrative hearings are used for site plans, subdivision plats, lot divisions, zoning adjustments, fee waivers, grading and drainage, floodplain problems, fire code variances, off-site improvement, and building code variances.

(4) *Preparation of Policy Manuals*

Several city departments have published policy manuals which are made available to builders as unified sources of information.

(5) *Use of "Over-the-Counter" Processing*

Virtually all small projects can be processed during a single visit by the developer or builder in the Building Safety, Planning, Streets and Traffic, Water and Wastewater, and Engineering Departments. Some more substantial types of approvals, including model home permits and minor site amendments, can also be processed in this fashion.

(6) *Use of Private Sector Consultants for Plan Review*

The Engineering Department permits developers to contract with approved private-sector consulting engineers for review of development plans. Reviews by such consultants can typically be completed more rapidly than reviews conducted through the Engineering Department. The developer contracts for the consultant's services, paying the consultant's fee in exchange for the time gained.

(7) *Interdepartmental Coordination for Complex Projects*

A development services' administrator in the city manager's office can assist in expediting the approval process through interdepartmental coordination. Among other things, this official can request the release of building permits if time is critical and review processes appear to be lagging.

Sioux Falls, South Dakota

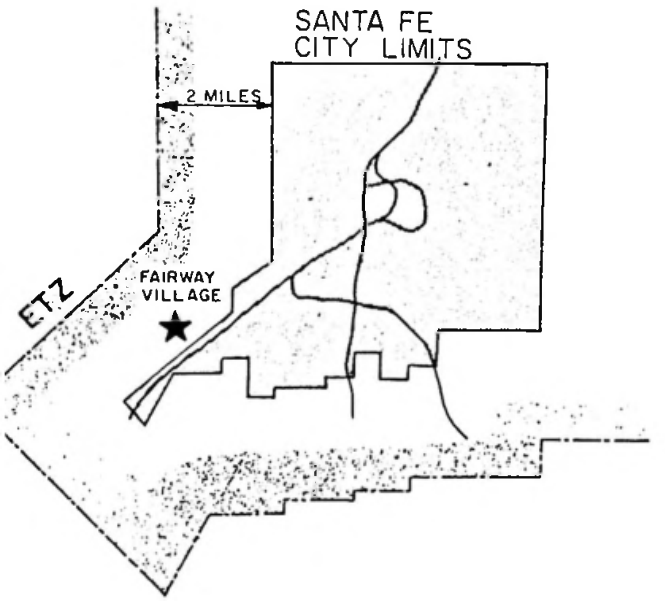
This city's ordinances allow a significant degree of flexibility in a number of areas of the approval process. For example, the city engineer can use his discretion in approving proposals in various matters affecting land use, such as width of rights-of-way, street paving width, and manhole spacing. Specific performance capability, rather than general standards, serve as the approval criteria, and the procedure saves time that would otherwise be devoted to hearings and reviews.

Knox County, Tennessee

The city permitted builder Phil Hamby to combine two of the three steps in the normal review process in securing approvals for his Woodpointe subdivision. The usual first step is to submit to two bodies, the Planning Commission and the County Commission, a "use on review" plan which is a concept plan showing the builder's intentions without a significant amount of detail. The second step is submission to the same two groups of a composite design plan showing the proposed location of lots, streets, utilities, and drainage. Combining these two steps saved Hamby 45 days of processing time, resulting in savings of $443 per unit.

Santa Fe, New Mexico

The New Mexico state inspector cooperated with Walton Chapman Builders by providing daily inspections of Fairway Village without being called. Each morning the inspector stopped at the project at the beginning of his daily rounds to inspect whatever was ready on that day. The City of Santa Fe rejected Chapman's request for concurrent rather than sequential processing, but it made every effort to expedite its procedures.



Fairway Village

Fairway Village is located just beyond the city limits in an area scheduled for annexation, making it necessary to satisfy the requirements of five entities -- the city, the county, the state, the Extraterritorial Zone Commission, and private utility companies. Cooperation among the entities involved is particularly important in building affordable housing in areas that are subject to more than one level of government.

White Marsh, Maryland

On July 16, 1984, the Zoning Commissioner of Baltimore County heard a request by Nottingham Properties (developers) to amend the original plan for Lawrence Hill to include cluster single-family homes, townhouses, and garden apartments. The cluster plan required variances

regarding distances between homes. Protestors (neighbors) argued that the proposed cluster single-family detached homes would adversely affect their property values. The commissioner stated that the protestors presented no evidence that their property values would be reduced, and that...

> "the proposed cluster design would not be detrimental to the health, safety or general welfare of the locality nor tend to create congestion in roads, streets, or alleys therein, nor be inconsistent with the purposes of the property's zoning classification, nor in any other way inconsistent with the spirit and intent of the Baltimore County Zoning Regulations."

The Commissioner accepted only facts, not unsubstantiated opinions, when hearing the request. The amendment was approved and the Lawrence Hill Project allowed to proceed.

Other Sites

Several cities allowed Affordable Housing Program developers to begin construction prior to granting of final plat approval. In *Blaine, Minnesota*, this procedure allowed Good Value Homes to construct models for its Cloverleaf Farm development in time for the spring buying season. Normal processing time for the units was reduced by 54 days, saving $283 per unit. In *Lincoln, Nebraska*, the same procedure enabled Empire Homes to save three months on the construction schedule for Parkside Village, with resulting savings of $1,116 per unit.

Affordable Housing Task Forces were active in *Santa Fe, Phoenix*, and *Sioux Falls.*

LAND DEVELOPMENT

Site planning and land development represent major areas of potential cost reduction for most builder/developers. These costs often increase in direct proportion to the complexity of local regulations, zoning requirements, and levels of required standards.

It is widely recognized that:

- One of the most rapidly increasing components of housing cost is the cost of land.
- Local governments have most of the control over land availability and use.

Land prices are sensitive to supply relative to demand. Where supply is limited and demand is heavy, the price of developable land rises rapidly. Local governments can affect the land supply for development by providing infrastructure, encouraging a balance between development and open space, allowing increased density through zoning, using surplus land, and examining its development-inhibiting regulatory structure. *Of the major cost components of new housing -- land, labor, materials, and capital -- land cost is the most influenced by local government policies.*

Attractive townhouse development

Higher density development, a method of making more land available for residences, *is a public necessity*. A recent NAHB survey showed home buyers are more willing to sacrifice land than to sacrifice quality or space inside the house. Most buyers will accept a smaller than standard lot to buy a home they can afford.

The number of dwelling units per acre is the primary development standard that effects the life style, economics, and environmental considerations of a residential development. Important factors relating to density follow:

- As net density increases, lot sizes become smaller and land needed for roads per housing unit decreases.
- Greater opportunities exist to preserve natural site features and open green space when lot sizes are decreased and houses clustered.
- Greater savings to the community, the builder/developer, and the home buyer can be achieved.

Most of the savings in development costs resulting from changes in development standards discussed in this manual can be attributed to

increased density. *Developers reported their biggest cost savings resulted from lower land and infrastructure improvement costs per unit due to the higher densities achieved by small lot development.* Higher density allows land and improvement costs to be spread over a larger number of units. Reduced frontage and front yard setbacks allow for less pavement and sidewalk per unit, shorter utility runs, and reduced material costs. Wide streets and rights-of-way, although sometimes functionally justifiable, add to land development and, ultimately, housing costs.

This section will examine the major factors in planning and developing land for residential use:

- Site planning
- Streets
- Parking
- Sidewalks and walkways
- Curbs and gutters
- Storm drainage systems
- Sanitary sewers
- Water supply
- Utilities/Utility easements

SITE PLANNING

Successful approaches to affordable housing require more efficient utilization of land than has often characterized American home building practices in the past.

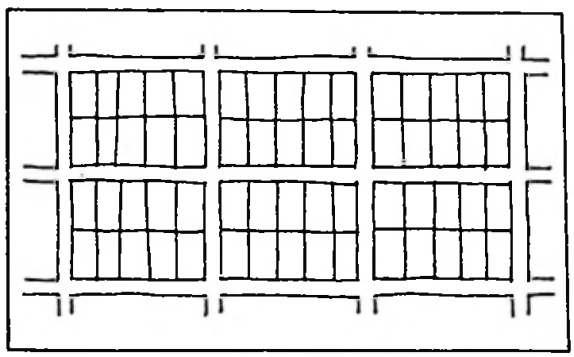
In most of the demonstration projects, reducing land cost per housing unit was the biggest single factor in achieving affordability. Lower housing cost is therefore closely linked to greater density of land utilization per acre.

This, in turn, poses challenges in the design and aesthetics of housing and land use to maintain and even improve liveability in the context of increased density.

Following are guidelines for site planning:

- Encourage plans to increase density and maintain open space.
- Avoid development plans with wide streets in grid patterns, large lots, deep setbacks, and low density.
- Encourage open space and preservation of natural features in site plans.
- Support cluster plans which increase density and create open space, provide adequate parking, and design privacy landscaping.
- Reduce or eliminate setbacks from all four lot boundaries.
- Support "zero-lot-line" and "Z" lot configurations.

Traditional Approaches



Conventional subdivision grid

Traditional housing development plans prevalent in the Post-World War II period are characterized by a grid pattern of wide streets with houses on large lots with large setbacks.

Such plans were widely viewed as affording privacy and providing desirable residential environments. These views were reflected in local housing ordinances, which often restricted density per acre and specified large setbacks.

However, there is little reason to believe that this extravagant use of land made any meaningful contribution

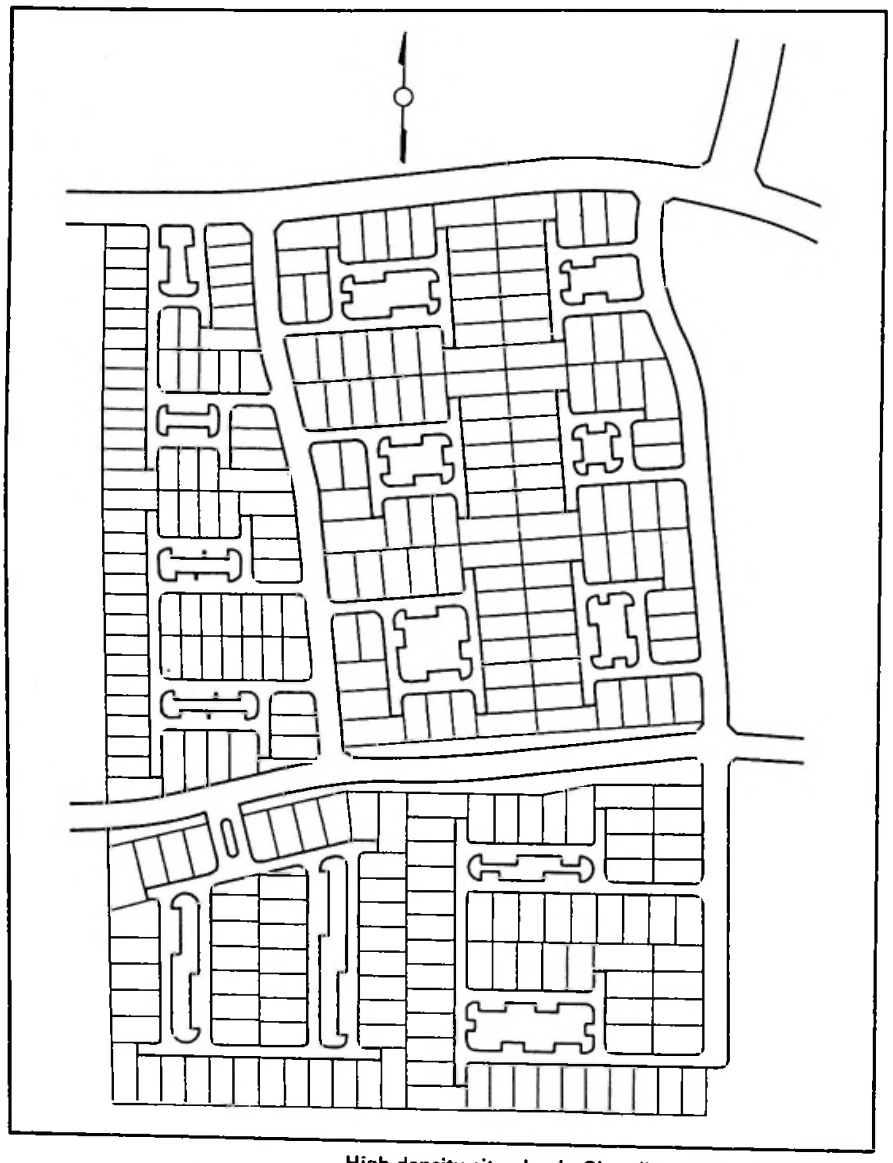
to the goals of desirability and privacy. There is nothing intrinsic in the arrangement which promotes or increases privacy, and "desirable residential environments" often turned out to be urban sprawl. In many instances, little provision was made for open or common land or for integration of common open space in the overall design of the development.

This type of development does not make efficient use of community services such as roads, and water and sewer systems because of the relatively low density. The cost of their wasted capacity is borne by both residents and the public sector.

Innovative Approaches

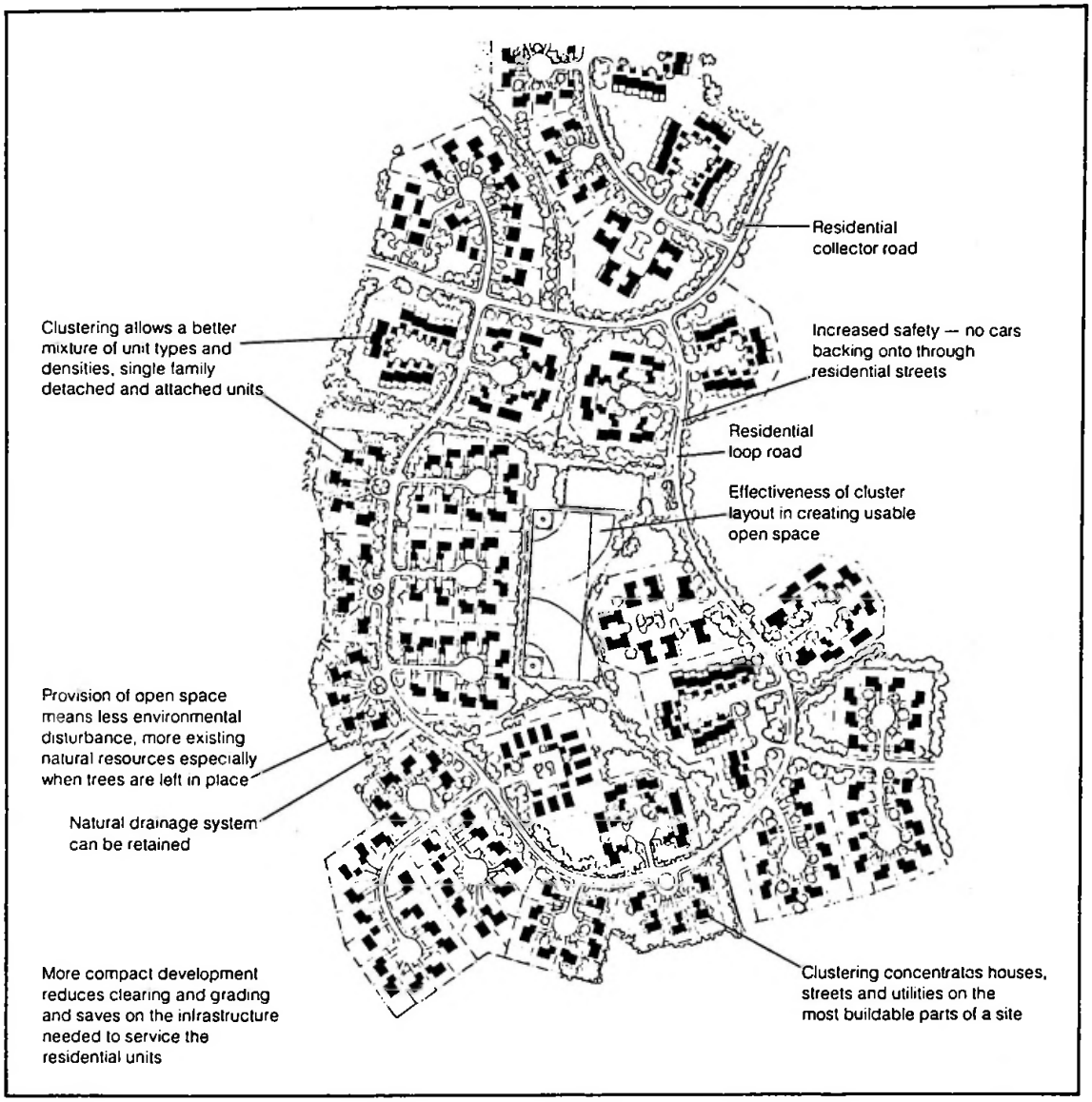
There are a number of ways in which well-planned higher density can contribute to, rather than detract from, beauty and liveability. For example, a greater amount of common open space and more possibilities for preservation of attractive natural features of the site are often easier rather than more difficult to incorporate into good plans for higher-density occupancy.

Other potential problems of higher density can be overcome through innovative planning. Two such problems are privacy and parking. Privacy can be provided by coordinating arrangements of fences and/or planting. For attached units, sound conditioning can be incorporated into common walls.



High density site plan in Chandler, AZ by Knoell homes

Rear yards and front entry courts can be enclosed. Parking can be provided through placement of garages or carports within parking areas and by use of planted islands.



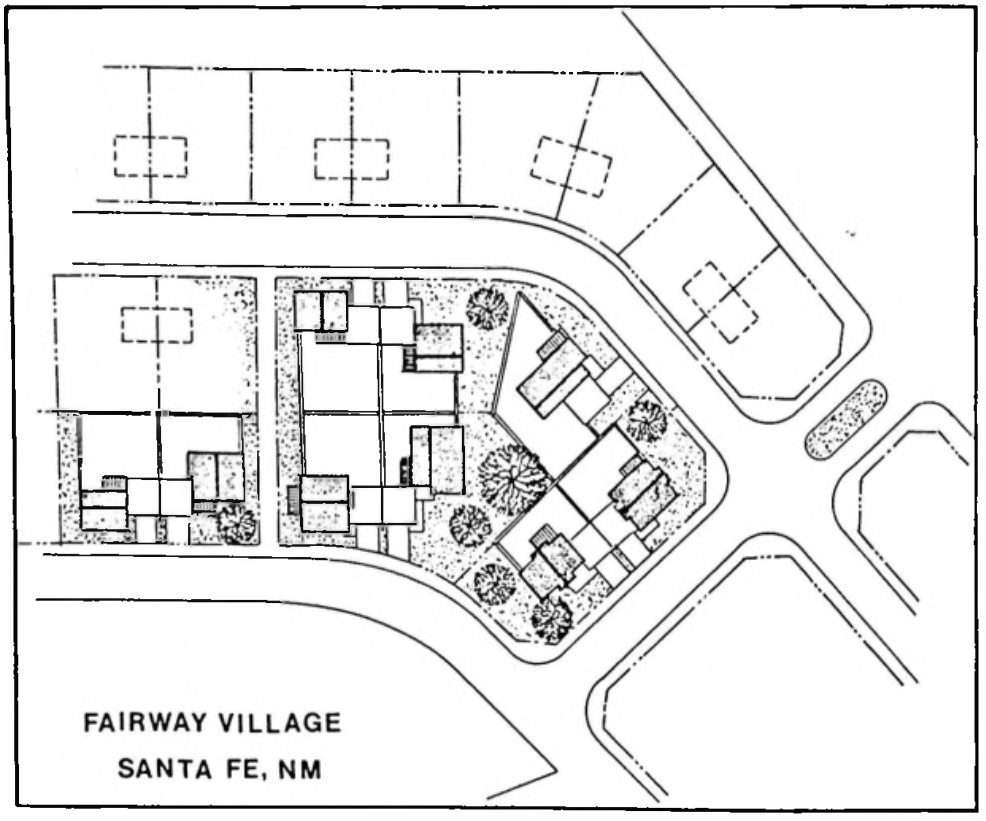
Typical plan of a cluster neighborhood

Clustering

Many clustering arrangements have been successfully designed to combine higher density, beauty, and liveability. Clusters can be incorporated into site development plans to preserve open space for community use while reducing development costs.

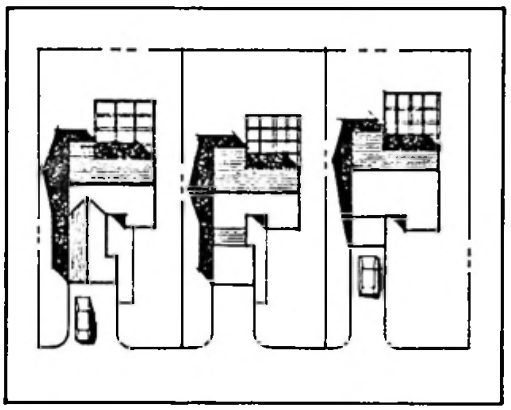
In addition, it has been found that such arrangements can increase the sense of community among residents within each cluster and among adjacent and neighboring clusters. A cluster can become a psychologically identifiable "place" more easily than can rows of detached houses on rectangular lots. Groups of clusters can relate to each other through joint access to common land.

Clusters can be designed for siting single-family detached or attached homes, duplexes, quadplexes, etc.

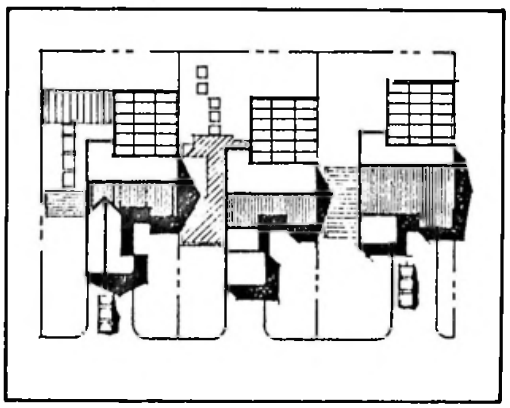


Typical pinwheel lot arrangement

Reduction or Elimination of Setback Requirements



Conventional siting practice

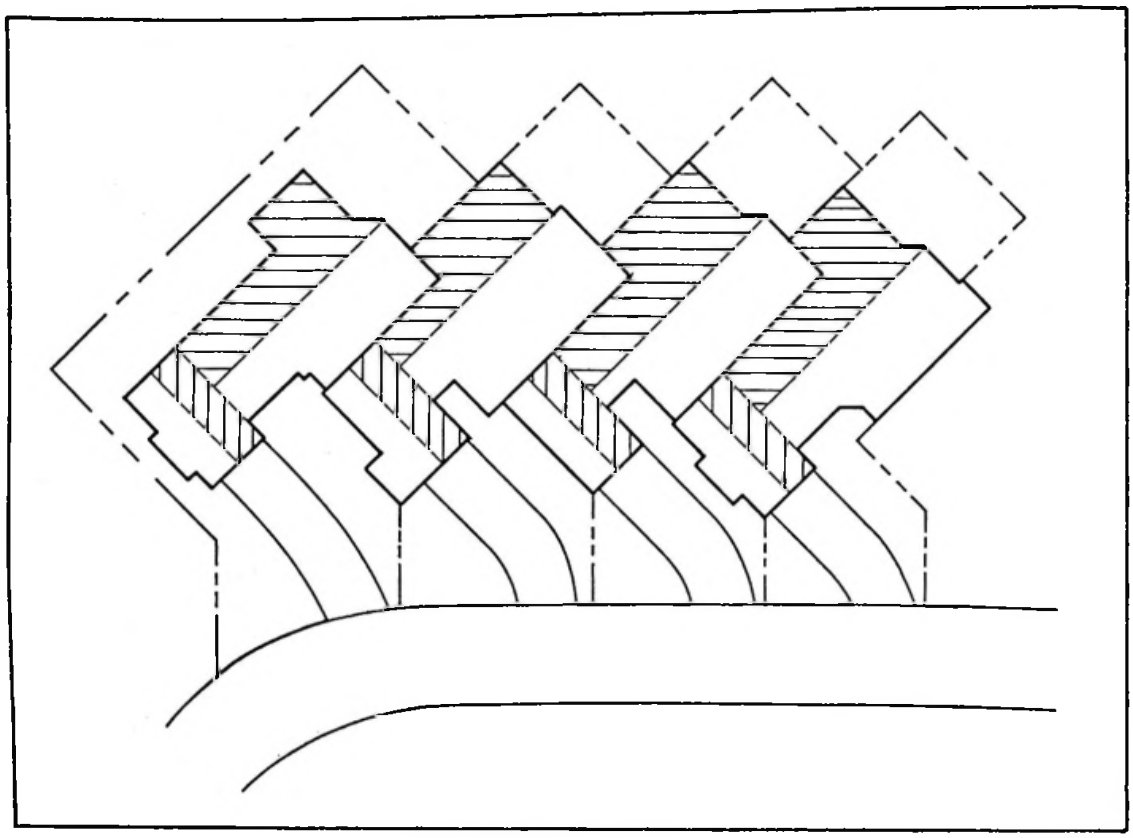


Zero lot line siting — larger, more useable side yard for outdoor living

The traditional practice of using large setbacks from all four boundaries of the lot reduces the usability of land on both sides of the house, particularly on smaller lots. By placing the house directly on the lot line on one side, usable land on the other side is doubled.

This "zero-lot-line" approach is basically a detached version of the duplex home. That is, by moving one duplex unit away from the common wall to the other side of the lot, high density is maintained while creating a freestanding single-family detached subdivision. This approach combines two small unusable side yards into one large usable side yard. Usually, main living areas are oriented toward the side, taking advantage of the "court."

On the smaller lots that most often are used in affordable housing developments, this can make the difference between having or not having usable outdoor space.



Typical "Z" lot

"Z" Lot Configuration

An adaptation of the zero-lot-line approach is an innovative concept called "Z" lots. Sometimes called "herringbone" or "sawtooth", these angled lots expand frontages and expose more of the home to the street. Because of the angle, garages don't dominate the streetscape as much as in more traditional rectangular lot layouts, especially if garage door locations are alternated. The JVAH site in Everett, WA, included a variation on the "Z" lot approach with garages set at an angle with the homes and the street.

