OUTDOOR RECREATIONAL LAND USE SELECTION MODEL

Dissertation for the Degree of Ph. D
MICHIGAN STATE UNIVERSITY

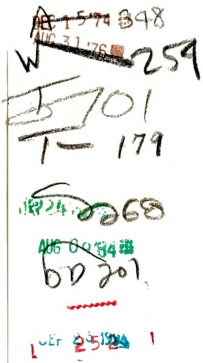
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ABSTRACT

OUTDOOR RECREATIONAL LAND USE
SELECTION MODEL

by Francis Martin Domoy

The problem presented within this research project concerns the location of feasible outdoor recreational sites; those which are in phase with community priorities. Community priorities are based upon the concerns for the economic, physical, and aesthetic resource characteristics within a planning area. The problem therefore, is to locate feasible outdoor recreational sites supporting community preferences.

The objective of this research project was to provide an outdoor recreational planning tool integrating the economic, physical, and aesthetic resource characteristics of a region and the incorporation of community objectives.

Orleans County, New York was selected as a county community for the formulation of the outdoor recreational planning model. This county was chosen since research indicated a need for an outdoor recreational facility, specifically, a full season campground.

Simulation techniques were utilized by mathematically transposing community priorities into single and multiple objective functions. These objective functions represented community concerns for the economic, physical, and aesthetic

resource characteristics. A single objective function, such as the minimization of development cost, may be the community priority in the selection of a feasible site. Multiple objective functions which incorporate a number of single objective functions in the selection procedure rank and present numerous alternatives for site selection. Computer mapping routines are utilized to visually represent alternative sites based upon the objective functions. The computer maps are displayed at three levels of intensity to represent low, medium, and high values corresponding to single and multiple objective functions. From the preliminary selection of feasible sites, each individual site may be further analyzed by reviewing the original data file for each site or by mapping cells of 247.1 acres.

It is the conclusion of this research project that those cells satisfying the multiple objective function combination of low property tax revenue loss, low development cost, and high aesthetic index shall be selected as feasible sites for public campground development. Furthermore, a specific site should be chosen from the seventeen cells selected from the total of 1056 possible cells within Orleans County. With the seventeen cell array isolated, the decision-maker may further analyze each cell by returning to the original data file representing all of the county's cells, from which the computer maps were produced.

OUTDOOR RECREATIONAL LAND USE SELECTION MODEL

By

Francis Martin Domoy

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CHAPTER I

INTRODUCTION

Orleans County, New York has experienced increased demands for land utilization, thus keeping pace with state and national trends. Specific pressures influencing the demand for individual land uses include: need for residential homes, desire for recreational space, fluctuation of domestic and foreign food supplies, and the expansion of industrial and commercial enterprises. A contemporary problem is the wise selection of feasible outdoor recreational sites. The objectives of this study, which will be further expanded upon later, are to develop a decision-making tool for feasible outdoor recreation site selections and to select areas which optimize the aesthetic, economic, and physical resources within the county. Problems are derived when local planning officials try to optimize all site characteristics within an area. In a land use planning sense, optimization refers to the maximization, or minimization of an objective function including one or more characteristics for one or more land parcels. As a result, the decision-maker is faced with a situation which forces him to establish priorities or specific objective functions. If we wish to select land parcels which provide the most aesthetically pleasing outdoor recreation facility for public

use, it may require either a high development and acquisition cost or high property tax loss to county tax revenue. On the other hand, if we wish to minimize property tax loss to the county, in providing public recreational facilities, the most marginal low value areas for agricultural and forestry production, may be selected. However, as a result of this decision, the development and maintenance costs may be high and the aesthetics of the site may be lacking. Therefore, economic, physical and aesthetic trade-offs are evaluated by the decision-maker in choosing an outdoor recreational site.

Importance

The importance of this research is to provide the decision-maker with a planning tool, which wil enable him to: 1) inventory selected land and water resource characteristics, 2) establish community priorities in the form of objective functions, and 3) select feasible sites which match the objectives of the community with the available resource characteristics. By examining available physical, economic, and aesthetic trade-offs for a geographic locale, it is hoped that the decision-maker can develop solutions which will optimally use the land and water resources of his area.

The recreational land use selection model developed in this dissertation will first examine several physical and

economical traits which characterize the one-thousand-fifty-six cells within Orleans County. An aesthetic index based upon geographical and geophysical data will then be developed as an indicator of the aesthetic appeal of each cell for a potential campground. The model is designed to classify each land unit, one-square-kilometer cell, within Orleans County, based upon its individual economic data (property tax revenue loss or opportunity cost, development cost, and total cost), and based upon its generated aesthetic attractiveness (dependent upon water to land ratio , contour differential, type of color contrast within forested areas, and the amount of land which was forested). Using economic and aesthetic data, the selection model will then rank each cell at three levels of achievement, (low, medium, and high) for four individual objective functions, and then for combinations of three objective functions. The objective functions which will be used in combination include: 1) property tax revenue loss from the acquisition of private land by the public sector, 2) the development cost of the facility, and 3) the aesthetic attractiveness of the cell for a year-round camping facility. Each classification pattern will appear as a computer map of Orleans County, showing a given objective function or multi-objective functions at either a low, medium, or high level of achievement for each cell. It will then be the decision-maker's prerogative to use the computer maps to aid in

his selection of the feasible sites for the proposed camping facility.