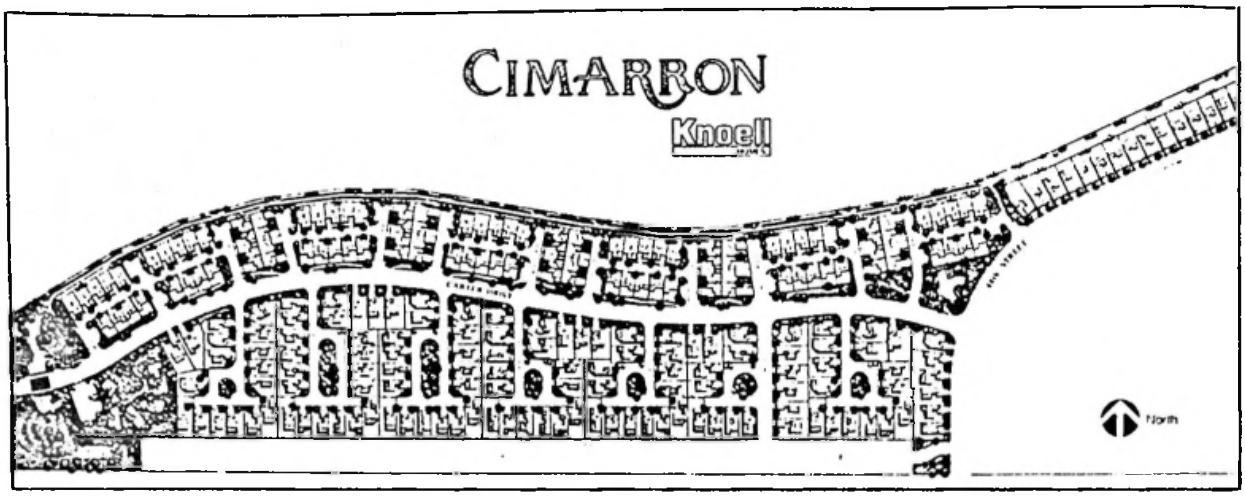
EXAMPLES FROM THE DEMONSTRATION PROJECTS

The accompanying illustrations show some site plans from demonstrations in the Affordable Housing Program. The sites vary greatly in shape and in their physical characteristics. However, each of the plans represents a creative relationship to the existing land. Densities vary from five units per acre for the least dense single-family detached homes to 17.4 units per acre for the most dense single-family attached homes.

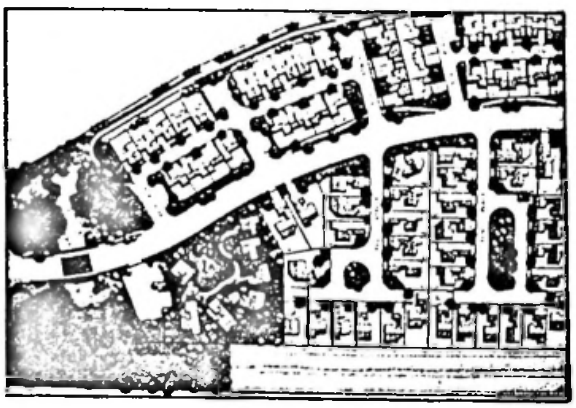
Local land use restrictions, and the degree to which local officials were willing to waive or modify certain existing zoning or code restrictions as requested by the developer, varied with each site. However, in all the affordable housing demonstrations, public officials and developers worked together with a high degree of cooperation to achieve affordability.

Phoenix, Arizona

The Cimarron development is situated on a narrow 38-acre plot of land which Knoell Homes had originally laid out for 149 detached single-family units. After joining the Demonstration Program, Knoell redesigned the development to add 106 units, bringing the total to 255.



Cimarron site plan



Entrance to Cimarron

Average lot size was reduced from 6,000 to 3,600 square feet and density was increased to 6.7 units per acre. The housing mix consists of 107 townhouses and 148 single-family units, ranging in initial (January, 1983) sale prices from $45,000 to $63,000. Reductions in widths of streets, rights-of-way, and sidewalks, subjects which are discussed more fully in an ensuing section, added about five acres to the land available for housing over the original plan.

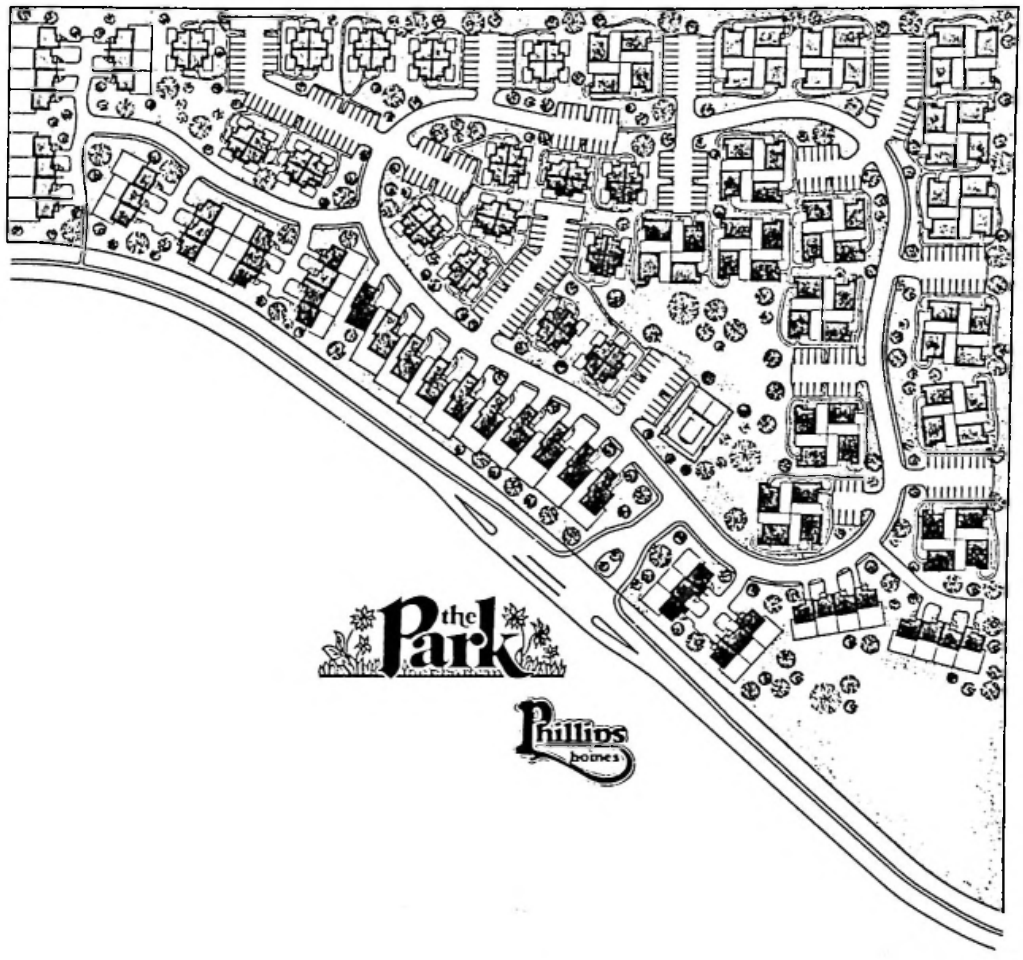
More than seven acres are devoted to open space which includes retention ponds set in attractive landscaping on either side of the development entrance, other landscaped areas, utility rights-of-way, a jogging course, and common land.

Lacey, Washington

Site plan (before)

The original plan for The Park called for the construction of 153 detached and attached units on a 21.9-acre site of approximately triangular shape. This initial plan was both innovative and efficient in terms of land use. However, when Phillips Homes joined the Affordable Housing Program, the site was redesigned to increase the number of units to 176, increasing density from 7 to 8 units per acre.

Site plan (after)

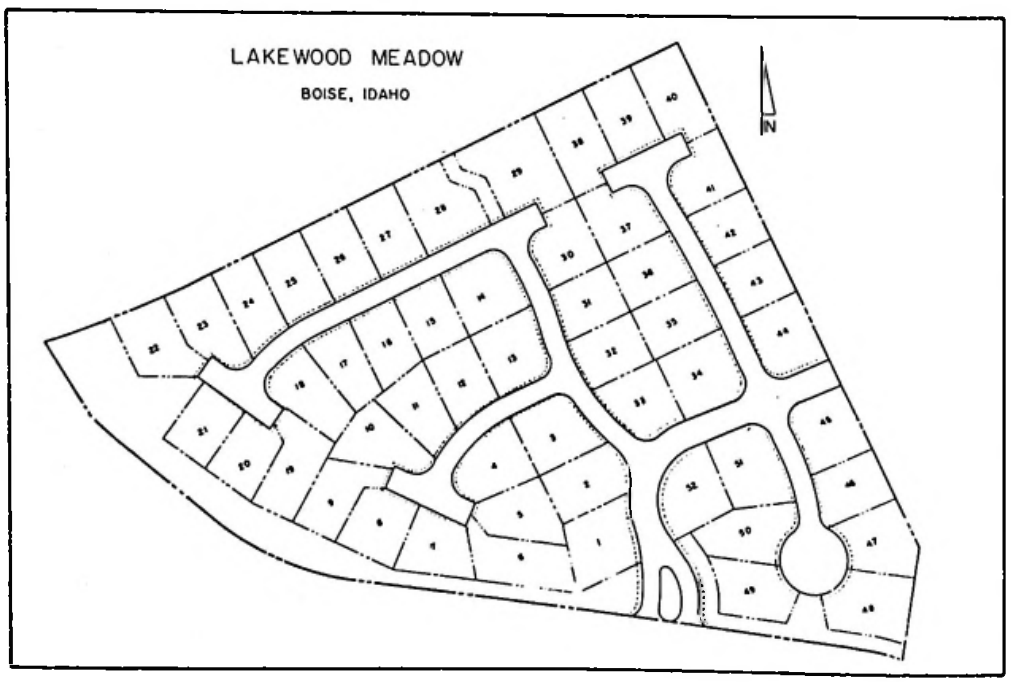


Loft homes in the natural park setting

The housing mix consists of 64 "pinwheel" cottages, 10 zero-lot-line patio homes, 38 townhouses, and 64 quadplex units called "loft homes." Units range in size from 648 to 1,287 square feet. Many large trees were preserved, and a central clubhouse and swimming pool are located in a small park.

Boise, Idaho

Lakewood Meadow, built by Triangle Development Company, is a 52-home project on a triangular 13.3-acre site. The project is part of a 263-acre planned residential community called Lakewood, situated in one of the most desirable residential areas in town.



Lakewood Meadow unit

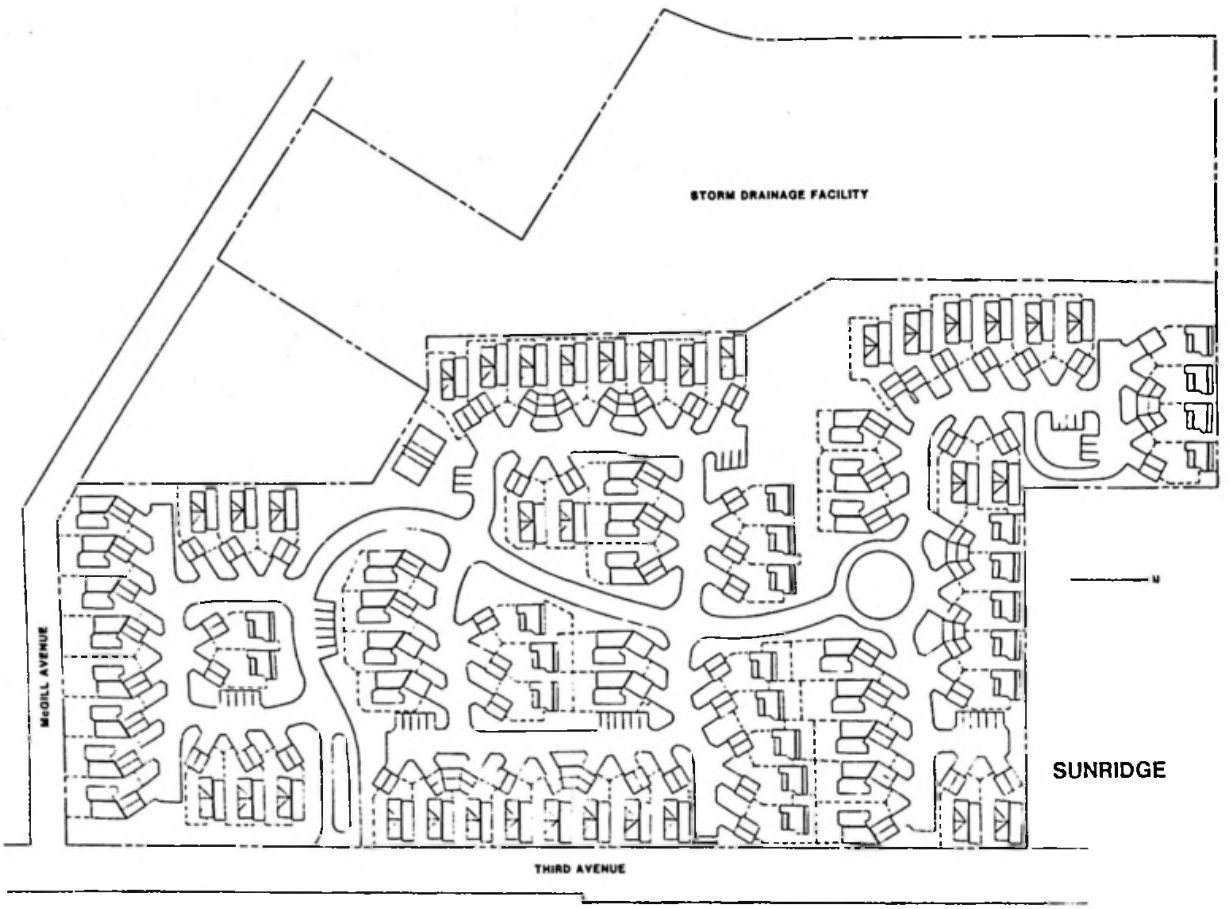
Lakewood Meadow demonstrates the feasibility of creating an affordable housing segment in a development whose other homes are more luxurious and expensive. The Affordable Housing segment incorporates such features as smaller lots, narrower streets, sidewalks on one side of the street only, T-turnarounds instead of cul-de-sacs, and roll curbs.

These features enabled the developer to add five building lots to the Lakewood Meadow segment while retaining amenities and architectural style that characterize the substantially more costly homes in the balance of the Lakewood development.

Lots in Lakewood Meadow are approximately 6,000 square feet, and homes range from 1,100 to 1,700 square feet in living area.

Everett, Washington

Sunridge is built on a 20.4-acre site of which about 6 acres along a stream were dedicated to the city for a stormwater detention system, and another 2.4 acres is consigned to commonly-owned space spread throughout the development. Eighty-one units were built on the remaining 12.2 acres, providing a density of 6.6 homes per acre.



Everett site plan

All of the homes have a southern exposure, and the house designs are oriented toward passive solar heating. All homes are zero-lot-line, and yards are fenced. Garages for all homes are sited at an angle to add interest to the streetscape.

Mature trees were preserved on the site wherever possible, and the development has been extensively landscaped. Three types of homes were built ranging from 1,076 to 1,624 feet in living area.

Portland, Oregon

North Meadow Village occupies a triangular 6-acre site. Density is 9.7 units per acre. Homes in the development are arranged in pinwheel clusters.

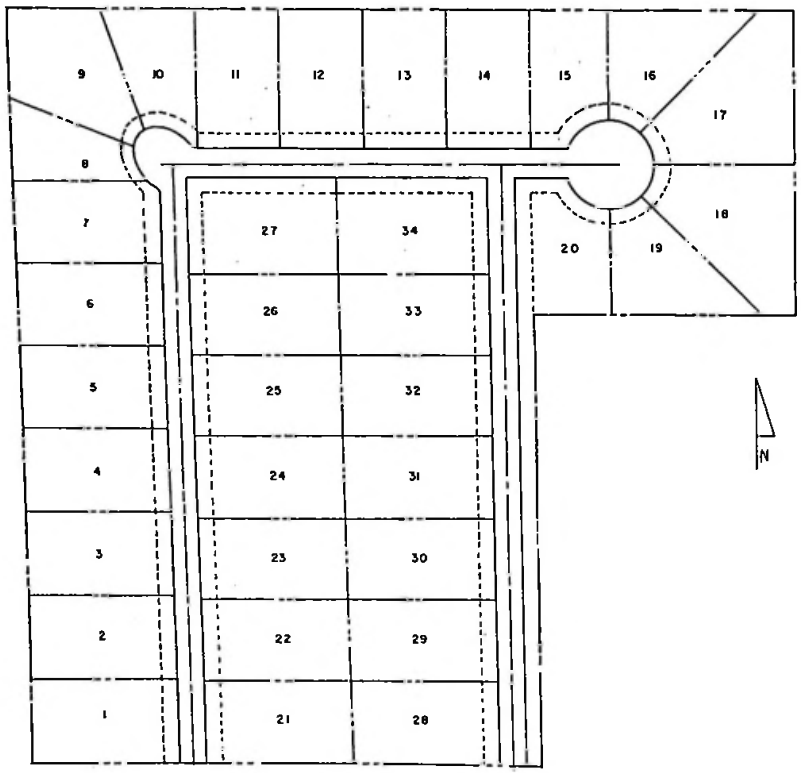
With the cooperation of municipal officials, the developer utilized reduced lot sizes, narrower streets and rights-of-way, smaller setbacks from the street, and common, covered off-street parking to make more land available for housing. Additional land was freed for home construction through use of an innovative storm-water drainage system employing three on-site dry sumps.

Portland land plan

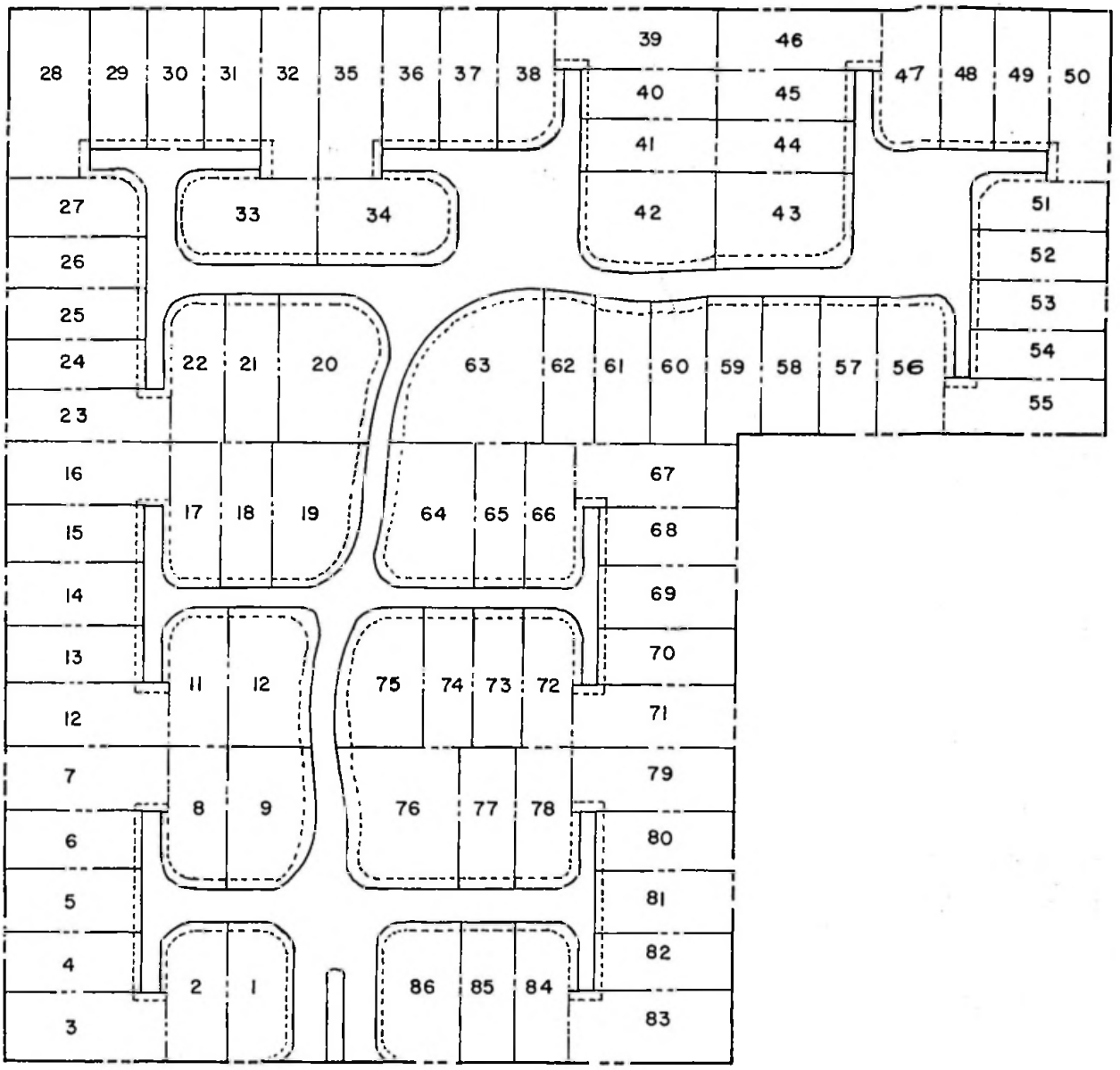
Tulsa, Oklahoma

Innovare Park is constructed on a panhandle-shaped 7.98-acre site. The original site plan was for 34 detached units in a traditional grid pattern with straight-run streets. After joining the Affordable Housing Program, Hood Enterprises redesigned the site to accommodate 86 detached units.

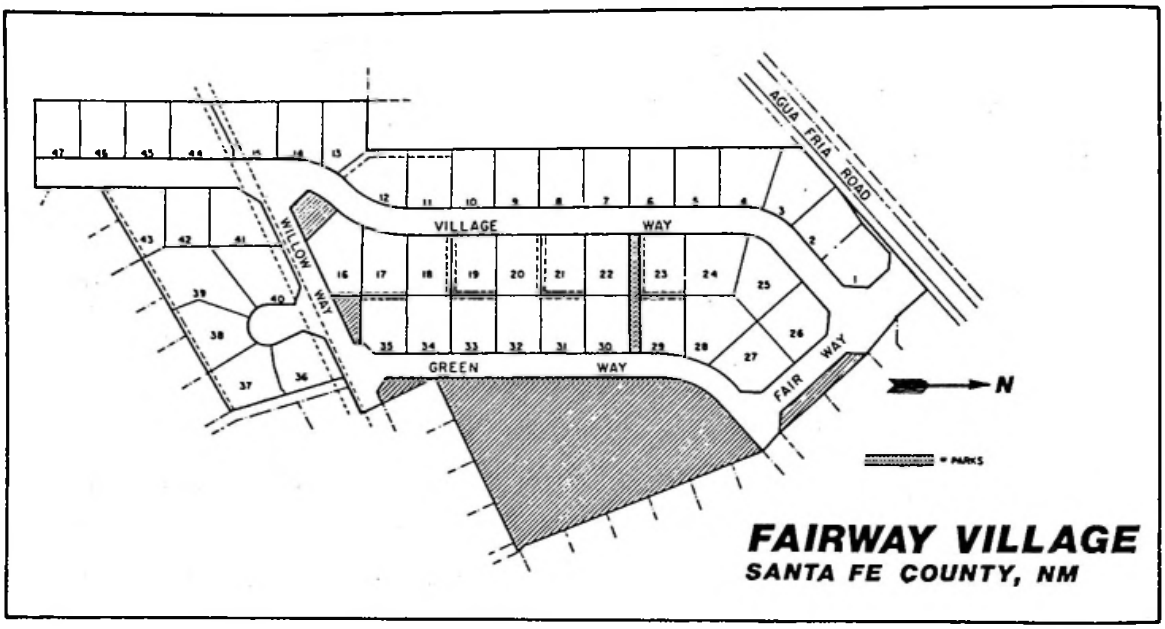
The revised plan utilizes one collector street with short feeder streets ending in T-turnarounds. The smallest lots are 2,250 square feet, but most are 35x80 feet, or 2,800 square feet. Houses are placed close to the lot line with a minimum 5-foot clearance between units.



Original site plan



Revised site plan



Santa Fe, New Mexico

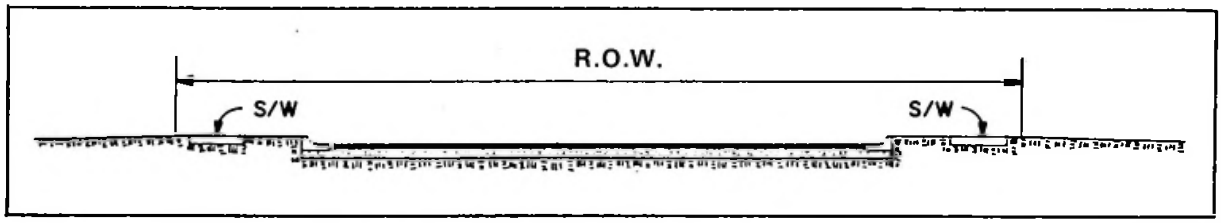
Fairway Village, built by Walton Chapman Builders, is a 154-home project on 31 acres just outside the city limits in an area planned for future annexation. Homes are sited in a pinwheel arrangement rather than in traditional rows. Varying setbacks create interesting front yards and streetscapes.

The pinwheel siting creates a feeling of community and enhances outdoor privacy. A 1.5-acre park with recreational equipment provided by the builder completes the village.

STREETS

Streets are an integral part of neighborhoods, and must be designed to provide adequate access to individual lots with minimal interference in the daily lives of residents. Wide pavements and rights-of-way occupy land which could be used to increase housing density or as open space. Following are guidelines for local streets:

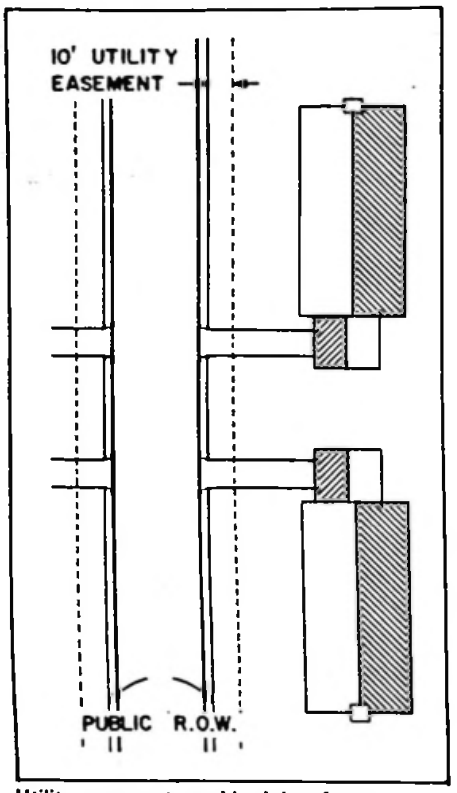
- Limit right-of-way widths to the minimum necessary for street construction and maintenance.
- Use easements rather than rights-of-way for sidewalks and utilities.
- Design streets for their anticipated use.
- Coordinate street widths with the number of travel lanes and amount of parking necessary.
- Reduce pavement thickness, where possible, to match structural design with actual performance needs of subdivision streets.
- Reduce the traditional radius requirements for "bulb" cul-de-sacs, or substitute hammerheads, T-turnarounds, and islands.



Typical right-of-way

Rights-of-Way and Easements

Rights-of-way are publicly-owned land on which streets, sidewalks, curbs, and gutters are built, and which often accommodate utilities such as water, sewer, and electrical service. The government body that owns the right-of-way grants the right of use and passage to the public, or to designated parties such as utilities, under conditions specified by the government. Right-of-way land is not on the property tax rolls and generates no tax income.



Utility easement outside right-of-way

Easements are rights of passage and/or use on property that remains in private ownership. In residential situations, the owners of easement land are homeowners, and the holder of the easements is the utility company or municipality. The municipality prescribes types and conditions of use of easements, as it does for rights-of-way. The same access to utilities is available as when utilities are installed in rights-of-way. Easement land is taxable.

Advantages of Easement Usage

Use of easements as an alternative to rights-of-way provides benefits to each of the parties involved in residential development.

The *municipality* gains:

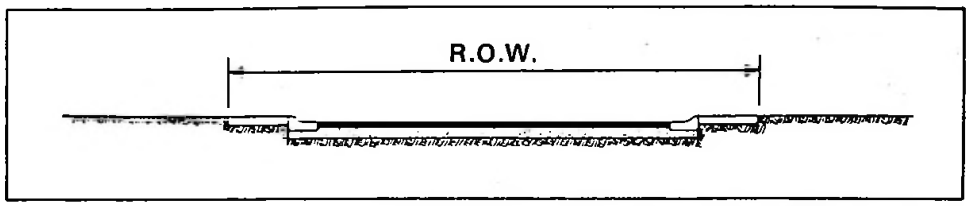
- Additional land on the tax rolls
- Reduction in land for which it has responsibility of maintenance

The *builder* gains:

- More land to sell
- Increased design flexibility

The *homeowner* gains:

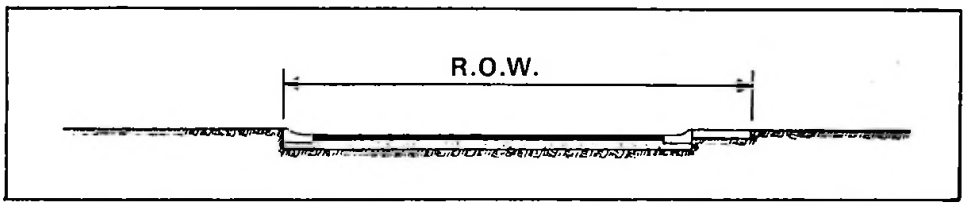
- More usable land
- Lower home costs



Sidewalks and street within right-of-way

Right-of-Way Width

Jurisdictions routinely specify a minimum right-of-way width of 50 feet or greater, which comprises sufficient width for a roadway 30 to 36 feet wide, with broad margins for sidewalks and utilities. Such specifications reflect a past era of lower land values. In today's environment, they should be subjected to rigorous review to reduce housing costs.



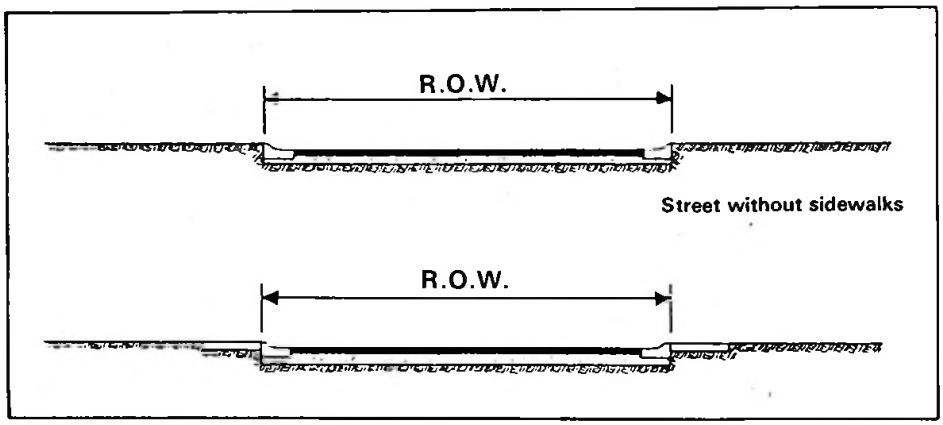
Single sidewalk within right-of-way

The basic facility that must be accommodated by a right-of-way is the roadway with its associated shoulders, curbs, and gutters. As discussed below, traditional designs often resulted in streets much wider than were necessary. This was done for two reasons:

- Detailed planning to relate road width to reasonable anticipated usage was usually not carried out.

- Substantial road capacity was routinely built to allow for unevaluated possibilities of "future growth."

The first step in reducing right-of-way width is substituting detailed traffic analysis and planning for general guidelines, and applying this planning to the width of residential roadways and connecting streets.



Sidewalks located outside right-of-way

Other uses of rights-of-way, including sidewalks, placement of utilities, snow storage space, and planting strips, should be evaluated. One alternative is to accommodate uses other than roads with easements. If easements cannot be used for such applications, right-of-way requirements for them often can be reduced, as discussed in ensuing sections.

Several configurations are illustrated with different ROW limits. Each varies according to the pavement width, the sidewalk placement, utility strips, and other related items.

Street Design

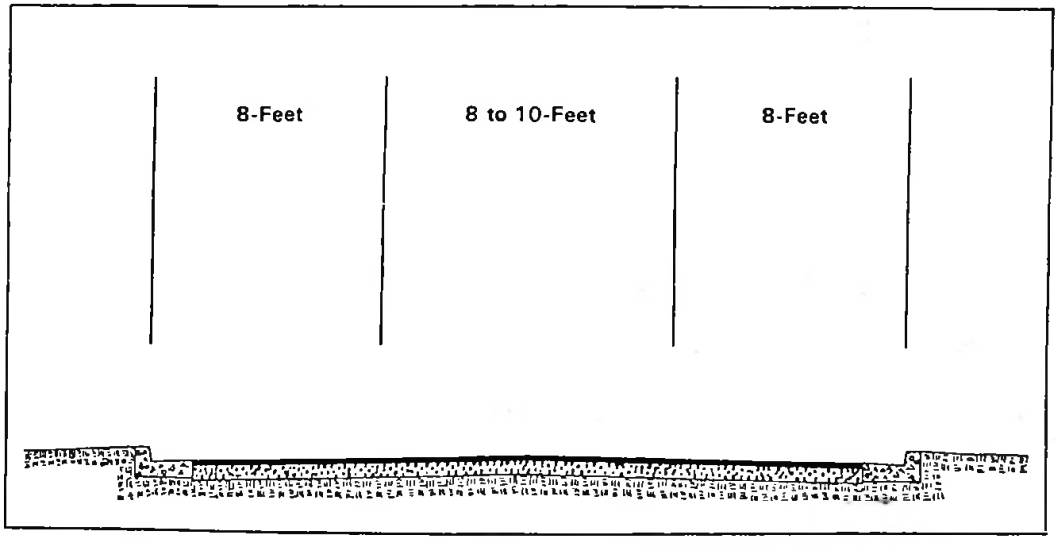
State highway standards often serve as a basis for local street standards. However, traffic characteristics, construction and maintenance requirements, and performance needs of residential streets differ from those of highways. Reductions in cost and in land use can be achieved by

designing residential streets so as not to exceed these characteristics, requirements, and needs. This will often involve departure from established criteria and practices which are based on broad application of general rules rather than individual analysis.

Pavement Width

Local construction standards often specify a minimum pavement width of 30 to 36 feet, an excessive amount of space for most residential streets. Depending on such factors as speed limit, parking requirements, and lane width, street pavement widths can be reduced to as narrow as 18 feet. Such narrower streets will effectively and safely accommodate the relatively low speed limits appropriate for subdivisions.

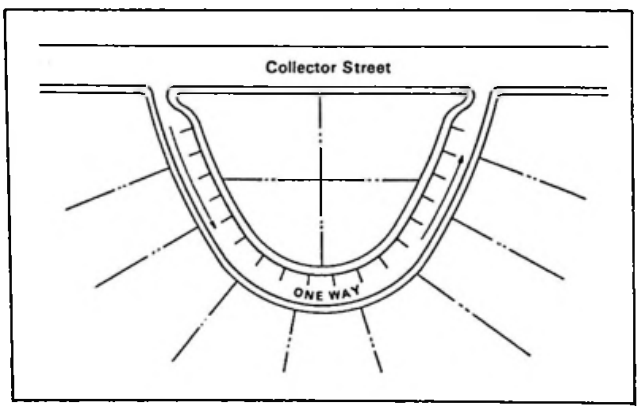
The number of lanes and their width are the primary factors upon which pavement width should be based. Eight feet is usually adequate for parking lanes, with moving lanes requiring 8 to 10 feet depending on individual conditions. Guidelines



Residential street with parking on both sides

published jointly by the National Association of Home Builders, the American Society of Civil Engineers, and the Urban Land Institute state that a street width of 24 feet is adequate for two parking lanes and one moving lane. On low volume, low speed streets typical in a residential neighborhood, it is not necessary to provide two unobstructed moving lanes. If two cars are parked directly across from each other, there is usually room for one moving vehicle to pull over and let the other pass. This is a minor inconvenience on a residential street and is outweighed by the savings in land, construction, and maintenance costs.

Pavement widths can be narrowed further by eliminating one or both parking lanes. Rural streets and collector streets that do not provide direct access to homes are not used for parking and do not require a pavement width greater than that which will allow two cars to pass. Pavement widths of 18 to 20 feet are adequate for such roads.



Loop street

Loops

Loop streets can reduce costs, especially if designed for one-way traffic. A 16- to 18-foot pavement on

a one-way loop will accommodate both moving traffic and a lane of parked cars, as illustrated.

The one-way loop provides two points of ingress and egress for fire equipment and other emergency vehicles.

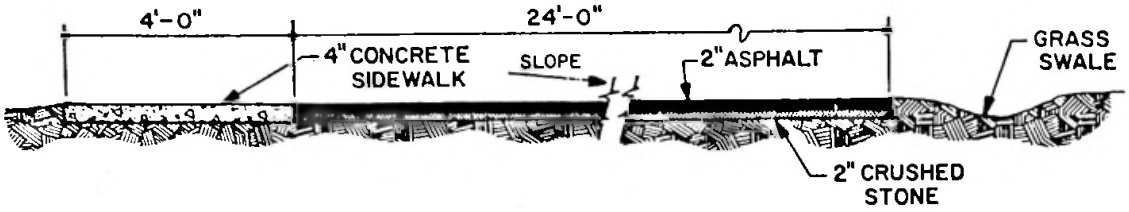
Street Construction

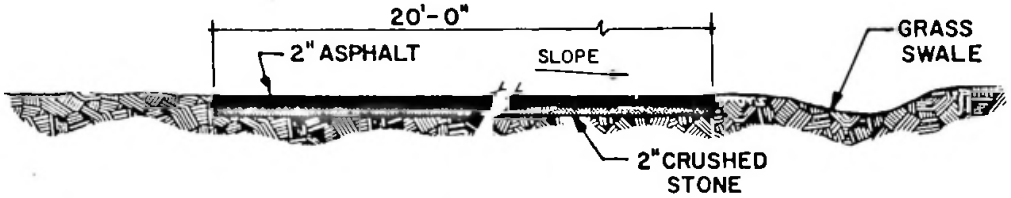
Construction of a safe, durable roadway is a function of traffic volume, of the weight of vehicles expected to use the roadway, and of underlying soil conditions.

State highway departments generally prescribe minimum standards for state roads regarding the thickness of pavements and construction materials and methods. These standards are for roads that will ordinarily carry heavier vehicles and more traffic than expected on subdivision streets. However, many municipalities and local governments adopt standards for subdivision streets that reflect those for state roads. Significant cost savings can be realized by substituting analysis of the actual functional requirements of subdivision streets.

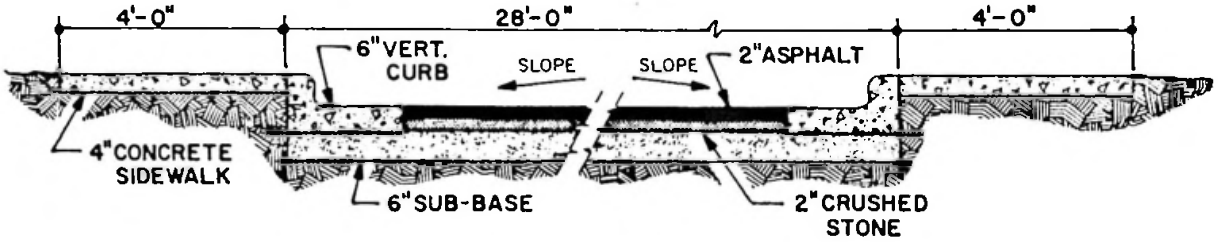
Base Layer and Soil Characteristics

A minimum thickness of 8 to 12 inches for the base layer of crushed stone aggregate, or other material underlying the paved road surface, is not an uncommon requirement for residential streets. Consideration can be given to reducing the thickness of the base layer to match actual functional requirements, as was done in the Lacey, Washington, affordable housing project, as shown.





DEMONSTRATION STREETS



TYPICAL LACEY STREET

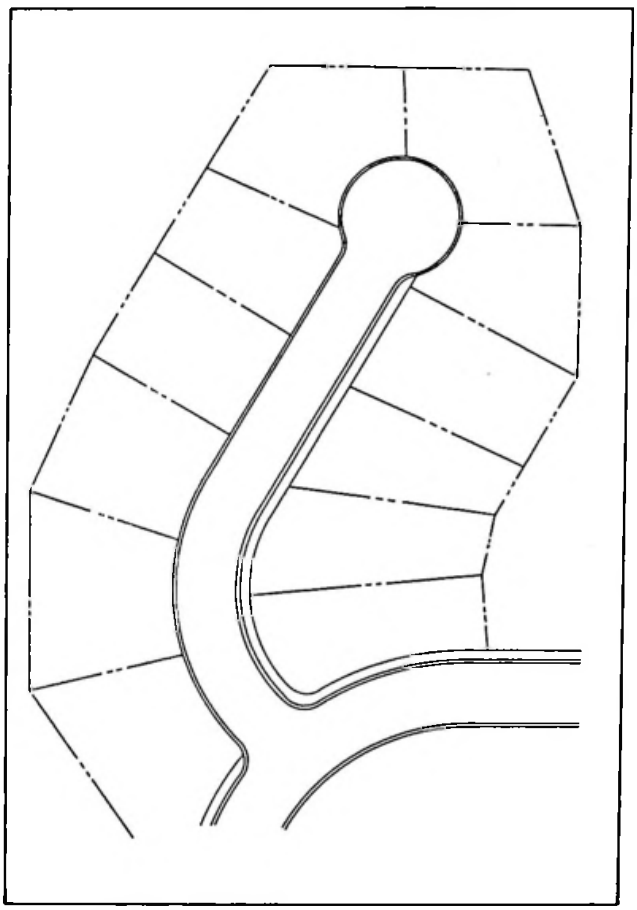
Local aggregates for the base layer are often available at lower cost than typical crushed stone bases. Such materials should be used when possible.

Intermediate Asphalt Applications and Surface Courses

Intermediate asphalt applications, usually a carry-over from highway construction practices, can be eliminated from most subdivision street designs. Because the major contribution to pavement stability is provided by the underlying base layer and subgrade, a single 1 1/2-inch to 2-inch surface course, depending on the size of the aggregate in the asphalt, is usually adequate.

Cul-de-sac and Deadend Streets

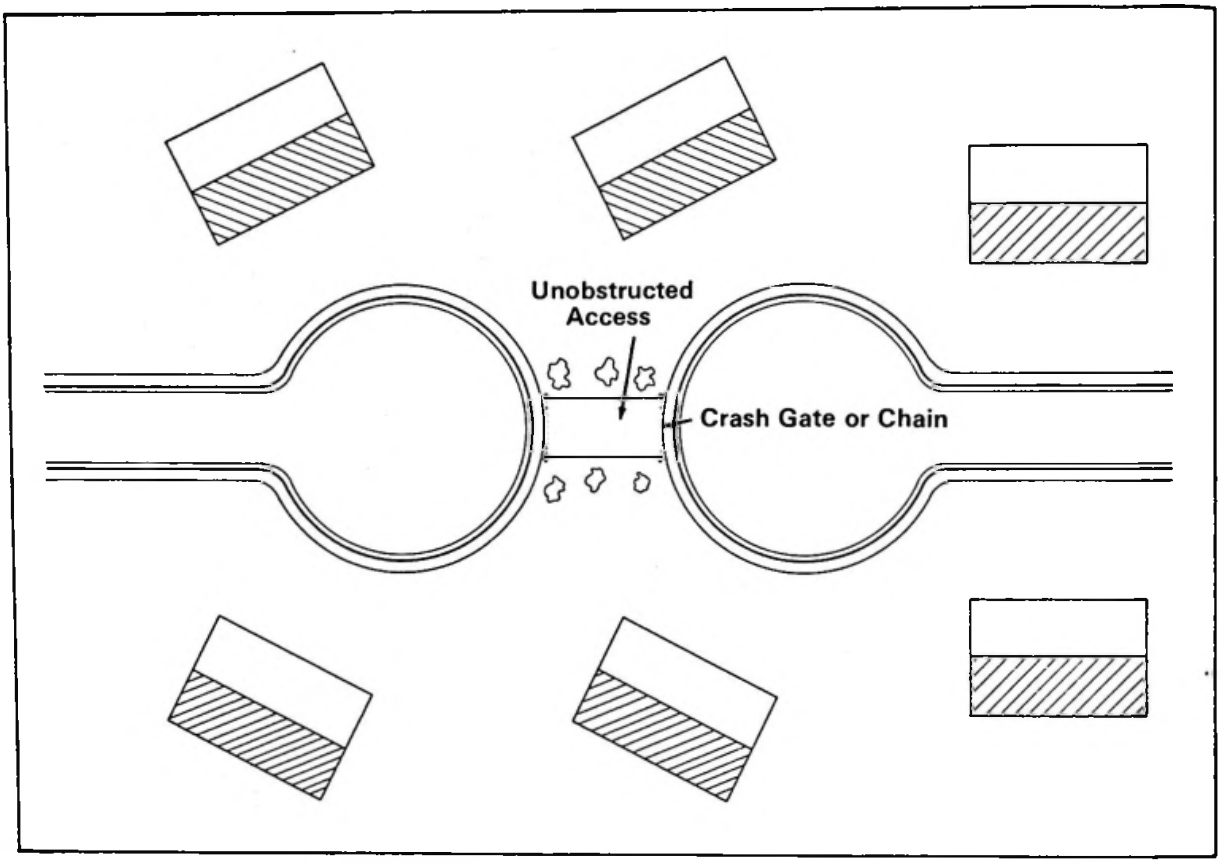
In addition to savings from adoption of functional construction criteria, other savings can be achieved through modification of certain features of layout and design.



Bulb shaped cul-de-sac

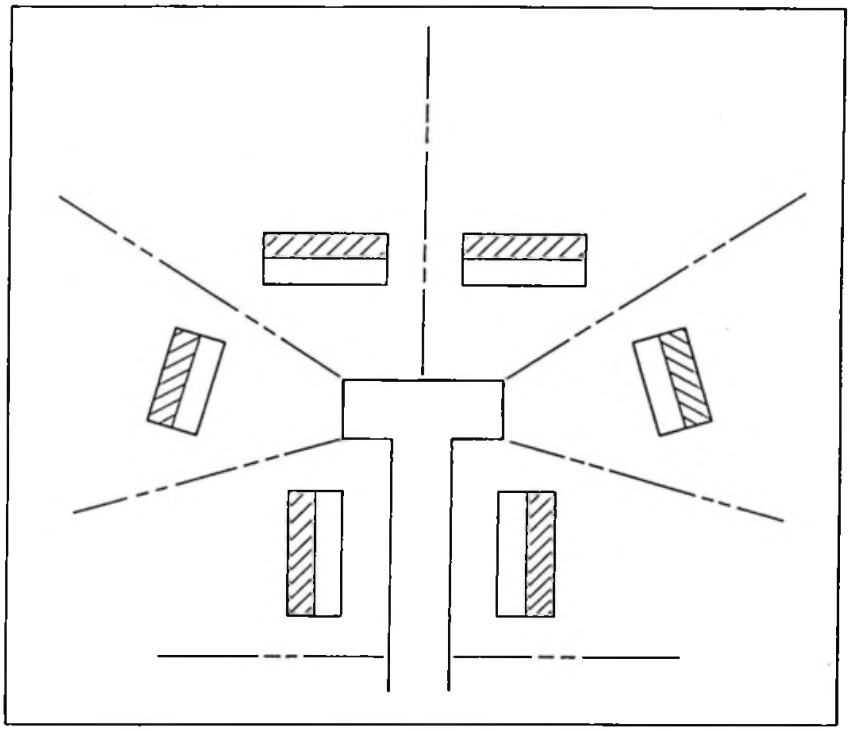
Alternative designs for the traditional large "bulb-shaped" cul-de-sac can be cost effective. Many communities require that cul-de-sacs have a radius of 50 to 60 feet. However, 35 to 40 foot cul-de-sacs are adequate in most residential settings.

Large cul-de-sacs are often adopted at the urging of fire officials to assure an adequate turning radius for fire-fighting equipment. In some instances, requirements of this type have been in effect for substantial periods of time and reflect the time when fire trucks did not have reverse gears. However, 50 feet significantly exceeds the turning radius of modern compact fire trucks. Communities with very large trucks should consider more compact equipment at replacement time, both for direct savings and for additional savings through the adoption of more economical street designs.



Cul-de-sac with emergency access

Cul-de-sacs and deadend streets can be laid out "back to back" with a short intervening space between them over which the municipality has an easement for use as emergency access. The concept of emergency access can also be applied to deadend streets that have been narrowed as a cost saving measure. Property owners should not be permitted to install any type of fencing, planting, or landscaping that would form a serious barrier to emergency vehicles.



Hammerhead or t-turnaround

Hammerheads, T-Turnarounds, Islands

Other cost-saving alternatives to the traditional bulb-shaped cul-de-sac include the hammerhead or T-turnaround, and islands. Both configurations require significantly less pavement than is required for bulb cul-de-sacs and a narrower right-of-way.

EXAMPLES FROM THE DEMONSTRATION PROJECTS

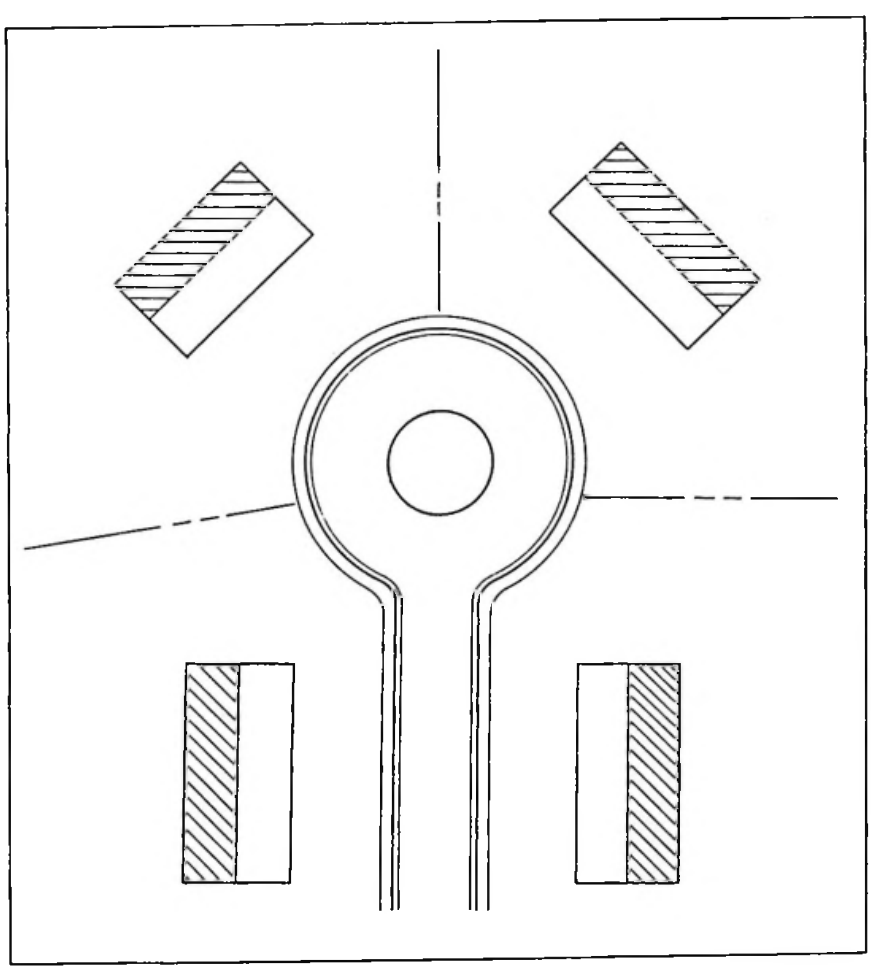
Knox County, Tennessee

At Woodpointe, the Knoxville/Knox County Planning Commission approved modifications in right-of-way, road width, and road construction requirements, as follows:

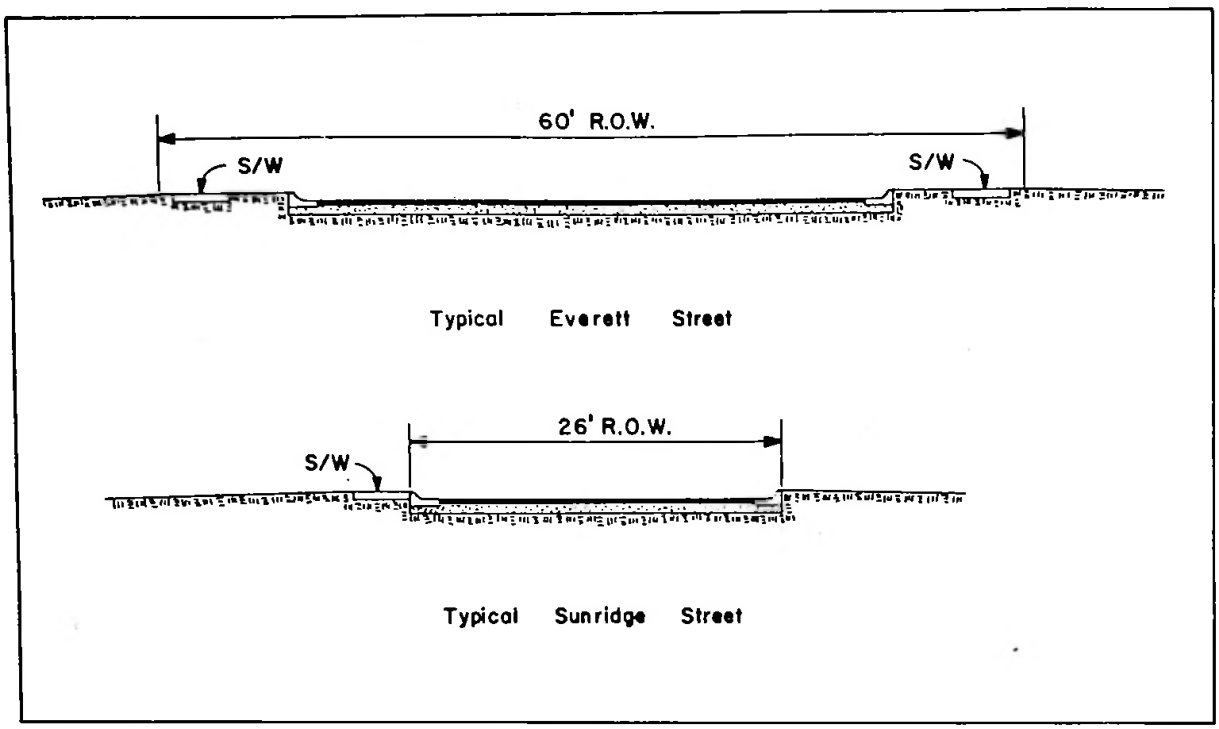
- The right-of-way width requirement was reduced from 50 feet to 35 feet on streets leading into cul-de-sacs, and from 50 feet to 30 feet on other streets.
- The street width requirement was reduced from 26 feet to 22 feet, with a further reduction to 20 feet on deadend streets where there was no possibility of future extension.
- The thickness requirement for the base layer of the roadway was reduced from 8 inches to 6 inches crushed stone, and the surface coarse was reduced from 2 inches to 1 1/4 inches.

Woodpointe employed two approaches to reducing the costs associated with traditional cul-de-sac construction. In the first approach, cul-de-sac radius was reduced from 40 feet to 30 feet resulting in savings of 2,199 square feet of pavement and buildable land, or nearly half an additional lot per cul-de-sac. In the second approach, cul-de-sacs were replaced by island turnarounds with a 16-foot pavement width surrounding a 14-foot diameter island.

Costs for clearing and grading were reduced $13,267 due to reduction in ROW widths. Total savings in street construction at Woodpointe amounted to $38,267, or $705 per lot.



Island turnaround



Comparison of right-of-way

Everett, Washington

At Sunridge, the city of Everett permitted 60-foot and 50-foot right-of-way requirements to be reduced to 26 feet and 24 feet respectively. The reduction from 60 feet to 26 feet increased the amount of available land by 3,400 square feet per 100 linear feet of street. Since the minimum lot size was 4,500 square feet, an additional lot could be gained for every 133 linear feet of 26-foot wide street.

Oklahoma City, Oklahoma

In Woodland Hills, streets are privately owned and maintained by a homeowners' association. In exchange for being relieved of street construction and maintenance cost, the city agreed to the following reductions in required widths for rights-of-way and streets:

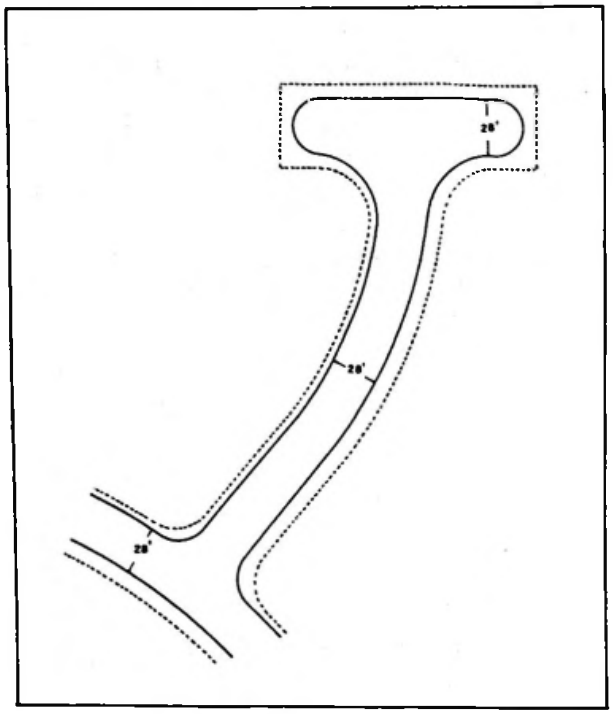
- *Collector loops*: Rights-of-way were reduced from 60 feet to 40 feet, and street widths were reduced from 32 feet to 24 feet.
- *Side streets*: Rights-of-way were reduced from 50 feet to 30 feet, and street widths were reduced from 26 feet to 18 feet.

The reduction in right-of-way requirements added three acres of available land for building. An additional 29 lots were created from this design.

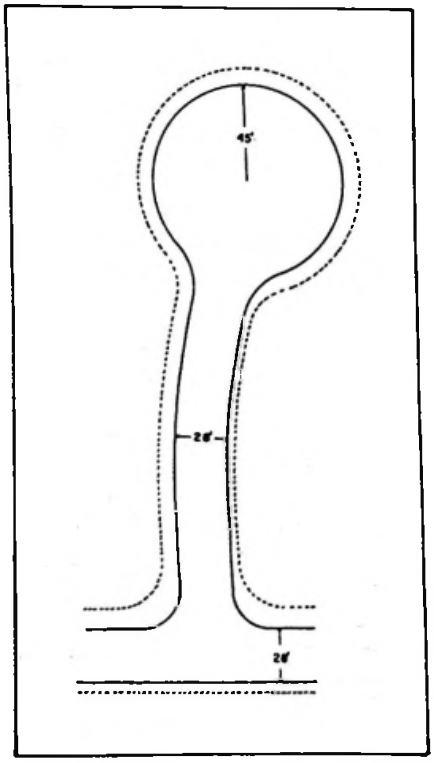
Lacey, Washington

Standard street construction in Lacey involves a 6-inch subbase layer, a 2-inch crushed stone layer, and a 2-inch asphalt surface. Phillips Homes conducted soil bearing tests throughout the site of The Park. On the basis of the results of these tests and analysis of anticipated traffic, the city agreed to street construction that involved only 2 inches of crushed stone and a 2-inch asphalt surface. A cross section comparison of the standard Lacey street and streets in The Park, is shown earlier. Elimination of the 6-inch subbase layer saved $74,820, or $425 per unit.

Boise, Idaho



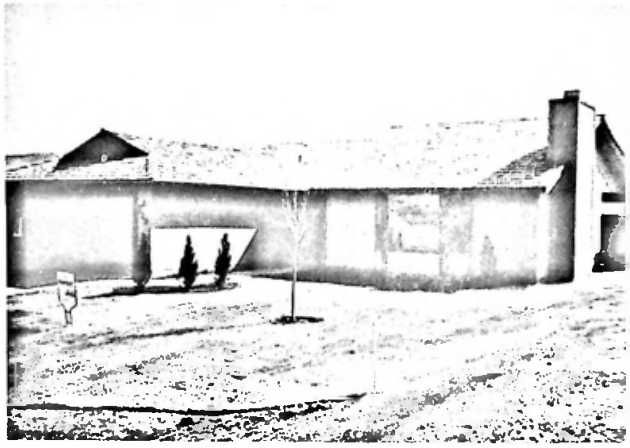
Lakeview Meadow turnaround



Boise cul-de-sac

At Lakeview Meadow, the city of Boise permitted installation of 28-foot wide T-turnarounds in place of three 90-foot diameter cul-de-sacs. This saved 8,586 square feet of paving.

After construction was completed, tests of ingress and egress by city fire trucks were conducted. The equipment performed in the T-turnarounds to the satisfaction of the city's fire officials.



Pavement width was also reduced in: *Phoenix, Arizona; Santa Fe, New Mexico; Portland, Oregon; Christian County, Kentucky; Crittenden County, Arkansas; Lincoln, Nebraska; Sioux Falls, South Dakota; White Marsh, Maryland;* and *Greensboro, North Carolina.*

Rights-of-way were reduced in *Charlotte* and *Greensboro, North Carolina.*

PARKING

Automobile parking poses a significant land use problem in subdivision planning. In the recent past, common practice provided for wide local streets, often capable of accommodating a row of parked cars on each side in addition to two lanes of moving traffic. Such parking space has often been provided where there are also private driveways and other off-street parking that can accommodate several cars. Good planning can reduce this heavy commitment of land to parking without sacrificing adequate accommodation of vehicles.

Following are guidelines for parking:

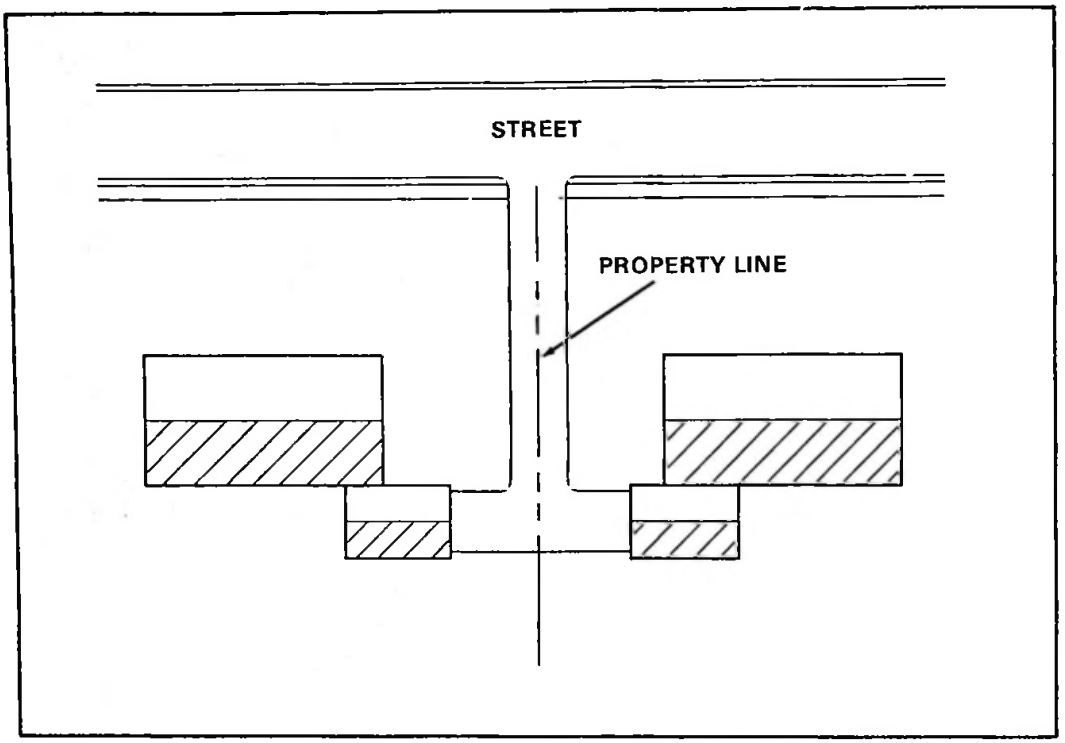
- Provide off-street parking areas whenever possible.
- Use common driveways.
- Design paving thickness to meet actual parking load requirements rather than to general standards.
- Eliminate curbs and gutters in parking areas.
- If curbs must be built, use roll curbs or other alternatives to standard requirements.
- If street parking must be used, limit such parking to one side of the street.
- Use unpaved shoulders for parking to reduce road pavement width.
- Consider traditionally unused space, such as in a cul-de-sac or court, for parking.

Off-Street Parking

Common off-street parking

Reduction of street width reduces both the direct costs of street construction and maintenance, and the indirect cost of unnecessary land use. Elimination of one or both parking lanes along as many streets as possible through off-street parking makes a major contribution to the achievement of these savings.

Off-street parking can be accommodated by various types of common parking areas. Townhouses or clusters lend themselves well to these solutions.



Common driveway serving two homes

Detached units can often share a driveway, eliminating additional curb cuts and their associated costs. The necessary width of a common driveway may vary according to the number of units being served, but should generally be no wider than the usual width of a single driveway.

Construction

Two significant variables in the construction cost of parking areas are pavement thickness and requirements for curbs and gutters. Although local requirements for pavement design and curb and gutter construction usually do not apply to private driveways, many do apply to common parking areas.

Pavement Design

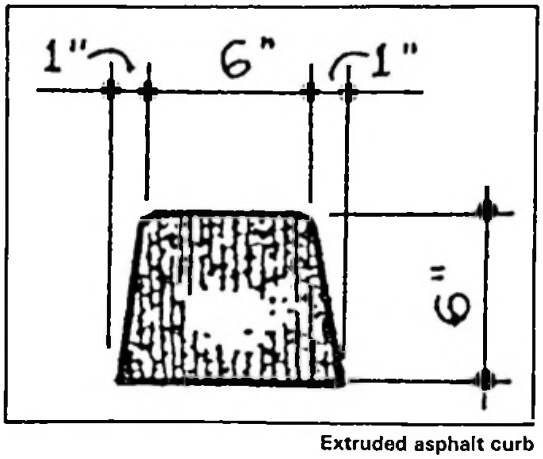
Pavement thickness should be based on anticipated usage, both with regard to volume and to loadings. Standards that apply to roads and highways are rarely appropriate for residential parking areas.

Typical community standards for residential parking areas specify a minimum base of 4 to 6 inches. However, a 2-inch base of crushed stone is frequently adequate. As is discussed in the section on Streets, the nature and condition of the subsoil must be considered.

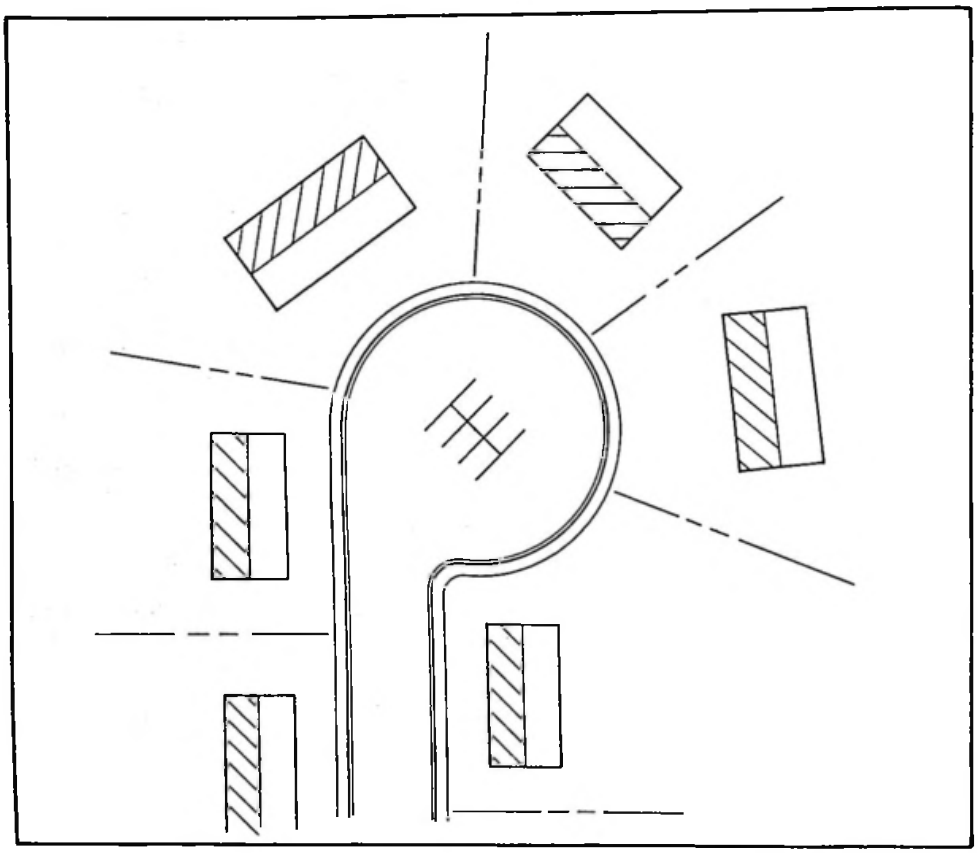
Another factor is the question of whether the parking area will be used by heavy vehicles, notably trash trucks. Placement of trash dumpsters and routes for heavier vehicles can be planned to minimize the amount of pavement that such vehicles will traverse, and that must be strengthened to accommodate them.

Curbs and Gutters

Curbs and gutters can be eliminated in parking areas; stormwater can be diverted and drained off by sheet flows and swales. Where curb and gutter requirements exist, relatively inexpensive approaches such as roll curbs, extruded asphalt curbs, wheel stops, and integral curbs and sidewalks can be considered in place of more costly approaches. More detailed information is provided in the sections on Curbs and Gutters, and Stormwater Drainage.



Extruded asphalt curb



Parking in cul-de-sac

On-Street Parking

Where it is not practical to accommodate part or all of residential parking by off-street facilities, the street must be used. However, the need for street parking must be evaluated on an individual basis. Consideration should be given to confining such parking to one side or to parking on road shoulders, reducing street pavement width.

The center of a court or bulb cul-de-sac can accommodate additional parking without increasing street dimensions. A quick and relatively simple method is to "stripe" or paint additional parking spaces in the center of the bulb.

EXAMPLES FROM THE DEMONSTRATION PROJECTS

Lacey, Washington

Typical parking areas in Lacey are built on a 6-inch subbase and a 2-inch crushed stone base. After conducting soil-bearing tests, the developer of The Park requested and received approval to construct parking areas with a 2-inch crushed stone base and a 2-inch asphalt cover.

Lacey standards also require concrete wheel stops to be located 2 feet in front of an asphalt curb. At The Park, the city approved use of wheel stops without curbs, thereby eliminating the need for 4,936 linear feet of curbing.

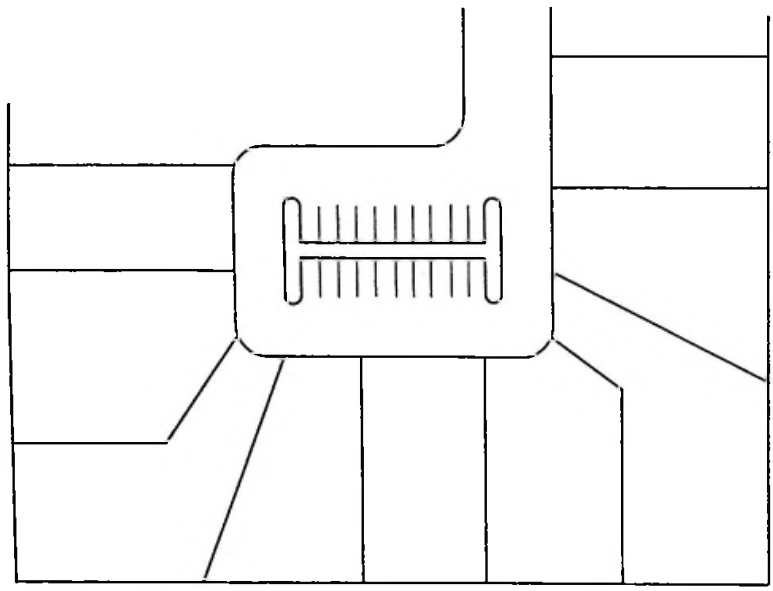
These modifications resulted in cost savings of $38,000, or $215 per unit.

Portland, Oregon

Black Bull Enterprises, builder/developer of North Meadow Village, received permission to install parking bays along streets in lieu of driveways, thereby saving land that would have been required for full driveways.

Charlotte, North Carolina

At Lynton Place, the John Crosland Company revised their original cul-de-sac plans to provide off-street visitor parking in the center of the paved area.



Parking in cul-de-sac

White Marsh, Maryland

The developer of Lawrence Hill clustered homes in groups of four or five with common off-street parking provided for each cluster. This not only reduced the parking load on the street, but also enhanced the development's aesthetics, provided large rear yards, and enabled existing trees to be saved.

SIDEWALKS AND WALKWAYS

Many local zoning ordinances and construction standards specify that sidewalks be built on both sides of residential streets. These requirements were developed during an era of lower land values and lower construction costs, and should be reviewed in the context of today's higher costs.

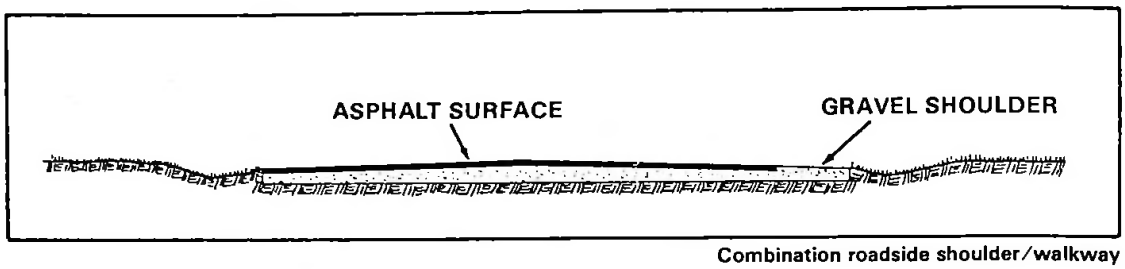
Following are guidelines for sidewalks and walkways:

- Construct sidewalks on one side rather than both sides of local streets, and consider elimination altogether on lightly traveled streets.
- Eliminate sidewalks around deadend streets and cul-de-sacs.
- Minimize placing homes facing collector and higher-order streets, thereby reducing or eliminating the need for sidewalks on these streets.
- Replace infrequently used sidewalks on streets with pathways between groups of residences, bus stops, stores, playgrounds, and other community facilities.
- If sidewalks are necessary, limit their width to three feet.
- Consider using sidewalks integral with curbs.

Sidewalks in Residential Areas

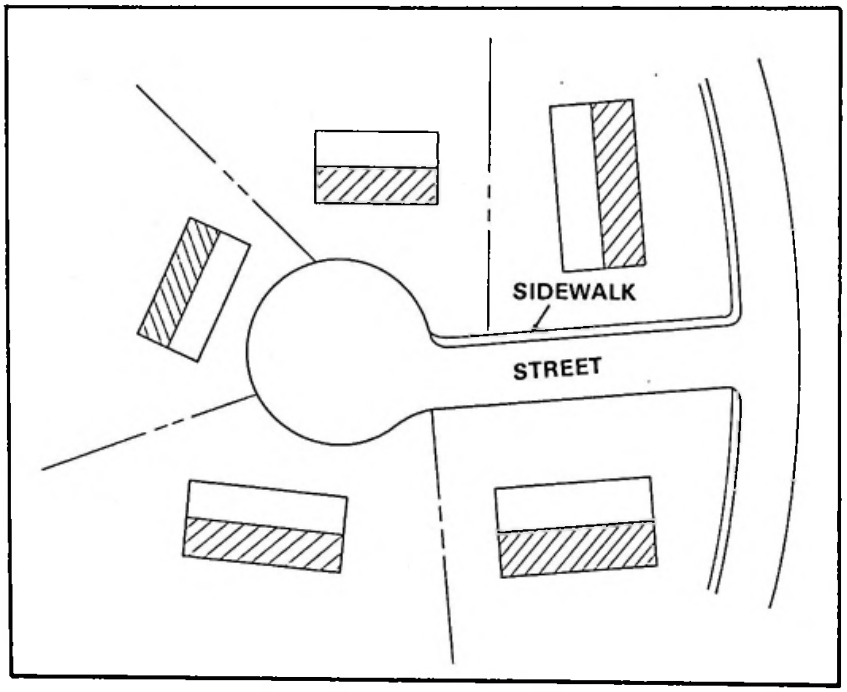
Local governments, builders, and home buyers all benefit from cost savings that can be achieved in sidewalk construction. Builders and home buyers save through lower construction costs. Local governments save through reductions in maintenance and replacement.

An increasing number of communities have dropped requirements for sidewalks in residential communities from their standards. Streets in these areas generate insignificant amounts of pedestrian traffic and a low volume of vehicular traffic moving at slow speeds. A properly graded shoulder, or the roadway itself, can provide a suitable pedestrian pathway.



Combination roadside shoulder/walkway

For the same reasons, sidewalks can also be eliminated around deadends and cul-de-sacs.



Sidewalk on one side only

On higher-order local streets and collector streets, safety is often cited as the rationale for building sidewalks on both sides of the street. However, in the majority of these cases, a single sidewalk will suffice. Situations

in which a single sidewalk will generate substantial street-crossing activity by pedestrians can be individually evaluated.

Single sidewalk along higher-order street

Sidewalks along higher-order streets can be eliminated completely by reducing the number of residences which face such streets. Pedestrians will then use the local streets on which homes are situated.

In planning for sidewalks, and also for pathways as discussed below, consideration should be given to likely pedestrian destinations. These include such places as bus stops, playgrounds, and convenience stores. Accommodation of significant foot traffic along standard walking routes is more important than accommodation of occasional and casual traffic between and among homes.

Pathways and Walkways

Pathways and walkways offer an alternative to sidewalks that is cost effective and eliminates safety hazards to pedestrians that might arise from passing vehicles. This consideration can be prominent in planning the layout of subdivisions.

Such planning can provide for concrete walks, asphalt paths, or gravel paths between and among strategic locations. Walking access can be established between groups of residences and such facilities as parks,

Pathways often eliminate need for sidewalks

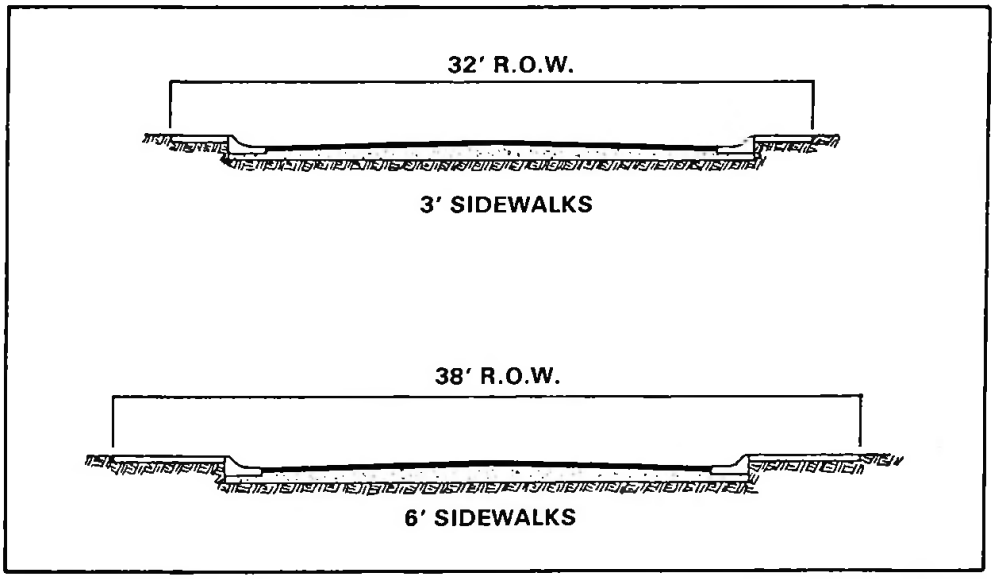
community centers, and shopping centers. The paths and walkways can pass over easements that constitute part of the total subdivision plan. Townhouse and cluster developments lend themselves well to this type of integrated planning.

Dimensions and Construction

The width of sidewalks has a direct impact on construction cost, and, often, an indirect effect through its influence on right-of-way width.

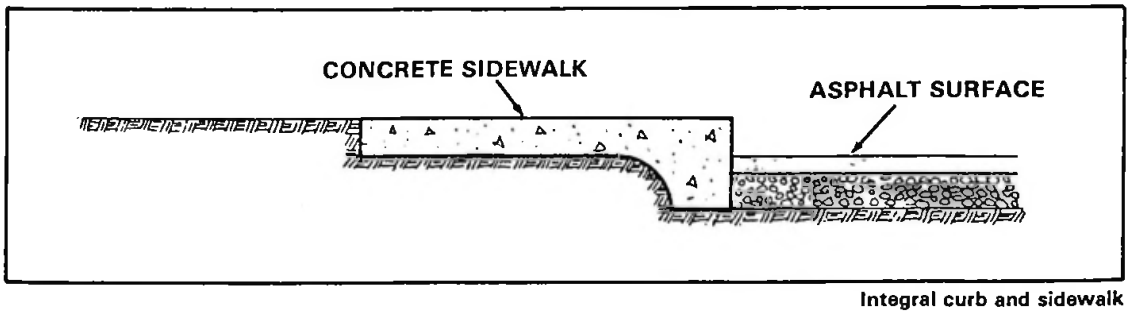
Many communities specify sidewalk widths as great as 5 to 7 feet. Actually, 3 feet is a reasonable width for pedestrian travel in residential areas. On these lightly-used walkways, the fact that a pedestrian may occasionally step off the sidewalk to let another pass, does not justify the cost of greater width.

In the illustration, a 3-foot and 6-foot sidewalk are compared. It should be noted that, in addition to a 50 percent reduction in the quantity of materials required, the 3-foot sidewalk reduces the required right-of-way or easement by 6 feet.



Three-foot and 6-foot sidewalk

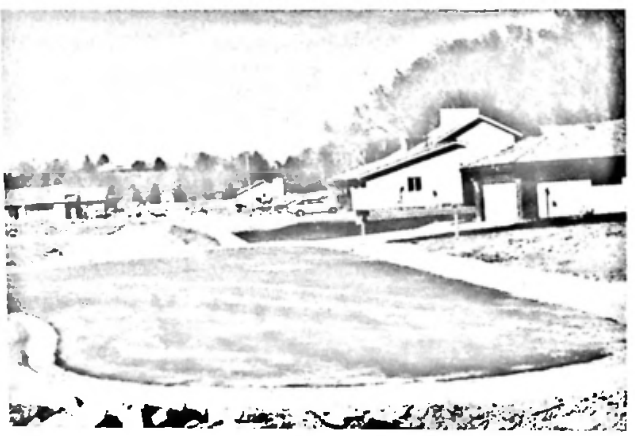
An integral curb and sidewalk combines two separate processes into a single step. One edge of the sidewalk is "thickened" and its side doubles as a curb.



Integral curb and sidewalk

EXAMPLES FROM THE DEMONSTRATION PROJECTS

Boise, Idaho



Typical Boise streets have sidewalks on both sides. At Lakewood Meadows, the city permitted elimination of sidewalks on one side of the subdivision's streets and around T-turnarounds. One higher-order collector street was required to have sidewalks on both sides, but a sidewalk on one side only was allowed for a high-volume arterial street. Walkways were provided in common areas and between T-turnarounds.

The builder estimated that 2,696 additional linear feet of sidewalk would have been required to comply with existing Boise standards. Construction costs were decreased by $8,088, a per-unit reduction of $216.

Lincoln, Nebraska

Existing Lincoln standards call for 4-foot wide sidewalks on both sides of all residential streets. At Parkside Village, the city permitted Empire Homes to install 3-foot wide sidewalks on one side of the street only. Cost savings were $4,289, or $191 per unit.

Christian County, Kentucky

County standards call for sidewalks on both sides of residential streets. At the Hermitage Hill affordable housing project, this requirement was waived altogether, and no sidewalks were installed. Savings were $40,348, or $558 for each of the 73 units.

Crittenden County, Arkansas

Rex Rogers, in Harvard Yard, used an 8-foot concrete swale on one side of the street and graded the street so stormwater was channeled to that side. The swale is only slightly angled and doubles as a sidewalk.

Other demonstration sites which eliminated sidewalks altogether or used them on only one side, contrary to normal local practice, include: *Charlotte, North Carolina; Phoenix, Arizona; Tulsa, Oklahoma; Santa Fe, New Mexico; Lacey, Washington;* and *White Marsh, Maryland.*

Pedestrian pathways or meandering walkway systems are used in *Phoenix, Arizona* and *Portland, Oregon.*

CURBS AND GUTTERS

Curbs and gutters convey rainfall into storm drainage systems, which are discussed in the next section. There are, however, less costly alternatives to the traditional vertical curb and gutter construction.

Following are guidelines for curbs and gutters:

- Substitute grassy swales for curbs and gutters.
- Where curbs are installed, build rolled curbs rather than traditional vertical curbs.
- Reduce the width of concrete gutters or eliminate them entirely.
- Eliminate reverse-flow curbs and gutters in parking lots, or replace them with asphalt curb, header curb, wheel stops, or integral curb/sidewalks.
- With concrete vertical curbs, use extruded construction rather than formwork.

Grassy Swales

Typical roadside swale

Grassy swales are depressed areas running parallel to the street that serve in lieu of curbs and gutters to convey stormwater. The grading required to construct a swale can be completed during the grading of the surrounding lots or during final street grading. Therefore, cost savings are approximately equivalent to the cost of installing a curb and gutter.

In addition to providing savings in initial construction, swales offer continued savings in the form of lower long-term maintenance. Periodic flushing, replacement, or rehabilitation of pipes is eliminated. Swales within the public right-of-way are typically maintained by the home owner. Most swales can be graded to insure easy mowing.

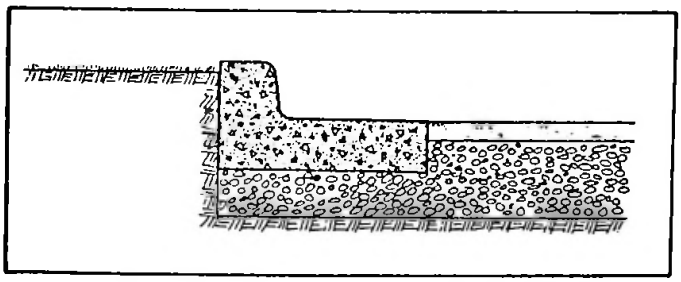
Where runoff can be accommodated by a shallow swale, the depressions can be carried directly across driveways. Where a deeper depression is required for greater runoff capacity, concrete or metal conduits can be installed under driveways. At street intersections, stormwater pipe can be installed under the street.

In addition to providing cost savings, swales allow for local retention of moisture from rainfall and melting snow. This is discussed in greater detail in the next section.

Types of Curbs

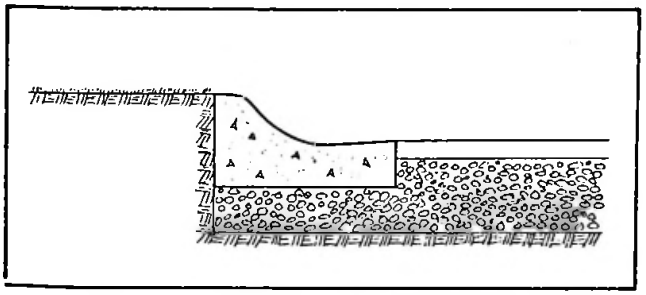
The most common type curb in urban residential settings is the vertical combination curb and gutter.

A less costly alternative is the ***rolled curb***, also called the rollover, roll, or mountable curb. Rolled curbs are typically 6 inches or less in height with a plane sloping face or well-rounded corners with a 2-inch to 3-inch radius which allow vehicles to cross them with varying degrees of ease. They can be sized to meet local hydraulic demands; the slope across the face of the gutter and the height of the curb can be designed to meet the projected capacity.



Vertical curb and gutter

In many instances, curbs are installed before the type of house to be constructed or a lot is selected, and before driveway placement is decided. Therefore, it is usually necessary to remove the vertical curb, install a curb cut for the driveway, and haul away the old curb. With a rolled curb this is not necessary, saving approximately *$300 to $450* per housing unit in the affordable housing demonstrations.



Mountable or rolled curb

However, if vertical curb is chosen, good planning can reduce the added cost of removing any curb. A simple method gaining in popularity is to leave a space for the driveway and pour a separate entrance later. If possible, the driveway entrance should be installed during construction of the adjacent sidewalk to avoid added labor costs.

Gutters

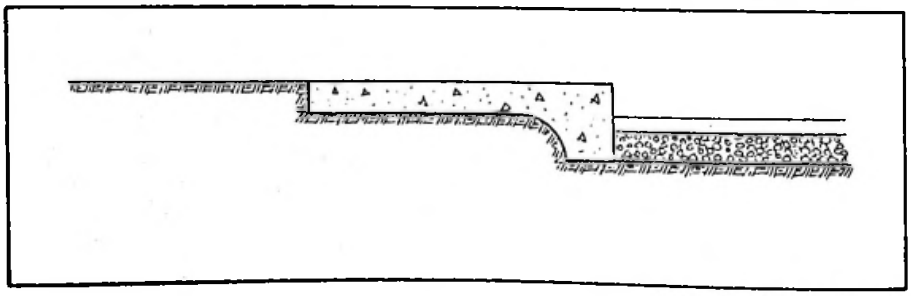
Concrete gutters, 18 inches to 24 inches wide, are a standard requirement in many development specifications. In most areas, a 12-inch gutter is sufficient, while in more arid regions, gutters can be eliminated entirely by simply extending the asphalt surface to the shoulder or curb. Local weather data should be reviewed, and gutters reduced in size or eliminated where rainfall rates warrant.

Curbs in Off-Street Parking

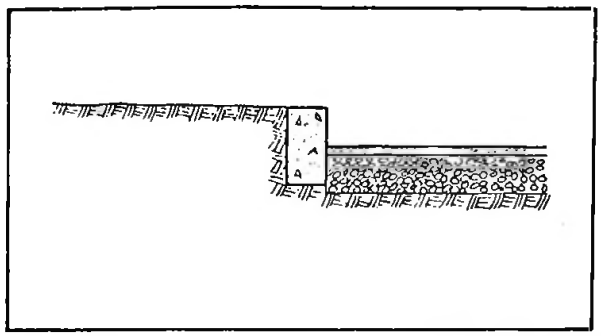
Alternatives to vertical curbs in off-street parking include:

- elimination of curbs and gutters
- header curbs
- asphalt curb construction
- integral curb and sidewalk
- wheel stops

Combination curb and gutter can be eliminated in many parking lots by encouraging the use of sheet flows.



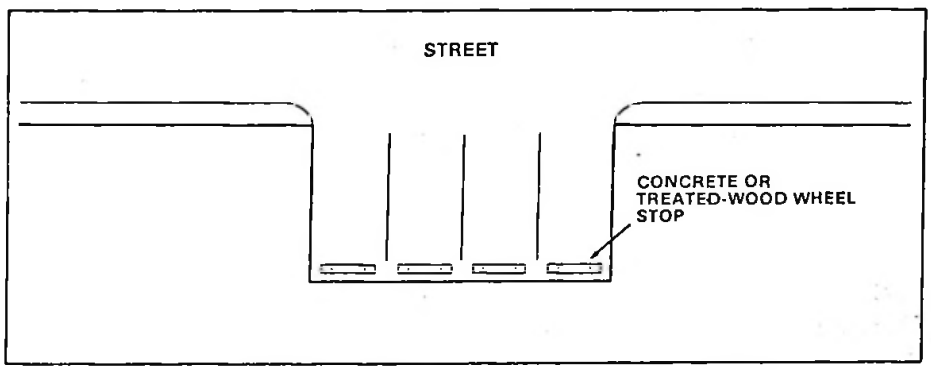
Integral curb and sidewalk



Header curb

Much of the curb line in parking areas generally consists of reverse flow gutters -- that is, gutters that do not convey water as a conventional gutter does, but simply divert water away from the curb. This can usually be accomplished without a curb by proper grading of the parking lot surface.

Where curbs are required or chosen, they can often be replaced with header curbs, asphalt curbs, or integral curb and sidewalk, especially in cases where a gutter is not warranted.



Wheel stops in parking bays

Wheel stops are a less expensive alternative to curbs that keep intact the psychological barrier provided by curbs.

Construction Methods

Installation of curbs and gutters traditionally required labor-intensive formwork and preparation. Such construction methods have increasingly been replaced by extrusion or "slip form" techniques in which the operator, following a string line with a machine, "lays" the concrete out in its final form. This technique can be used to construct either a traditional curb or alternative types of rolled curbs. In areas where traditional formwork is still done, builders should check the availability of labor-saving alternatives.

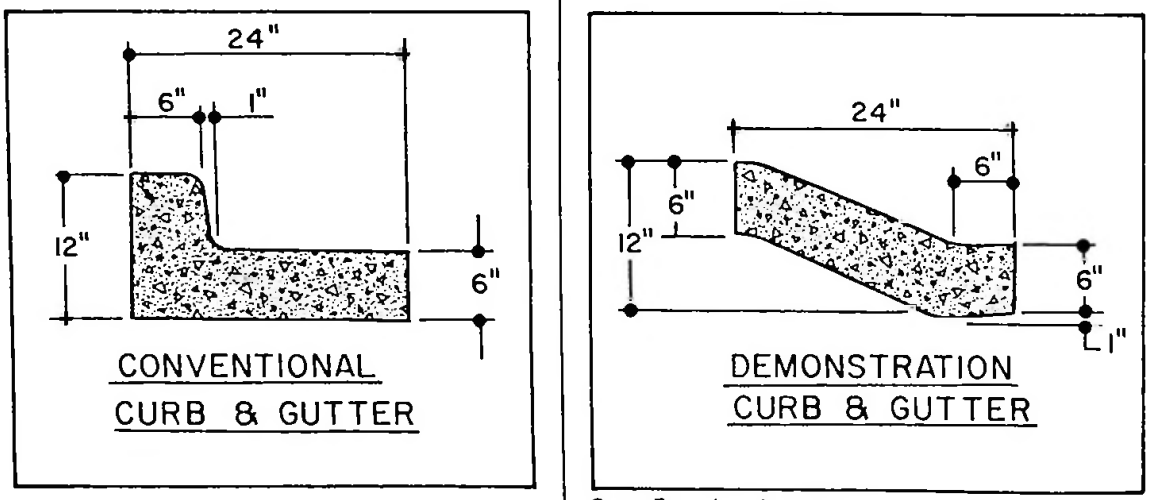
EXAMPLES FROM THE DEMONSTRATION PROJECTS

Boise, Idaho

The city permitted construction of rolled curbs as a substitute for 6-inch curbs along the residential streets of the Lakewood Meadows development. A total of 3,720 feet of rolled curb was installed at a cost of $16,740. Traditional vertical curbs were required along one collector street; 1,063 linear feet at a cost of $6,112. The rolled curb saved $1.25 per foot or $146 per housing unit.

Santa Fe, New Mexico

In Fairway Village, the city permitted substitution of a rolled curb for a 6-inch vertical curb. The rolled curb cost $2.00 per foot less to install. Savings were $10,368 or $477 per unit.



Santa Fe curb and gutter vs Fairway Village curb and gutter

Elkhart County, Indiana

Elkhart County approved the elimination of curbs and gutters, and substitution of a system of drainage swales. The cost of typical Elkhart streets, including curbs and gutters, averaged $32 per foot. The curbless demonstration project streets averaged $21 per foot. A total of $330 was saved on each 60-foot wide demonstration lot.

Other affordable housing demonstration projects using rolled curbs instead of the typical vertical curbs include: *Tulsa, Oklahoma; Oklahoma City, Oklahoma; Birmingham, Alabama; White Marsh, Maryland;* and *Sioux Falls, South Dakota.*

Demonstrations in *Christian County, Kentucky; Mesa County, Colorado; Greensboro, North Carolina;* and *Lacey, Washington* eliminated curbs and gutters.

STORM DRAINAGE SYSTEMS

Gutters, which are discussed in the previous section, are just one component of the complete storm drainage system. However, important economies can be achieved in the construction of entire storm drainage systems.

Following are guidelines for storm drainage systems:

- Use performance requirements in place of prescriptive standards in all components of storm drainage design.
- Consider detention/retention basins, especially when regional management is preferred.
- Use less expensive alternatives to corrugated metal and concrete pipe.
- Consider precast structures if available from local suppliers.
- Reduce the use of manholes and inlets by increasing spacings between structures, or by replacing them with curved pipe sections, tees, and wyes where appropriate.

Traditional stormwater systems were usually "closed": that is, once water entered the system, it passed through nonporous pipes and channels, sometimes for substantial distances, until it was finally discharged into a moving stream or river. More recently, the undesirability of removing a significant portion of runoff from local areas where precipitation falls has become increasingly clear. Consequences can include: inadequate recharge of groundwater supplies; increased potential for contamination of groundwater; soil subsidence, such as the formation of sinkholes that occurred in central Florida; and downstream flooding.

Modern systems increasingly emphasize retention of rainfall in the local area where it falls. Parts of the conveyance system can be left "open," substituting grassy swales and natural drainage for closed piping. Detention and/or retention basins can also accommodate excess stormwater, enabling the gradual recharge of local groundwater supplies.

Open portions of drainage systems cost less than equivalent closed piping. Environmental considerations and cost savings therefore go hand in hand. Additional savings can be achieved through regional stormwater management serving the entire drainage basin or several specific sites within a basin. Regional control of stormwater generally requires less construction by developers, and the local jurisdiction achieves savings in operational and management costs. Improved efficiency is another benefit over individual site controls, since the need for "piecemeal" planning can be reduced.

Design Storm Requirement

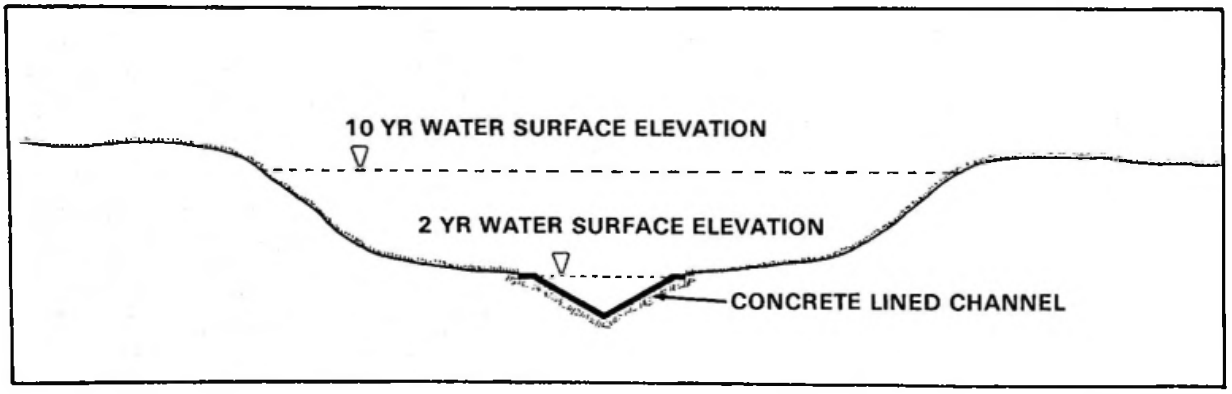
A ten-year design storm is the typical standard for the "minor" stormwater system in a residential development. However, major channels or culverts with large contributing areas require special consideration. Design storm frequency is based on convenience and economics. A community decides how much to pay to insure against the possibility of flooding. The merits of each proposed site plan must be considered, since each site adapts differently to various designs. Performance requirements, which generally encourage innovative and less costly alternatives, should be used over prescription standards.

Detention/Retention

Two effective methods for carrying excessive stormwater use detention and/or retention basins and "overland relief." Retention/detention facilities can take a variety of forms. Manmade lakes and subsurface absorption are two of the more popular systems. Although each has its own pros and cons, both achieve the intended objective of effective stormwater management. Lakes contribute to aesthetic value but require more land area. Soil absorption systems can be installed on "tighter" sites but are limited to the capacity of the soil.

Overland Relief

Culverts and open concrete channels can be reduced in size by grading the surrounding land to direct stormwater on an overland path to the stormwater system downstream if the design storm is exceeded. Grassy swales provide overland relief in a residential neighborhood. Larger "flood banks" are used in major drainage areas.



Overland relief

Materials

In recent years, less expensive, more durable plastics have begun to replace traditional corrugated metal pipe (CMP) and reinforced concrete pipe (RCP). Polyvinyl chloride (PVC) and polybutylene (PB), both exhibit excellent resistance to corrosion and are currently used for stormwater pipe.

PVC, a relatively inexpensive plastic, can be installed throughout most of the "minor" storm drainage system. PB is manufactured in sizes small enough for water supply systems, large enough for highway culverts, and in most sizes in between, usually in a corrugated configuration to provide the appropriate structural qualities. Due to their relatively light weight, PVC and PB pipe do not generally require special equipment for placement in the trench.

Stormwater Structures

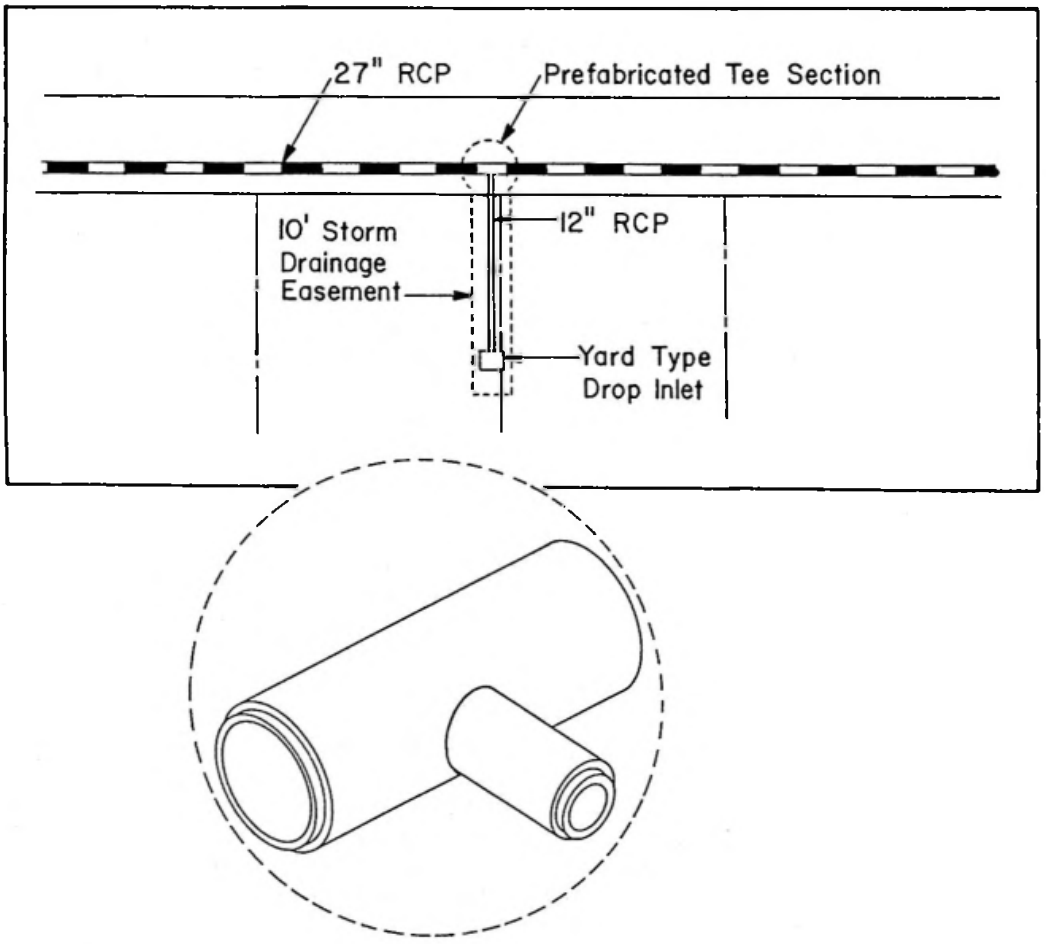
Components of a sewer system -- manholes, sewers, inlet and outlet structures -- must be examined for possible cost savings in installation methods, choice of materials, and use of new designs. Where available, precast manholes and inlets generally provide a less costly alternative to labor intensive, site-built structures.

Manholes/Inlets

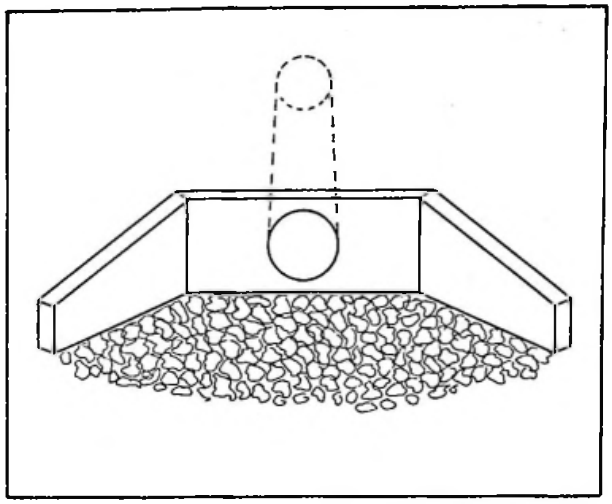
An average of $1,000 to $1,500 can be saved by eliminating a single manhole, depending on depth and local cost factors. Although many communities allow manholes or inlets to be spaced a maximum of 600 to 800 feet apart, some standards limit maximum spacings to as little as 200 feet. These shorter spacings are carry-overs from an era when clean-out capabilities and construction techniques were inferior to those today. Officials must periodically review such standards to encourage state-of-the-art construction.

Manholes can also be eliminated by installing a curved section of pipe at nonabrupt changes in direction. Many communities also recommend installing a cleanout or other access within 50 feet of a bend to clear possible obstructions. The need for such access is questionable, since there is little risk of stoppage in the curved storm sewer alignment.

Manholes can be eliminated where smaller pipes join larger storm "mains." For example, a prefabricated tee or wye section can join a building roof drain (downspout) with the public storm drain, thereby avoiding the added cost of a manhole.



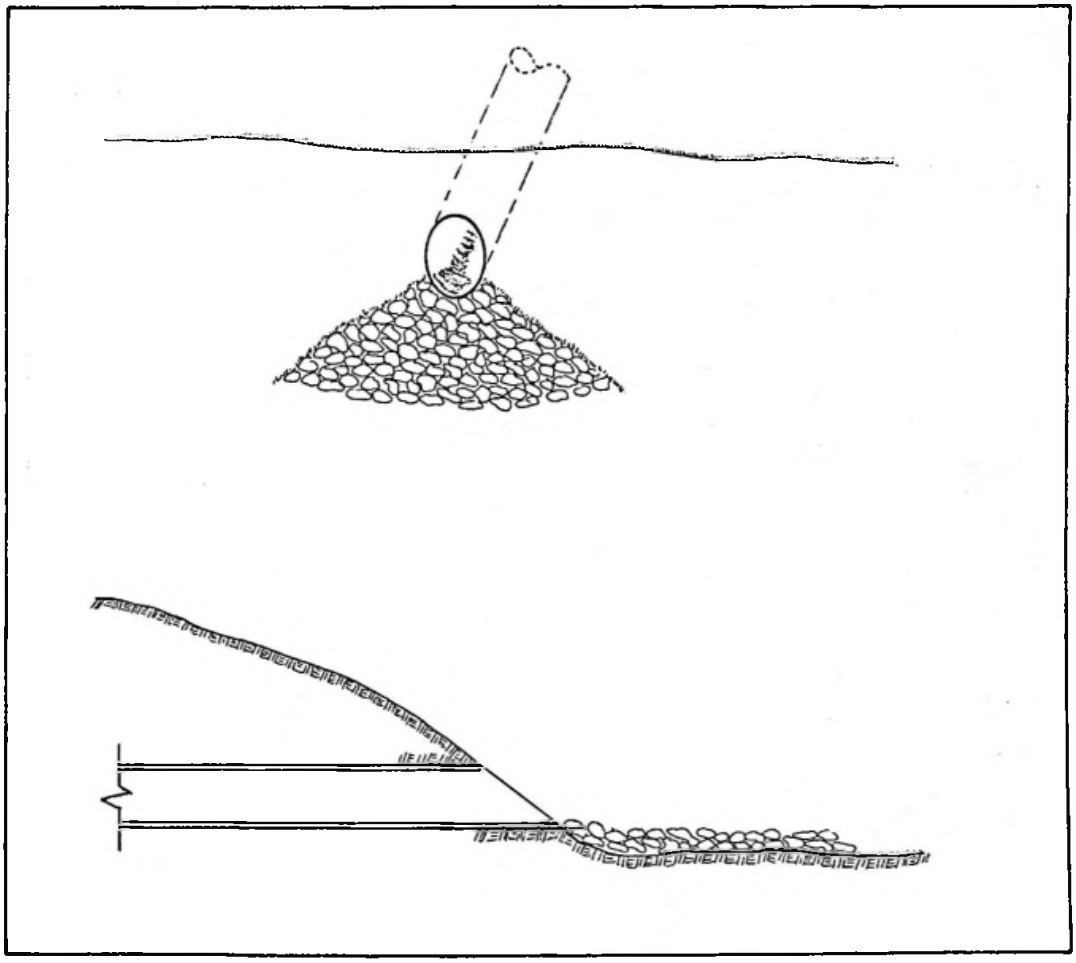
Prefabricated tee section



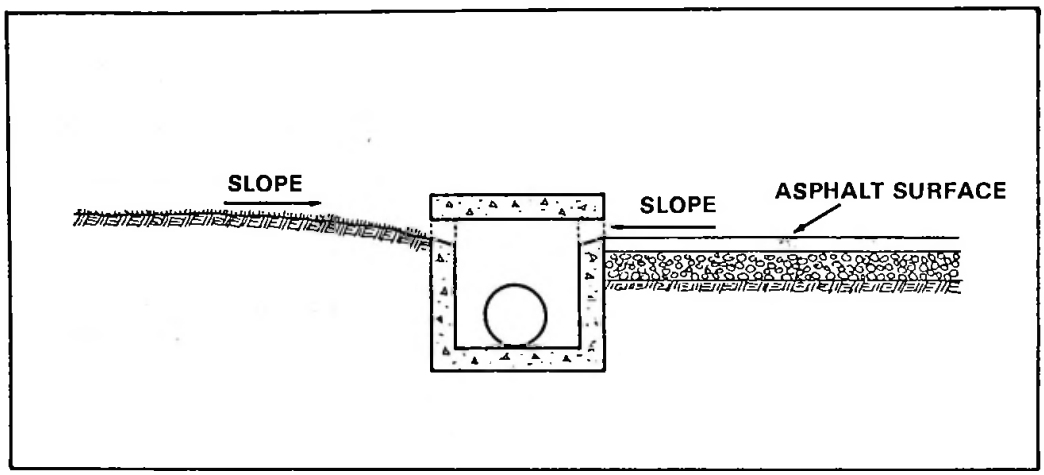
Concrete endwall at pipe outlet

Endwalls, commonly installed at the end of a drainage pipe, can also be eliminated. With proper grading at the terminal end of the pipe, a flared end section will provide the needed transition at a much lower cost than an endwall.

Multiple use of drainage structures should be encouraged when possible. A yard inlet, combined with a curb type inlet, can achieve greater efficiency at less cost, receiving runoff from two or more directions.



Flared end section at pipe outlet



Combination curb / yard inlet

In some cases, inlet structures can be completely eliminated and replaced with flared end sections. If the surrounding area is graded properly, an end section can be used as an inlet in place of a drop type structure. Since the cost of an end section is similar to a standard section of pipe, overall savings would be equivalent to the cost of any eliminated inlet structure.

Inlet/Outlet Controls

Rip-rap, grouted stone, or other erosion controls can often be replaced with one of the commercially available fabrics designed for soil stabilization. The fabric is placed at the end of the channel or pipe after the area has been graded and seeded. Fabrics can be installed at less cost than concrete or stone erosion controls, and provide a more appealing site.

EXAMPLES FROM THE DEMONSTRATION PROJECTS

Lacey, Washington

The Park, developed and built by John Phillips, realized savings through changes in the storm drainage standards. The typical Lacey street is constructed with catch basins every 250 feet. Underground concrete pipes convey water from basins to a location off site. In addition, manholes are required at a spacing not to exceed 250 feet.

Phillips proposed a number of changes to Lacey standards. He received permission to replace curbs and gutters with a grassy swale along one side of the street and sloped the road surface toward the swale, a deviation from the typical crowned street. One catch basin drained into a retention pond, and another part of the site drained into an existing ditch.

Storm Water Drainage Cost Comparison

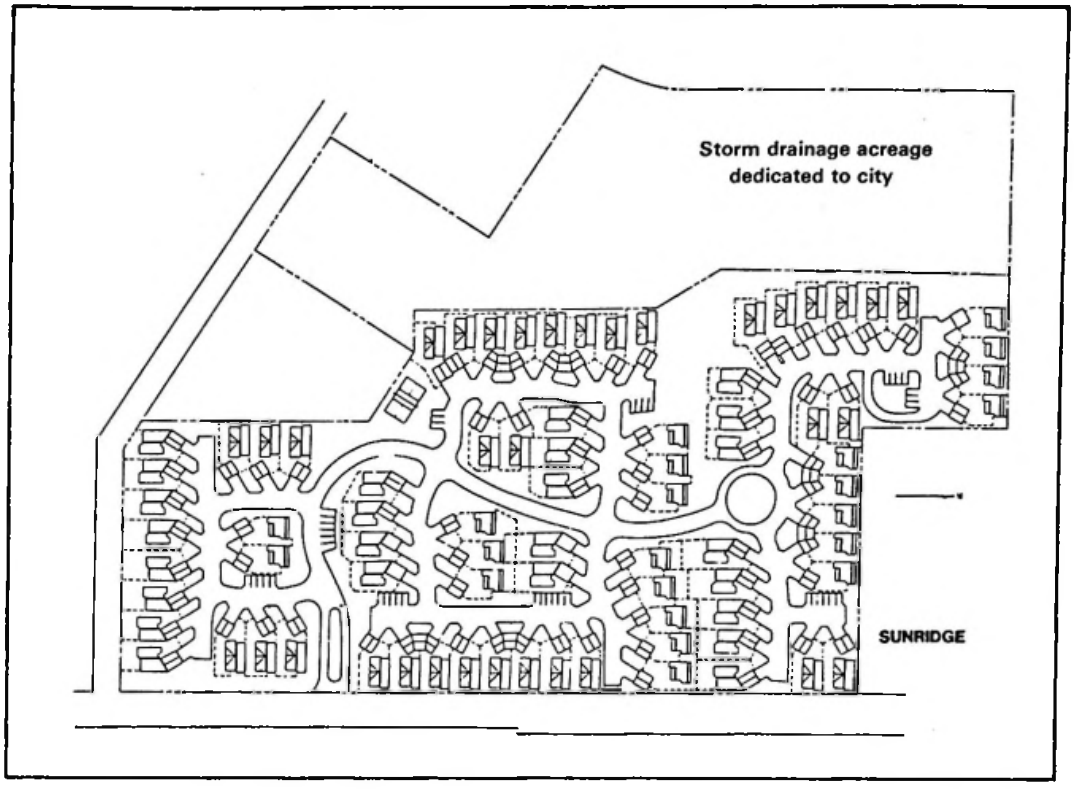
	Demonstration	Comparison	Savings
Grading	$40,000	$ 40,000	$ -0-
Type I catch basin	475	5,700	5,225
Pipe and tubing			
- 18" Concrete culvert	2,989	4,788	
- 15" Concrete culvert	740	39,818	
- 12" Concrete culvert	3,266	5,221	
- Drainage tubing	3,477	-0-	
SUBTOTAL	10,472	49,827	39,355
Manholes	-0-	12,600	12,600
6" Vertical curb and gutter	-0-	39,816	39,816
6' Valley gutters	-0-	2,736	2,736
Rip rap	1,320	2,640	1,320
Sales tax (7.8%)	4,077	12,996	8,919
TOTAL	$56,344	$166,315	$109,971
Cost Per Unit	$ 320*	$ 1,087**	$ 767

*176 units
**153 units

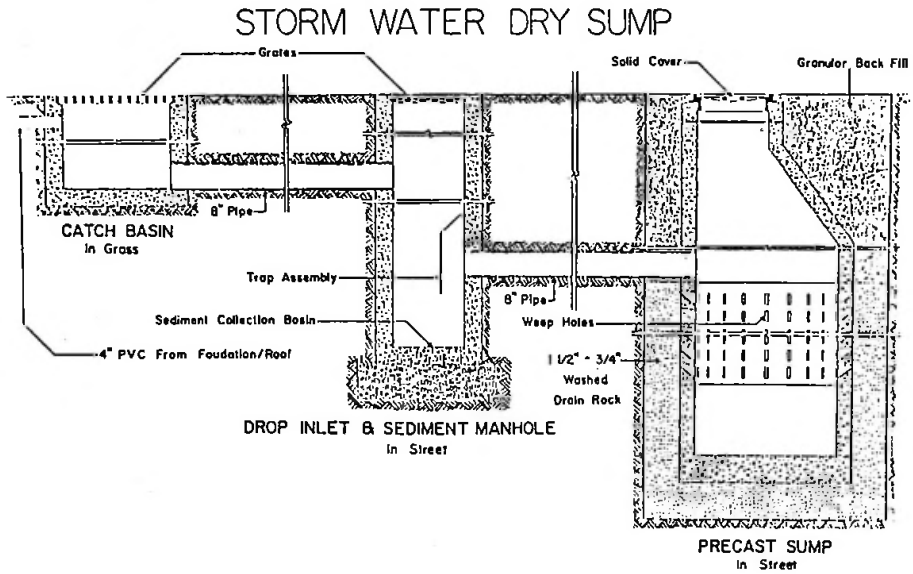
Cost savings attributed to changes in storm drainage standards at The Park are shown. Total savings of $767 were realized per unit.

Everett, Washington

Sunridge, a subdivision developed and built by Rich Boyden, used existing site conditions and alternate materials to improve cost effectiveness of the development. Normal procedure in Everett is to install CMP for the underground storm drainage system. It is also standard procedure to apply a per unit drainage fee of $432 to new residential construction.



In exchange for dedication of a 5.8 acre tract of land in the flood plain, the city agreed to waive the drainage fee at the site. Based on its successful use as sanitary sewer and water pipe, the city also permitted PVC to be installed in place of CMP storm pipe, resulting in a savings of $2,916. When added to the $432 per unit drainage fee, the total storm drainage system at Sunridge was installed at a savings of $27,108. This illustrates benefits of a reasonable compromise to both the community and the developer.



Portland, Oregon

In North Meadow Village, developed and built by Black Bull Enterprises in Portland, Oregon, the developer proposed changes deleting 630 feet of storm sewer pipe and adding an effective means of groundwater recharge.

A system of swales was designed to convey runoff into three on-site sumps where it could soak into the soil. Where storm sewer pipe was required, PVC was used in place of concrete pipe. The combination of savings from each change in the storm drainage system resulted in a savings of $6,350. This was equivalent to a per unit savings of $742.

Phoenix, Arizona

Cimarron entrance

Drainage for Cimarron, developed and built by Knoell Homes, Inc., was primarily above ground. Concrete valley gutters were used in some streets, and normal street curbs and gutters in other streets to direct stormwater to a channel and then to retention basins. The retention basins further created a visually attractive entrance to Cimarron. This drainage plan saved $70,578 over the original plan which required some underground drainage through an 18-inch concrete pipe, and a pumping station to lift stormwater to an existing canal.

Greensboro, North Carolina

In Covington Place, builder/ developer Norcon Builders, Inc., eliminated typical Greensboro curbs and gutters. Ninety percent of the stormwater is absorbed by grassy swales along the sides of the streets and filters into natural areas on the site. This design saved approximately $200 per unit, and added to the attractive, woody, natural feeling of the subdivision.

Charlotte, North Carolina

Stormwater in Lynton Place, John Crosland Company builder and developer, is carried by grassy swales to a retention pond, with culverts used where necessary. This saved $16,390 compared to the curb, gutter, and piping system normally used in Charlotte.

The following demonstrations also used grassy swales instead of the typical locally accepted culverts for stormwater drainage: ***Oklahoma City, Oklahoma***, and ***Knox County, Tennessee.***

SANITARY SEWERS

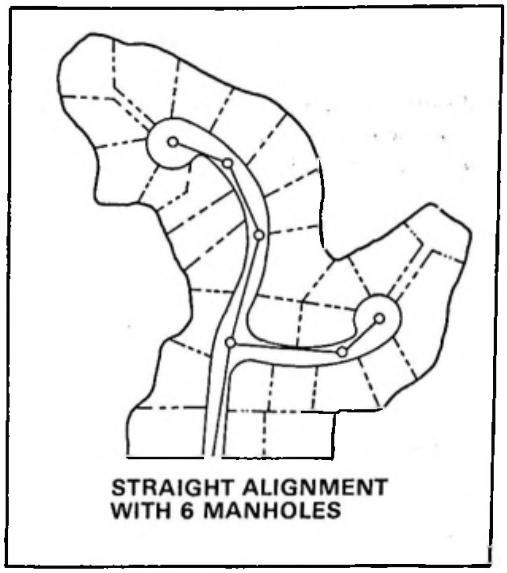
Residential neighborhoods often have overdesigned, underutilized sewer systems which local officials must review for cost reduction possibilities. Various sanitary sewer system alternatives are available today to communities using traditional, outmoded procedures, designs, and materials.

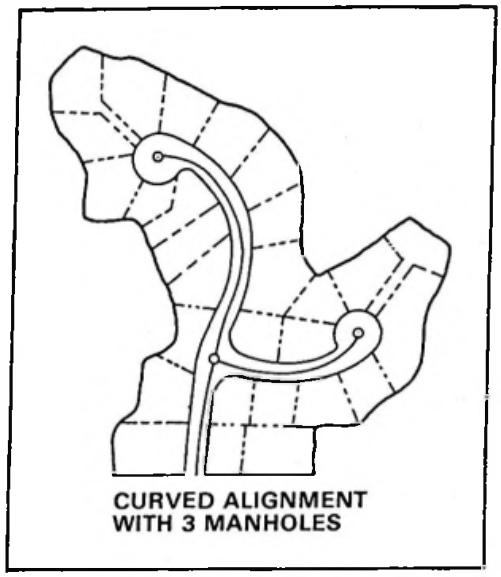
Following are guidelines for sanitary sewers:

- Use curvilinear sewers where feasible.
- Increase maximum manhole spacing.
- Use cleanouts as an alternative to manholes for maintenance.
- Use plastic pipe instead of concrete or metallic pipe.
- When appropriate, use inside drop connections.
- Design sewer pipe size and slope to meet the need.
- Use "state-of-the-art" inspection procedures.
- Use common laterals.

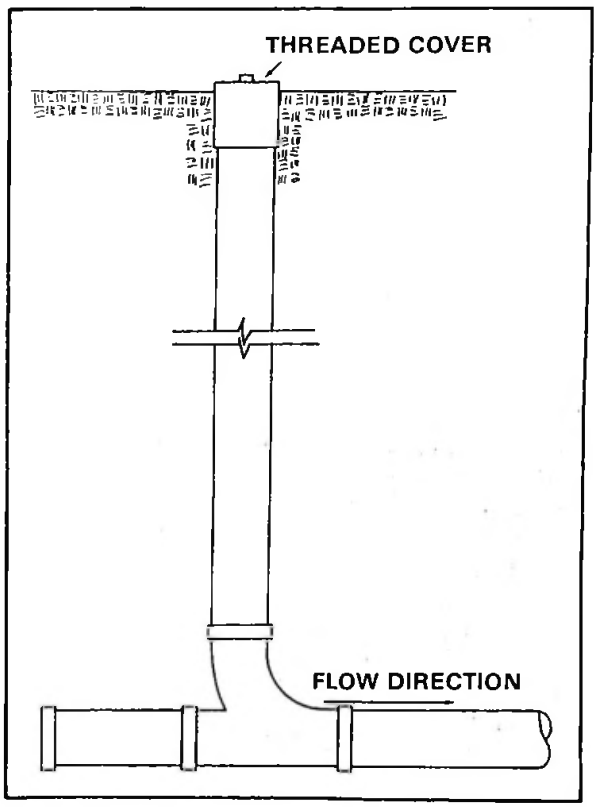
Manholes, Curvilinear Sewers, Cleanouts

Requiring fewer manholes than the norm, encouraging curvilinear sewer designs, and allowing use of cleanouts can save money for developers, local governments, and home buyers. Curvilinear sewers reduce the total length of sewer pipe, but the greater savings are from a reduction of manholes at $1,000 to $1,500 each. Hydraulic performance within a sewer is not adversely affected by the curved sections.





Curvilinear vs. straight sewer alignment



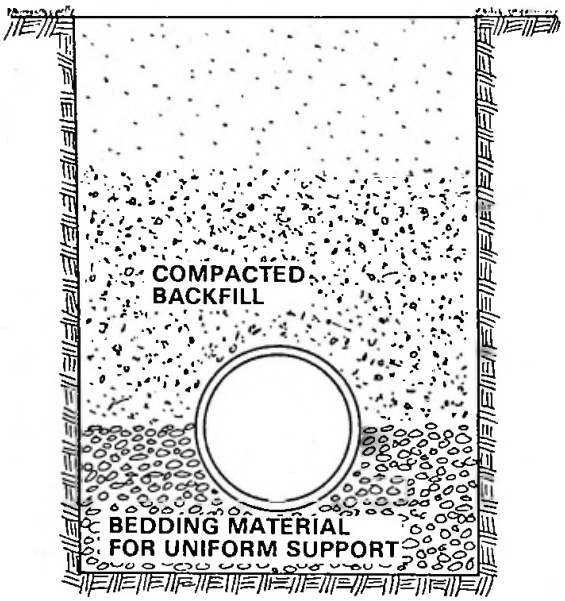
Typical cleanout

Although many communities require that manholes be spaced at a maximum of 200 to 400 feet, many more places now permit spacings in excess of 600 feet, due to improved methods of maintenance and construction and equipment development. For example, flush trucks capable of cleaning sewer lines 600 to 800 feet in length are now standard equipment for many public works departments.

Cleanouts can be provided in lieu of manholes both in curvilinear and straight runs. Cleanouts can also be installed at a much lower cost than a manhole at the terminal end of the sewer line. They offer a cost effective alternative in flood prone areas or in areas of high water tables because of installation, lower material costs, and better protection against infiltration.

Although cleanouts are a proven cost-effective alternative, manholes may still be required at a slope change or where multiple pipes converge.

Pipe Materials

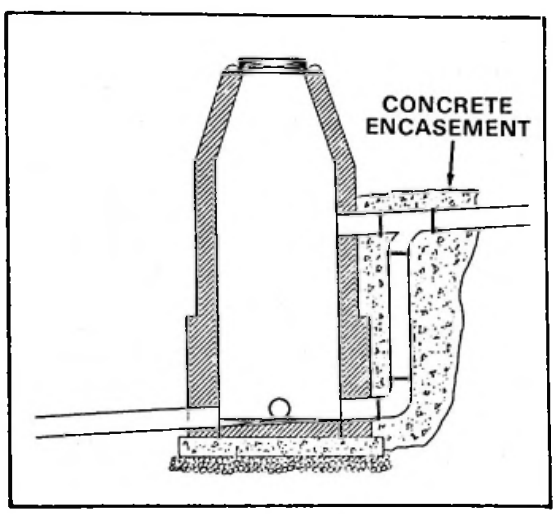


Ditch cross section for PVC pipe

Plastic pipe is being used in an increasing number of communities, offering reductions in material, installation, and replacement/maintenance costs when compared to total costs of more "traditional" materials.

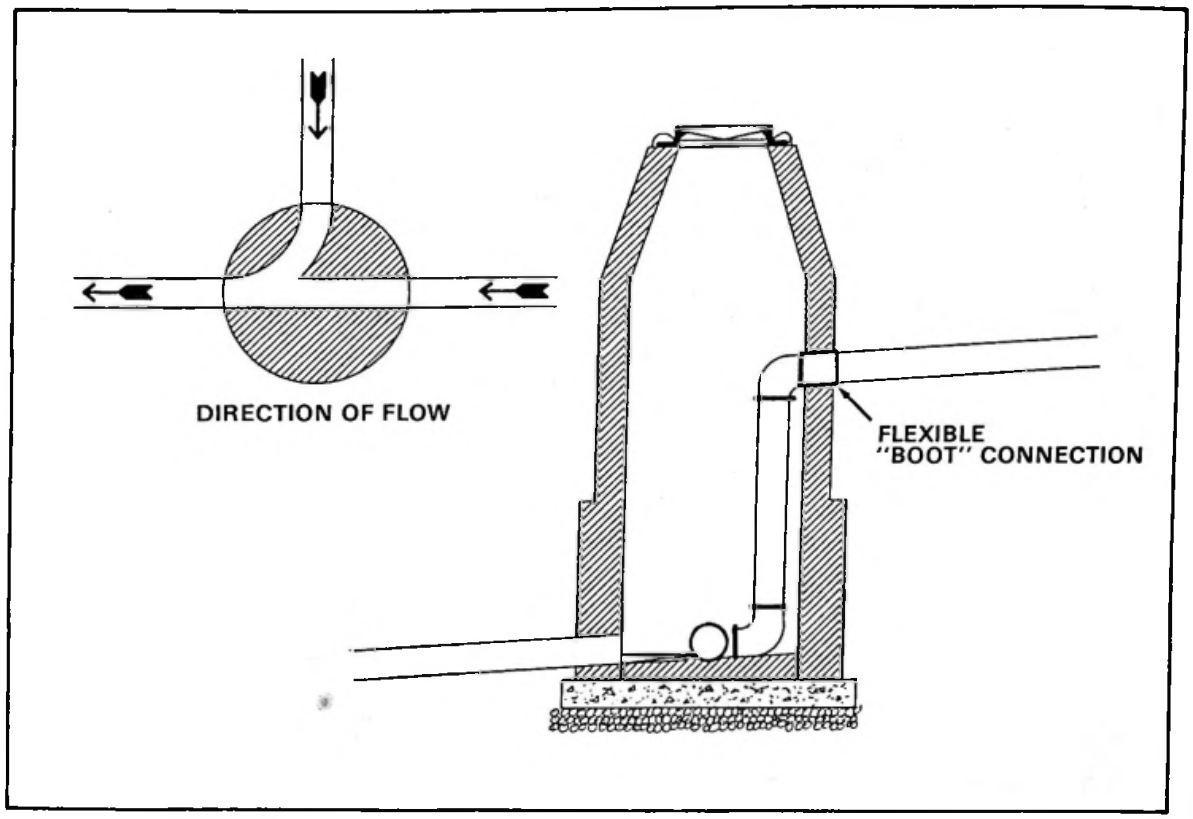
Polyvinyl chloride (PVC) is strong, lightweight, and considerably less expensive than concrete and metallic piping and has proven its durability and reliability over several decades of use in sanitary systems. Many of the early problems associated with PVC can be traced to improper bedding procedures. If the entire length of the pipe, including joints, is supported by the bedding materials, the pipe is secure. A clean, carefully placed backfill is also recommended.

Drop Inlets



Outside drop manhole

Sewer designers and construction crews installing sanitary sewers must insure the continuous flow of wastewater through manholes, especially when significant elevation differences exist between the influent and effluent pipes. Most areas require an outside drop connection to convey wastewater across an elevation drop, a costly solution requiring added piping and concrete blocking. An inside drop connection is less costly because it requires less materials, is easier to install, reduces stress at the connection and needs less excavation and backfill.



Inside drop manhole

Design Criteria

A sanitary sewer must be designed to coordinate with a master plan for sewer extensions, which all communities should have to ensure efficient integrated systems. Often, in lieu of a master plan, community standards arbitrarily require a minimum 8-inch diameter pipe. In many instances, especially on cul-de-sacs, deadends, and other areas where the sewer serves only a few houses, smaller pipes of 4 or 6 inch diameter actually provide better service because of faster flow. Larger pipe sizes may be detrimental since they could promote deposition of solids at low flows. A 3-inch house lateral is generally sufficient for a single dwelling unit.

Sizing criteria should be evaluated to reflect actual conditions. In the past, 100 gpcd was considered the standard design flow from a dwelling. However, researchers have shown that 40 to 50 gpcd more accurately reflects typical average flows.

An "across the board" minimum slope cannot be applied to all pipe. The minimum slope required for a sanitary sewer should not be an arbitrary standard, but should be determined for a specific site. Flatter sloped sewers reduce trenching depth, a critical factor where bedrock or other obstacles exist.

SUMMARY OF AVERAGE DAILY RESIDENTIAL WASTEWATER FLOWS

Study	No. of Residences	Duration of Study months	Wastewater Flow Study Average gpcd	Wastewater Flow Range of Individual Residence Averages gpcd
Linaweaver, et al.	22	-	49	36 - 66
Anderson and Watson	18	4	44	18 - 69
Watson, et al.	3	2-12	53	25 - 65
Cohen and Wallman	8	6	52	37.8 - 101.6
Laak	5	24	41.4	26.3 - 65.4
Bennett and Linstedt	5	0.5	44.5	31.8 - 82.5
Siegrist, et al.	11	1	42.6	25.4 - 56.9
Otis	21	12	36	8 - 71
Duffy, et al.	16	12	42.3	-
		Weighted Average	44	

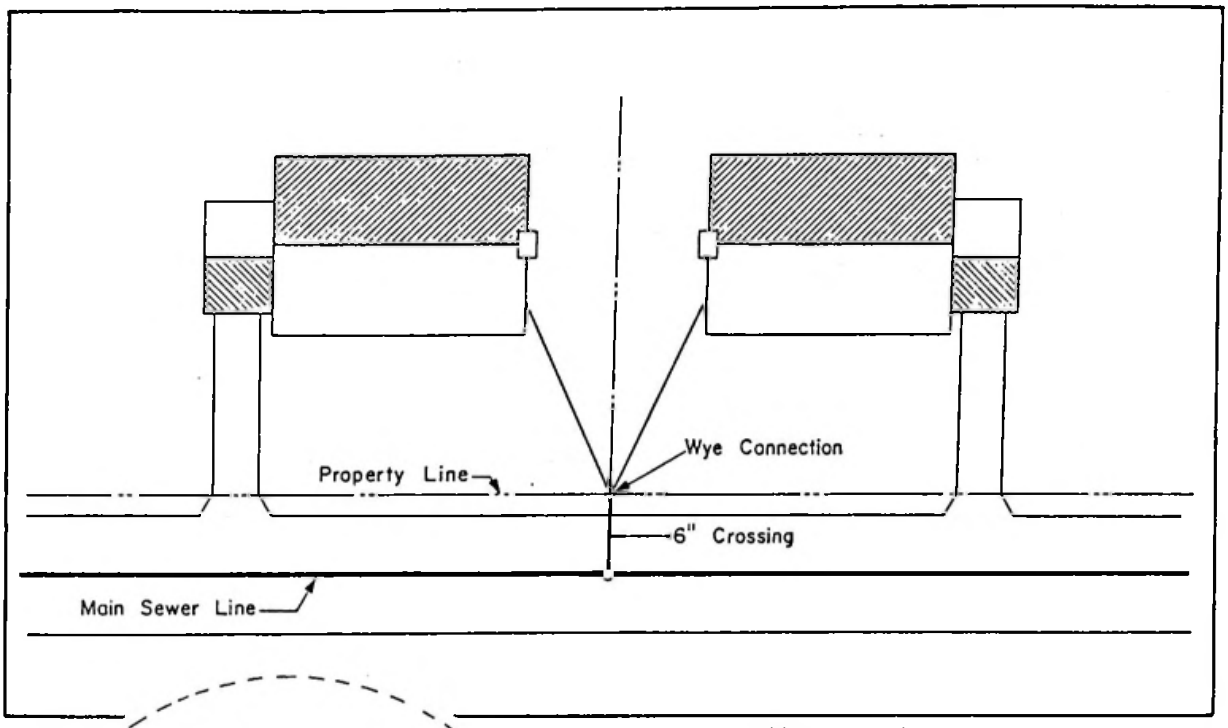
Source: *On-Site Wastewater Treatment and Disposal Systems*, U.S. EPA - 1980

Inspection

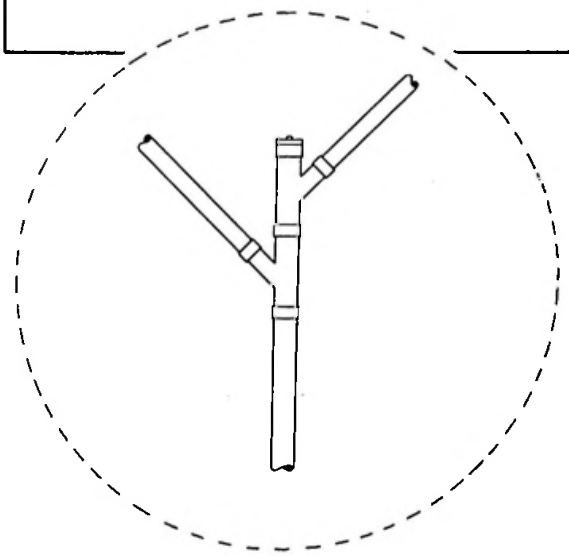
Television cameras can locate leaks with a higher degree of accuracy than a visual inspection conducted by a maintenance crew because they actually travel the distance of the pipe. If combined with an effective maintenance program, T.V. inspections help to insure quality construction and indirectly result in savings in future repairs or replacement.

Common Laterals

Common laterals can be used to connect the public sewer to more than one house, reducing total trench



Multiple connections to a common sewer lateral



Wye connection detail

length and quantity of materials. Since many communities charge fees based on the number of connections, additional savings come from the reduction in the number of connections to the main.

Two adjoining lots can be serviced by one lateral installed along the common property line with an easement dedicated to insure access for maintenance and/or replacement. A standard wye fitting is installed at the junction of the individual building drains. Pipe length is decreased by almost 50 percent since every other lateral is eliminated.

Clusters and townhouses also adapt well to common laterals by connecting three or more units to a single line. In any application of common sewer connections, benefits increase as the distance from buildings to public sewer increases.

Public Sewers Alternatives

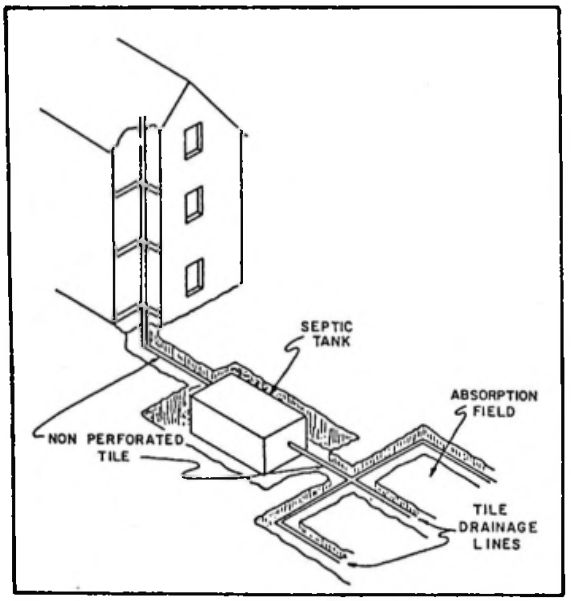
An alternative to the traditional high-cost public sewer system is the various on-site technologies currently available; the most typical is the conventional septic tank/soil absorption system.

Considered an excellent system if functioning properly, the septic system has several advantages: the need for a treatment plant is eliminated, sewer mains and pumping stations are eliminated, sewer tap fees are eliminated, and groundwater recharge is encouraged.

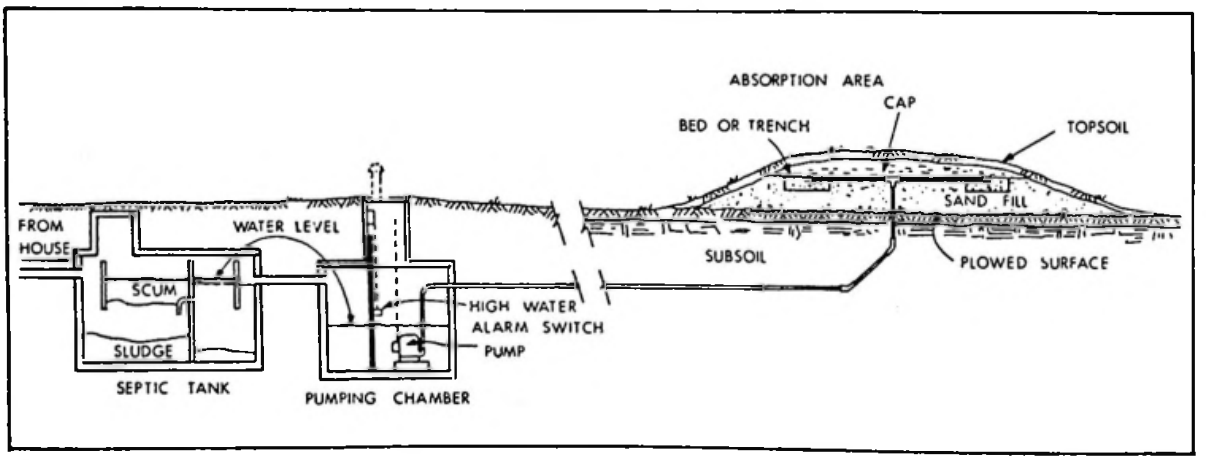
There is also a major disadvantage with septic systems: a large percentage of soils in the U.S. are not suitable for this purpose.

On-site mound or fill systems are gaining acceptance across the nation in areas where soil conditions were previously considered "unsuitable."

Evapotranspiration systems, effective in semi-arid climates, "treat" septic tank effluent by discharging it into an evapotranspiration bed. The effluent is disposed of through evaporation and plant uptake. In community on-site systems, the land best suited for a soil



Conventional septic system
Source: ***Alternatives to Public Sewer,*** **NAHB - 1978**

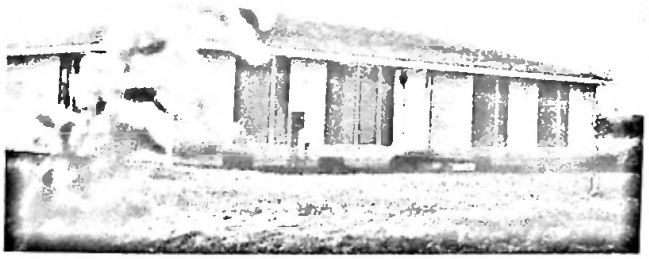


Typical mound system
Source: ***Residential Wastewater Systems,*** **NAHB - 1980**

absorption system is reserved for the drain field. Effluent from each dwelling is pumped from (or flows from) an individual septic tank to the community drain field. Although the absorption area required for the system would be much larger than an individual drain field, it can be used for other purposes such as open space requirements.

EXAMPLES FROM THE DEMONSTRATION PROJECTS

Christian County, Kentucky



The developer of Heritage Hill, Robertson-Tomberlin Homes, substituted PVC sanitary sewer mains and laterals for clay pipe normally required by the county. This resulted in a savings of $18,544 for the main sewer and $3,480 for 73 laterals. Cleanouts were installed in certain areas instead of manholes, eliminating seven manholes for a net savings of $13,755. Total savings attributable to changes in sanitary sewer standards amounted to $491 per home.

Lacey, Washington

At "The Park," John Phillips was allowed to use 6-inch diameter PVC branch sewer mains to serve 15 to 25 dwellings. The city normally requires 8-inch sewer mains.

Curvilinear sewer lines were used, allowing Phillips flexibility in serving more units with one lateral or branch feeder. Phillips used the PVC pipe manufacturer's data for curving the pipe, and Lacey accepted the curved lines based upon the pipe manufacturer's recommendations.

Four-inch diameter PVC sanitary sewer laterals with 4-inch wyes to serve several detached and attached units were requested and approved. Major trenches and laterals were reduced by about 75 percent over conventional use. Although this was a one-time only approval, Phillips believes that with a good maintenance track record the method will be approved for general use. Total sanitary sewer costs were reduced by almost $61,000.

Sioux Falls, South Dakota

Ronning Enterprises, Inc., builder/developer of the Sioux Falls demonstration site, installed curvilinear sewers instead of straight-run sewers. Manholes were spaced approximately 460 feet apart, an increase over the Sioux Falls norm. Six additional manholes would have been necessary had the more traditional sewer system been used. This resulted in a savings of $6,000 or $80 per unit.

Everett, Washington

Standard spacing between manholes in Everett is 300 feet. City officials permitted a maximum distance of 600 feet at the Sunridge project, developed and built by Rich Boyden. Three manholes were eliminated for a total savings of about $3,500.

Increased manhole spacing was also permitted in *Charlotte, North Carolina.*

Cleanouts were allowed in place of normally required manholes in: *Crittenden County, Arkansas; Christian County, Kentucky;* and *Portland, Oregon.*

Plastic pipe was permitted in: *Charlotte, North Carolina; Oklahoma City, Oklahoma; White Marsh, Maryland;* and *Phoenix, Arizona.*

One sewer was allowed for two or more units in: *Burlington, Vermont,* and *Charlotte, North Carolina.*

WATER SUPPLY

Alternatives to traditional standards, materials, and procedures used in residential water supply systems are often more cost efficient.

Following are guidelines for water supply:

- Consider alternative materials for water mains and service pipes.
- Use multiple connections to one common service where feasible.
- Size water distribution pipes to meet the projected need.
- Substitute blow-off mechanisms for some fire hydrants.
- Consider alternative meter arrangements.

Water Mains

Pressure water pipe has been constructed of concrete, vitrified clay, lead, ductile iron, cast iron, asbestos cement, and wood. The newest material, plastic, most often in the form of polyvinyl chloride (PVC) or polybutylene (PB), has performed equally well or better than many of the more "traditional" materials.

PVC is relatively light weight, easier to install, more resistant to corrosion, and less expensive than many of the alternatives. An 8-inch PVC water main will save $2.00 to $2.50 per linear foot compared with an 8-inch ductile iron water main.

Most sizes of PVC pipe can be installed without the use of expensive machinery normally required to lower the pipe into a trench, since its relatively long lengths are easily balanced against its lighter per unit weight. PVC does not require complicated mechanical or glued joints. The bell and O-ring joints of standard PVC water pipe are wedged into place, saving material and labor costs.

PVC pipe

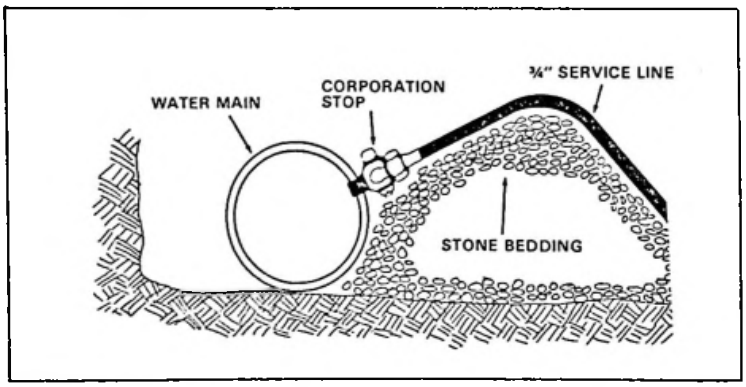
Water Service

An alternative to relatively expensive copper tubing for service lines is plastic tubing, usually manufactured from polyethylene (PE) or polybutylene (PB). Estimated savings of replacing 1-inch type K copper tubing with 1-inch plastic tubing is between $1.50 and $2.00 per linear foot.

Although local acceptance of plastic has been a slow process, both materials have been recognized under the major model plumbing codes. Available from most local suppliers, PB and PE have been rated at pressures well above those encountered in public water systems. Plastic tubing is flexible, lightweight, and easily joined with standard fittings. The relatively long lengths of most tubing insure that the number of joints will generally be limited to those at the main and the meter.

Connections

Saddle-type connections can be eliminated where a service line taps into the water main. A corporation stop assembly, used when tapping into ductile iron pipe, provides a complete, tight fitting connection without the saddle. The saddle adds $20 to $30 per tap, depending upon local factors. Crimping of tubing, especially near the tap, can be avoided by bedding the area within a foot or two of the connection with a local aggregate.



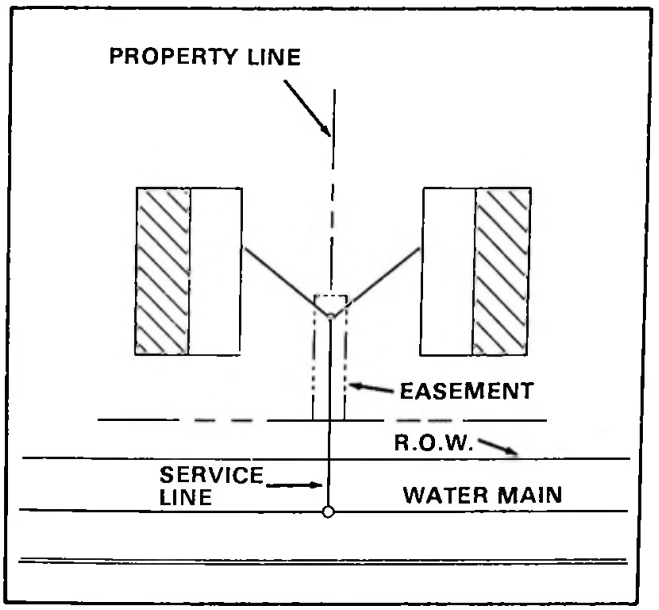
Service line connection to water main

Multiple Connections

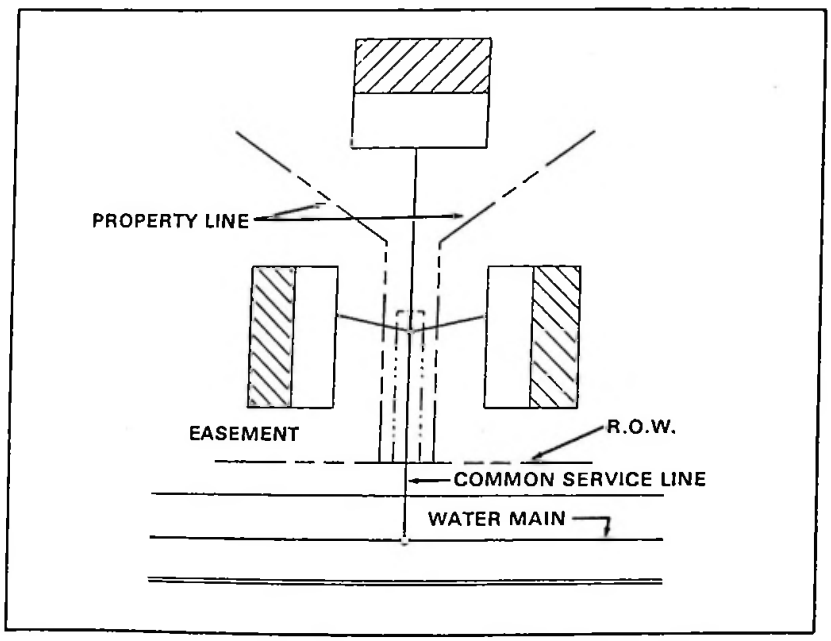
Communities should reevaluate standards that require a separate tap for each residence. Tap-in costs can be reduced significantly by branching off a tap to service more than one building or home. Multiple connections to one common service are frequently used with no adverse impact on performance.

A single water service can be installed along the common property line of adjoining lots. A standard wye or tee is used to branch off the common line near the meter, reducing the number of taps by 50 percent. Trenching costs and maintenance costs are also reduced since only one line is installed for two homes.

Common water service lines can serve a number of homes in cluster or townhouse developments. A larger branch than the typical 3/4-inch service line may be required if more units are to be served. Cost benefits of multiple service lines are directly proportional to the number of units each line serves.

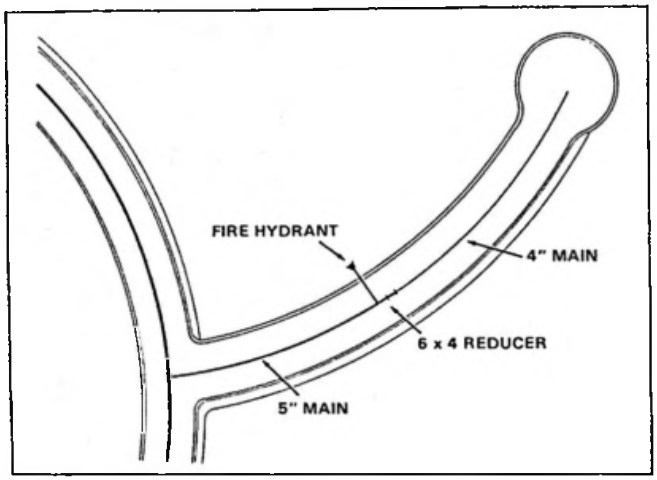


Common service line



Multiple connections to a single water service line

Sizing



Reduced size water main

Many communities' standards require a 6-inch, 8-inch, or even 10-inch minimum diameter for water mains. This often produces an overdesigned system.

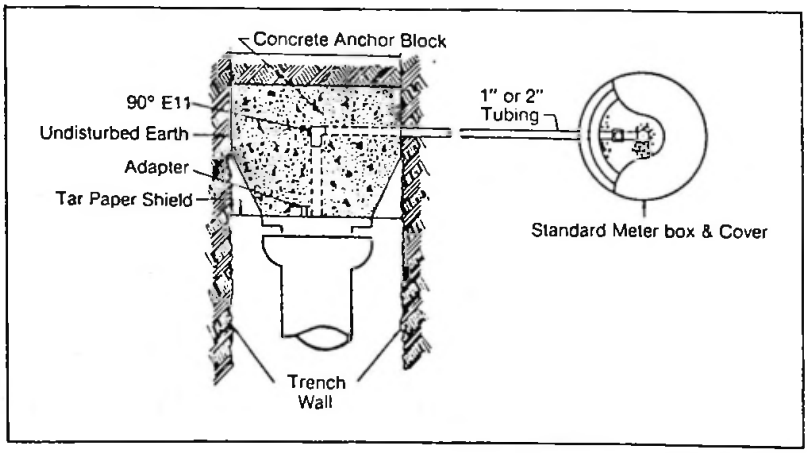
Residential water supply and fire flow requirements should determine the size of water distribution piping. These requirements can often be met on short runs with 2-inch to 4-inch water lines. A larger main is generally nearby if it is necessary to install a hydrant for fire protection.

Cost savings are estimated at $4.50 per foot when a 3-inch line is used compared to a 6-inch line.

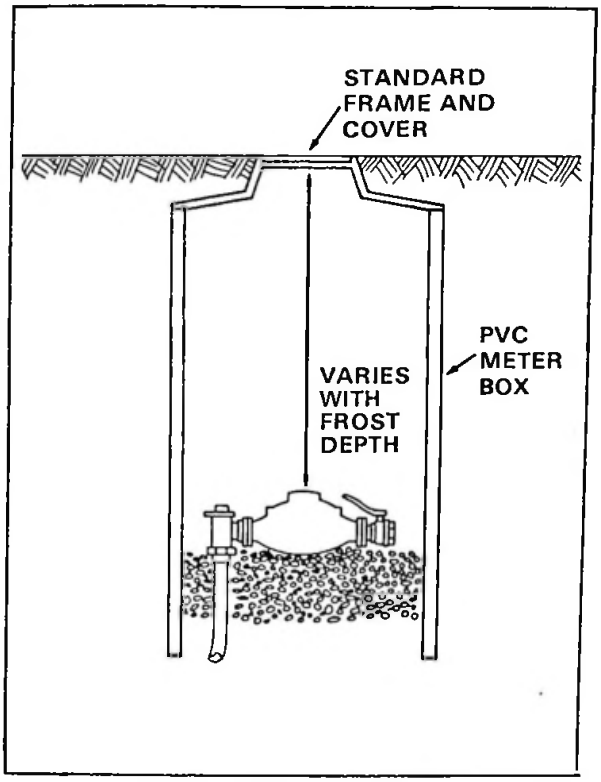
Accessory Items

Cost effective materials and construction techniques can be applied to meters, valves, hydrants and fittings.

Fire hydrants are routinely installed at the terminal end of water lines and at low lying points where it may be necessary to blow off the line. A blow-off mechanism can be substituted for hydrants that are not required for fire protection, saving approximately $1,000 per hydrant. A standard 2-inch blow off is usually adequate and can be installed by extending the main with a short section of 2-inch tubing.



Standard blowoff - plan view

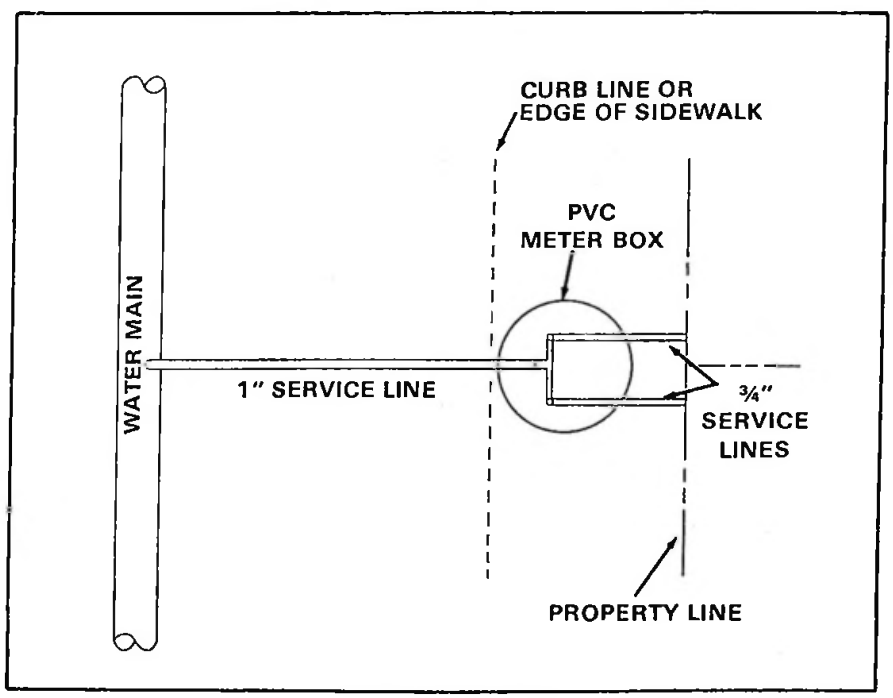


Exterior water meter

An *outdoor type water meter* enclosed in a plastic meter box eliminates both the remote reader and the curbstop shut-off commonly installed with an indoor water meter, saving approximately $60.

As a safeguard against freezing in colder climates, the top of the meter is covered and placed below local frost depth.

Multiple meters can be housed in a single box, especially efficient when multiple connections are made to a single tap.



Common meter box

EXAMPLES FROM THE DEMONSTRATION PROJECTS

Charlotte, North Carolina

In Lynton Place, built by the John Crosland Company, two major revisions to the city's water main construction standards were proposed and subsequently approved by the city. The first revision permitted a substitution of PVC water pipe for the ductile iron pipe (DIP) water mains usually required. The second change permitted a common service line to serve two homes. This variance, which eliminated the need for two individual taps (and one tap fee), was achieved through the installation of a single 1-inch service line in place of two 3/4-inch lines. The innovations to the water system resulted in a reduction in total costs of $8,310, a savings of approximately $554 per unit.

Mesa County, Colorado

In Mesa County, Colorado, water service to an individual building is typically installed using asbestos cement pipe. The county allowed Roger Ladd and Company to use polybutylene water service lines at the Coventry Club subdivision, resulting in a total savings of over $3,100 or approximately $63 per unit.

Portland, Oregon

Mike Robinson, President of Black Bull Enterprises, proposed substituting PVC water mains in place of the standard DIP in the North Meadow Village demonstration subdivision, and downsizing the water main from 8-inch lines to 6-inch fire hydrant and 4-inch domestic water lines, depending on the location. The city allowed both deviations from existing standards and permitted the elimination of individual meters for each unit with the understanding that the home owners' association would maintain the system as privately owned. Water lines outside of the ROW were allowed based on the private ownership of the system.

The total water distribution system savings at North Meadow Village were estimated at $1,283 per unit. This reduction was after the inclusion of a $72,500 lawn sprinkler system. Had the $72,500 been excluded from the demonstration cost calculations, savings reflected in the per unit cost would have increased significantly.

Lacey, Washington

The city allowed John Phillips, the builder, to install water mains outside the rights-of-way as long as easements were provided and the mains were in reasonably accessible locations.

Phillips also hooked one water line into two, three, or four water meters, meaning one tap and one corporation stop would serve as many as four dwellings. By placing four meters on a single tap, cost per unit was reduced from $530 to $211. This technique was practical only because the units were grouped and clustered. Total water service costs were reduced over $40,000.

Blaine, Minnesota

Good Value Homes (GVH), builder/developer of the Cloverleaf Farm 9th Addition, installed a 1 1/2-inch diameter water supply line to each eight-plex unit instead of the normal 2-inch line.

GVH also clustered the shut-off valves in one central location, and installed one water meter per building instead of the typical one meter per unit.

Burlington, Vermont

William R. Hauke, Hauke Building Supply, was permitted by the city to use one water line for four units in his infill demonstration, saving approximately $3,000.

Plastic pipe was also used in the following demonstrations: ***Oklahoma City, Oklahoma; Everett, Washington;*** and ***Charlotte, North Carolina.***

UTILITIES/UTILITY EASEMENTS

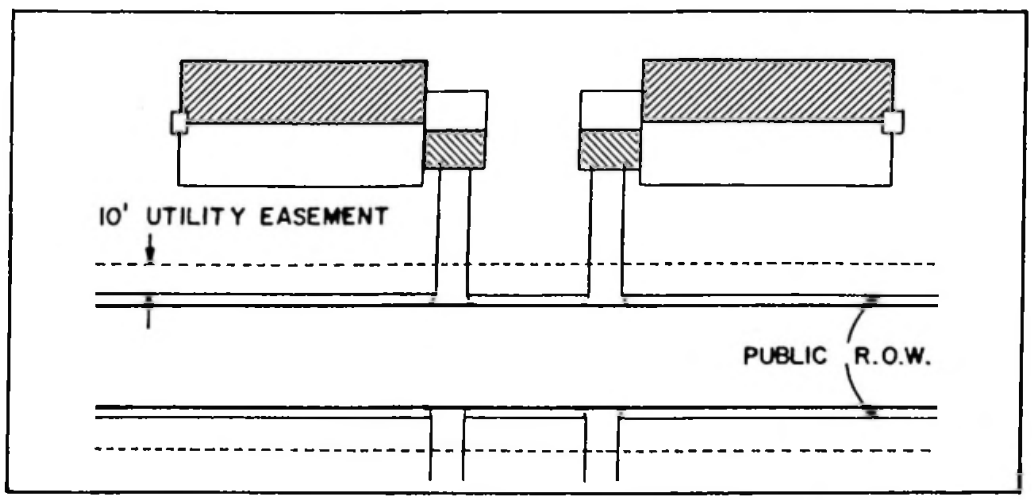
One of the most prohibitive local residential land development regulations requires placement of all utilities in public rights-of-way. A viable, less costly alternative is installation of utilities outside of the ROW in easements.

Following are guidelines for utilities and utility easements:

- Place utilities in easements instead of rights-of-way where appropriate.
- Use plastic piping in underground gas systems.
- Install direct buried phone, cable TV and electric lines.
- Use common trenching for multiple utility installations.

Easements/ Rights-of-Way

Utility easements are an acceptable procedure in many areas of the country. Benefits of easements compared to rights-of-way are detailed in the Streets section. Specific to utilities, however, an easement often allows placement of a line in the shortest available path, decreasing the overall length of the line and reducing costs.

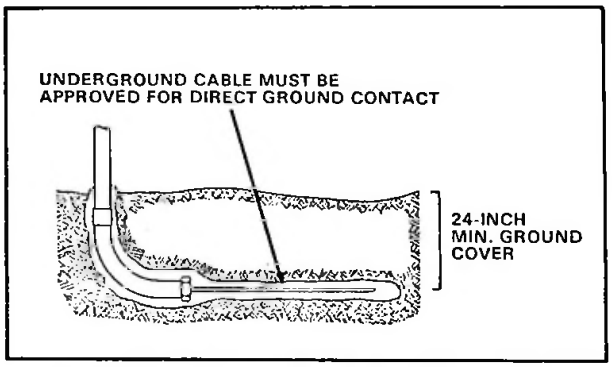


Typical utility easement

Home owners maintain and use easement areas, saving the locality money and adding land for the homeowners' enjoyment. Legal rights to the easement land are assigned to the community, utility companies, and home owners.

Materials

Several non-traditional materials for use in sanitary sewers, stormwater systems, and water service are discussed in earlier sections. Gas, electric, and cable TV can also use more effective, less costly materials.



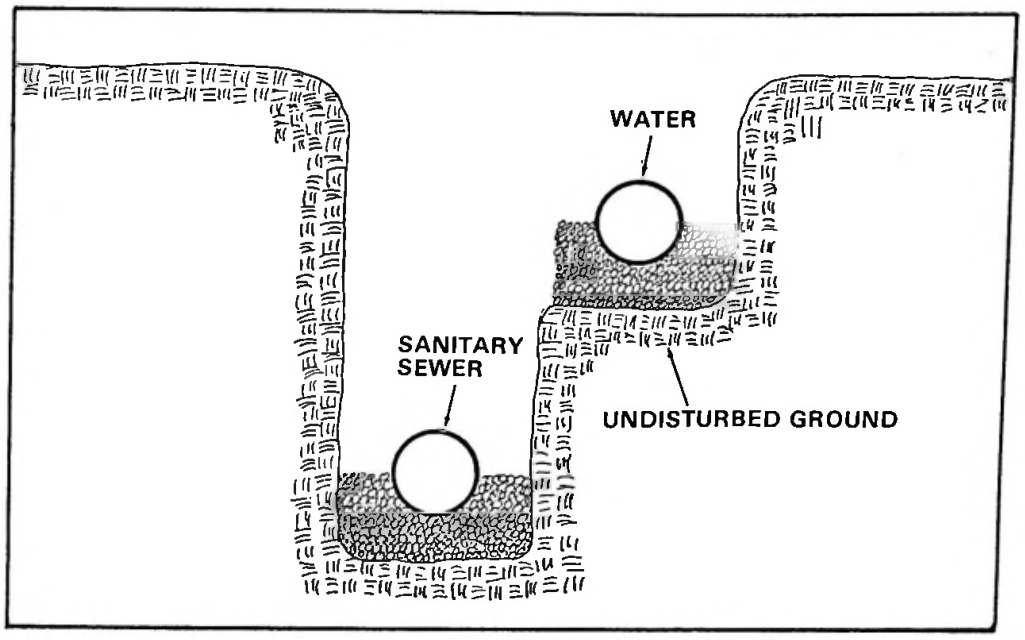
Installation of direct-burial cable

Plastic piping, usually polyvinyl chloride (PVC) or polyethylene (PE), is used in underground gas piping systems in lieu of the traditional black or galvanized steel, reducing costs and increasing ease of installation and corrosion resistance.

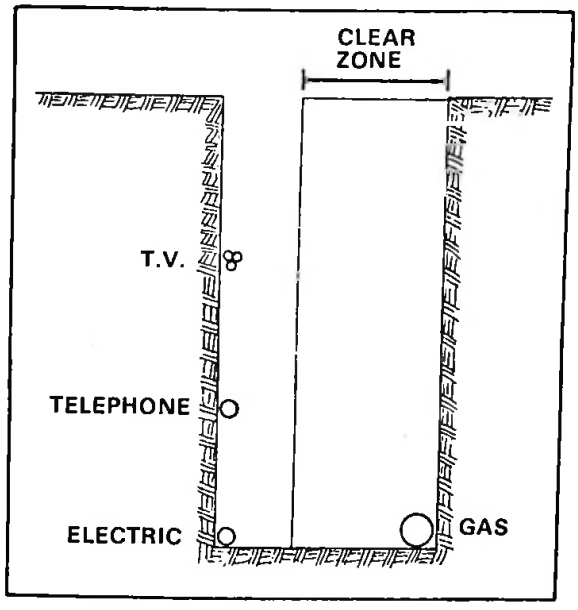
Direct-burial cable can be used for cable TV, phone, and electric lines, eliminating the need for a covering or conduit to serve as a protective sleeve. The National Electric Code (NEC) permits direct-burial cable when a minimum soil cover, or equivalent protection, is provided.

Installation

Common trenching of different combinations of utilities is becoming more acceptable. Common trenching of sanitary sewer and water lines is permitted by the major U.S. model building code organizations -- ICBO, BOCA, SBCCI and CABO. Approximately $5 per foot can be saved in installation costs of main lines, with a smaller savings of $2 per foot on service laterals. The water line is generally placed at least 12 inches above the sewer line, with a minimum horizontal separation of 18 inches. However, due to improved reliability in materials and construction techniques,



Common water/sewer trench



Joint utility trench

local codes are beginning to recognize that minimum separation distances are unnecessary.

Common trenching is used successfully with electric, telephone, cable TV, and gas lines. The installation cost is reduced substantially if three or four utility companies share trenching expenses.

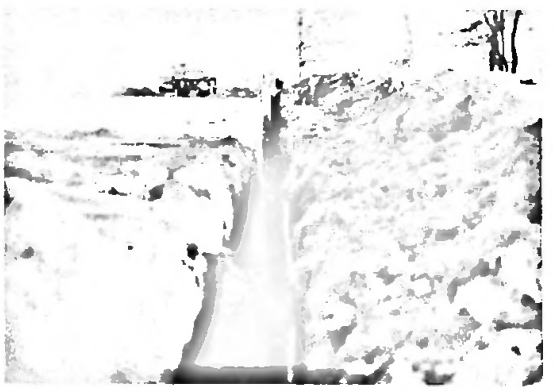
The city of Tacoma, Washington, estimates common trenching in residential areas reduces costs an average of 97 cents per foot where electric, telephone, and cable TV are installed in the same trench. Seattle, Washington, reports savings of 40 percent to 60 percent.

EXAMPLES FROM THE DEMONSTRATION PROJECTS

Santa Fe, New Mexico

The city permitted the Chapman Company to use PE piping in Fairway Village in lieu of 2-inch steel gas pipe. The use of PE was estimated to reduce the installed cost of gas piping by 94 cents per linear foot. This savings, when combined with an increase in density from 38 to 47 units, resulted in a $172 per unit cost reduction.

Tulsa, Oklahoma



Common trenching of utilities is typically prohibited in Tulsa, Oklahoma. However, the city relaxed this policy and permitted multiple use of a single trench at Innovare Park, developed and built by Hood Enterprises. Gas piping, telephone lines, and electric cables were installed in a single 2-foot wide by 4-foot deep trench.

The total savings from common trenching at the site are not available, since these services are provided by the utility companies. However, according to the developer, the time savings involved made it well worth the effort to continue this practice.

Lacey, Washington

The city of Lacey requires a 10-foot separation between public water and public sewer, a state and local code provision. When a sewer lateral crosses a water main or vice-versa, a 3-foot vertical separation must be maintained. This occurred in The Park, but Phillips was unable to make the 3-foot vertical separation. Because of this, the city required a heavy gauge metal sleeve around the water pipe within 10 feet of the sewer. This apparently is a carryover requirement from the time of cast iron and concrete soil pipe, when joints often broke and leaked. However, with longer lengths of seamless PVC pipe available, the separation requirements and the need for a metal sleeve appear to be unnecessary.

Portland, Oregon

Builders in Portland frequently install gas, electric, telephone, and TV lines in a common trench. In addition to allowing this practice, the city of Portland permitted Robinson to install his common trench and water line trench outside the right-of-way. The city also allowed the use of less expensive native backfill instead of off-site granular backfill. The city would not waive their normal requirement that sanitary sewer mains be placed in a separate trench in the right-of-way. Robinson saved $5,040 by installing his common trench and water line trench outside the right-of-way and using backfill from the site.

REFERENCES

The following references relate to administrative and procedural issues of affordable housing.

Center for Community Development and Preservation, Affordable Housing: Public and Private Partnerships for Construction Middle and Moderate Income Housing, White Plains, NY, CDP, 1982.

Moore, Colleen G. and Cheryl Siskin, PUDs in Practice, Washington, DC, Urban Land Institute, 1985.

Rogel, Stuart and Steve Weitz, Land for Housing: How Local Governments Can Help Increase Supply, Washington, DC, Urban Land Institute, 1984.

Sanders, Welford, Judith Getzels, David Mosena, and Jo Ann Butler, Affordable Single-Family Housing: A Review of Development Standards, Chicago, IL, American Planning Association, 1984.

Schnidman, Frank and Jane A. Silverman, Housing Supply and Affordability, Washington, DC, Urban Land Institute, 1983.

Vranicar, John, Welford Sanders, David Mosena, Streamlining Land Use Regulation, Washington, DC, U.S. Government Printing Office, 1980.

Weitz, Stevenson, Affordable Housing: How Local Regulatory Improvements Can Help, Washington, DC, U.S. Government Printing Office, 1982.

The following references relate to land development for affordable housing.

American Coal Ash Association, Ash at Work, Vol. XVIII: No. 2, Washington, DC, 1986.

American Public Works Association, Prevention and Correction of Excessive Infiltration and Inflow Into Sewer Systems (for EPA Water Quality Office), Washington, DC, U.S. Government Printing Office, 1971.

American Society of Civil Engineers, Gravity Sanitary Sewer Design and Construction (for Water Pollution Control Federation), Washington, DC, 1982.

American Society of Civil Engineers, Urban Land Institute, and National Association of Home Builders, Residential Stormwater Management, Washington, DC, 1975.

American Society of Civil Engineers, Urban Land Institute, and National Association of Home Builders, Residential Streets, Washington, DC, 1974.

Bucks County Planning Commission, Performance Streets, Doylestown, PA, 1980.

Bullen, Walter W. III, "Groundwater Laws: Opportunities for Management Protection," AWA Journal, June 1983.

Engineering-Science, Inc., Feasibility of Curvilinear Alignments for Residential Sanitary Sewers (prepared for FHA), Washington, DC, U.S. Government Printing Office, 1959.

Hartigan, John P., "Watershed-Wide Approach Significantly Reduces Local Stormwater Management Cost," Public Works, December 1983.

HOH Associates, Inc., Project Development Updates (for National Association of Home Builders), Washington, DC, 1980.

Jensen, David R. and HOH Associates, Zero Lot Line Housing, Washington, DC, Urban Land Institute, 1981.

National Association of Home Builders, Alternatives to Public Sewer, Washington, DC, 1978.

National Association of Home Builders, Cost Effective Site Planning: Single Family Development, Washington, DC, 1982.

National Association of Home Builders, Planning for Housing: Development Alternatives for Better Environments, Washington, DC, 1980.

National Association of Home Builders, Report of a National Study and Survey of Utility Design and Construction Practices for Residential Land Development, Washington, DC.

National Association of Home Builders, Residential Wastewater Systems, Washington, DC, 1980.

*NAHB Research Foundation, Inc., A Manual of Residential Storm Water Management Development Standards (preliminary report), Rockville, MD, 1973.

*NAHB Research Foundation, Inc., Building Affordable Homes: A Cost Savings Guide for Builder/Developers, Rockville, MD, 1983.

*NAHB Research Foundation, Inc., Utility Maintenance in Cluster Developments (preliminary report), Rockville, MD, 1984.

U.S. Department of Housing and Urban Development, Guidance Manual for Sewerless Sanitary Devices and Recycling Methods, Washington, DC.

U.S. Department of Housing and Urban Development, Innovative Site Utility Installations, Washington, DC, U.S. Government Printing Office, 1983.

U.S. Environmental Protection Agency, On-Site Wastewater Treatment and Disposal Systems, Washington, DC, 1980.

*Since October 1986, operating as NAHB National Research Center, Upper Marlboro, MD.

APPENDIX I

Joint Venture for Affordable Housing Demonstration Participants

Subdivision Demonstrations

Alaska, Fairbanks
"Woodsmoke"
Webb Construction Inc.
Tom Webb, President

Arkansas, Crittenden County
"Harvard Yard"
Rex Rogers' Homes, Inc.
Rex Rogers, President

Arizona, Phoenix
"Cimarron"
Knoell Homes, Inc.
Thomas E. Knoell, President
Richard Eneim, Vice President and General Manager

Colorado, Mesa County
"Coventry Club"
Roger Ladd and Company

Florida, Coral Springs, Broward County
"Village Pointe at Coral Springs"
Coral Ridge Properties, Developer
RDK Development, Builder

Georgia, Valdosta
"Forrestwood II"
Minchew Homes Corporation
Gary Minchew, President

Idaho, Boise
"Lakewood Meadow"
HOMCO, Inc.
Bryce L. Peterson, President

Indiana, Elkhart County
Coachman Industries, Inc.
John Letherman, President (Developer)

Kentucky, Christian County
"Hermitage Hill"
Robertson-Tomberlin Homes
Norris Glenn "Pup" Robertson

Maryland, White Marsh (Baltimore County)
"Lawrence Hill"
Nottingham Properties, Developer
The Ryland Group - modular manufacturer

Minnesota, Blaine
"Cloverleaf Farm - 9th Addition"
Good Value Homes
Donald Hardle, President
John Peterson, Land Development Director

Nebraska, Lincoln
"Parkside Village"
Empire Homes
Karl Witt, President

New Mexico, Santa Fe
"Fairway Village"
Walton Chapman Homes, Inc.
Walton and Michael Chapman

North Carolina, Charlotte
"Lynton Place"
John Crosland Company
John Crosland, President

North Carolina, Greensboro
"Covington Place"
Norcon Builders, Inc.
Norwood Stone, President

Oklahoma, Oklahoma City
"Woodland Hills"
Holland Land Company
Jack Holland, President

Oklahoma, Tulsa
"Innovare Park"
Hood Enterprises, Inc.
D. Wayne Hood President

Oregon, Portland
"North Meadow Village"
Black Bull Enterprises
Mike Robinson, President

South Dakota, Sioux Falls
"Ascot Park"
Ronning Enterprises, Inc.

Tennessee, Knox County
"Woodpointe"
Phil Hamby Construction Co., Inc.
Phil Hamby, President

Washington, Everett
"Sunridge"
Boyden Realty, Inc.
Richard Boyden, President

Washington, Lacey
"The Park"
Phillips Homes
John Phillips, President

Infill Demonstrations

Kentucky, Louisville
JRB Development, Inc., Developer
Jim Rey-Barreau President
All-American Housing - modular manufacturer
The Reasor Corporation - modular manufacturer

Massachusetts, Springfield
JDS, Inc., Developer
Robert L. Del Pozzo, President
ASI, modular manufacturer

New Jersey, Orange
"Concord Court"
Neighborhood Resources Passaic, Inc.
Joseph Deming, President
Ryland Group - modular manufacturer

New York, Albany
The Latham Four Partnership, Builder/Developer
Charles Touhey, President

Vermont, Burlington
"Franklin Square"
Hauke Building Supply
William R. Hauke, Jr., President

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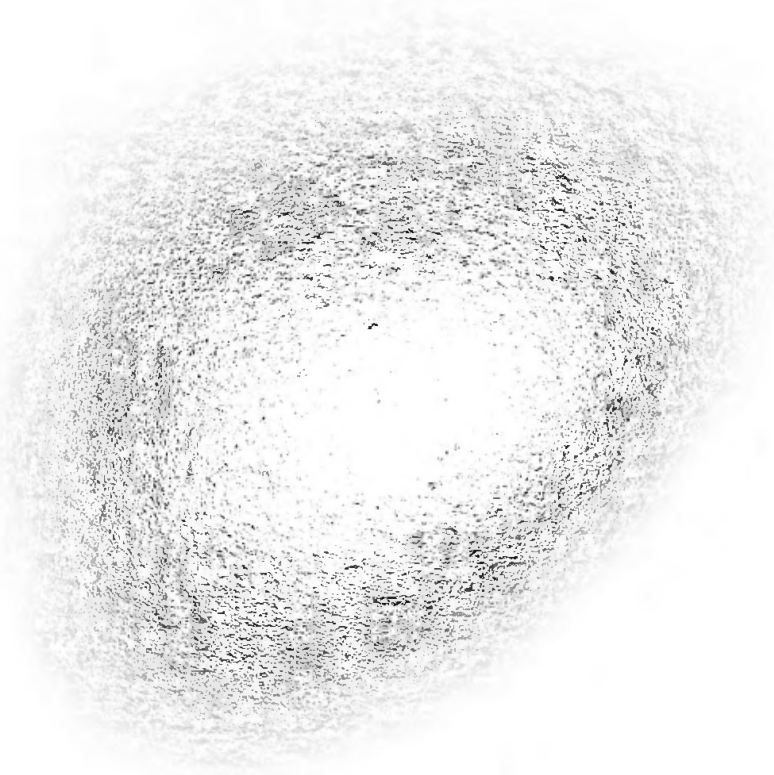

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HUD-1128 PDR (V.1)