Objectives

The primary objective of this research project was to develop a land use selection model for outdoor recreational planning which will assist public decision-makers in locating feasible recreational sites. In this study, a single activity, camping, was selected, since other activities may have specific characteristics and site attributes necessary in their site requirements. In order to stress the operations and utilization of the model as a planning tool, emphasis will be placed upon the model rather than upon the requirements of various outdoor recreational activities. However, further applications of the model to other outdoor recreational activities would be a logical extension of this research project, and will be discussed in the conclusions of this work.

It has been decided that a full season outdoor camping facility will be the focal point of this model. An outdoor camping facility was chosen as the single activity within the study area because of its suitability to Orleans County land characteristics. The research centered around the development of a full season camping facility as a result of increased usage and demand for year-round outdoor recreational facilities, (i.e. winter - snowmobiling, cross-country skiing; spring - fishing; summer - picnicking and swimming; autumn - hunting and fishing). As a result, the output of the model will be the selection of feasible camping facility sites within Orleans County. Therefore, the specific characteristics of full season outdoor recreational camping will be identified. The model

will be calibrated to spatially analyze the economic value, the physical characteristics, and the aesthetic attributes of land within the county for such a facility. The model is a planning framework and is a tool to be utilized by local decision-makers to assist them in selecting feasible sites. Furthermore, it is hoped that in assisting them by spatially identifying and analyzing the land characteristics, that decisions can be made to approach, if not obtain, optimality. As stated earlier, optimality can be derived by either maximizing a given factor, or by minimizing a related factor, assuming specific goals. Therefore, optimality can be realized only when a specific objective function is prescribed by the decision-maker. In other words, local planning agencies must isolate goals, and then define related objective functions to reflect these goals. It is therefore imperative to state specific objective functions and simulate the spatial variations of location for an outdoor recreational facility. Community priorities become the specific objective functions and these are the important representative goals of the decision-maker.

With the discussion of the primary objective presented as the development of a land use selection model for outdoor recreation planning, identifiable secondary objectives can be realized as by-products from the above-stated primary objective. Since the planning model is designed for county planning agencies, the application of this model to similar counties to solve outdoor recreational land use selection problems is feasible. The utility of this planning model is greatly increased since its application to other counties or multi-county

units is possible. Hopefully, further work can be initiated by other researchers and planning bodies to develop its utility.

Outdoor recreational consumption has increased over the past decade, and is reflected in the high participation and visitation at recreational sites.[1] Increases in recreational demand have been projected into the future based upon current participation or visitation rates and socio-economic characteristics in our society. Shifts in demand have been predicted based on changes in per capita income, occupations, tastes and preferences, transportation accessibility, outdoor recreational supplies, advertising, management, and population.[2] As a result of shifts in the demand curve, influenced by the above factors, we may infer that outdoor recreational demand is increasing. With this phenomenon occurring, it is necessary that the decision-maker be prepared to fulfill these desires both on a local level and in conjunction with adjacent regional population centers, affecting a county unit. It is assumed that, the source of revenue for the recreational facility indicates the clientele to be served within a local community. Therefore, a decision-making framework is necessary for the allocation of recreational lands, if we are willing to supply goods and services to meet either existing or future demands.

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[1]U.S. Outdoor Recreation Resources Review Commission, Outdoor Recreation for America (Washington, D.C.: U.S. Government Printing Office, January, 1962), p. 25.

[2]Marion Clawson and Jack L. Knetsch, Economics of Outdoor Recreation (Baltimore, Md.: John Hopkins University Press, 1966), pp. 137-140.

In analyzing land use within counties, marginal land being utilized for agriculture, or forestry, is being phased out of production because of its lower productivity. The contribution of this land to agricultural or forestry returns is low. Marginal land neither provides high profits nor can withstand the collection of substantial tax revenues. We may in this planning model analyze these lands and suggest other uses based upon specific valued attributes of recreation. By isolating recreational product attributes for specific activities, we may insure greater economic and social rent from low value marginal lands.

Finally, to allocate outdoor recreational areas and open space within a county, it is necessary to construct recreational land use selection models. Increased land use pressures have made planners aware of conflicts and externalities. Without an analytical framework to inventory land use characteristics and reflect community priorities, community desired land uses may be jeopardized.

From the above paragraphs there seems to be a need for an outdoor recreational planning and decision model. Furthermore, a model which can simulate community priorities and analytically portray the trade-offs of each decision can approach optimality in resource allocation.

CHAPTER II

RECREATIONAL PLANNING

Previous Planning Methods and Models

Outdoor recreational land use planning models have been developed by various levels of government, by private consulting agencies, by university research institutions, and stimulated by the needs of the local communities. The outputs of these individual organizations range from federal plans, to state comprehensive plans, and to municipal plans of large and small communities.

Outdoor recreational land use planning, in the theoretical sense, has occurred mostly within universities, where researchers strive to design integrated planning models. Federal and state agencies approach planning with a broader planning theme which supports general public needs. Private consulting firms tend to either support agency directions or are utilized to identify specific recreation needs and problems.

In general, two dimensions have been analyzed by outdoor recreational planners. First the temporal aspects of recreation have been identified as recreational needs which are extended into the future. The forecasting of outdoor recreational demand has been promoted by federal and state agencies in order to determine appropriations for recreational facilities.

Second, the spatial dimension, or the locational distribution of outdoor recreation developments, has generated attention. A necessity exists to balance the recreational desires of a population with the recreational resources available. Recreational resource inventories have assisted planners in evaluating the spatial dimension of outdoor recreation. Within this study the spatial dimension will be emphasized, to promote recreational planning. Furthermore, the author wishes to incorporate decision rules dictating the selecting of sites from a spatial array.

In the past, spatial analysis of recreational resource information has been investigated or researched mostly by university personnel, but state planning agencies have begun to analyze these topics more recently. One of the most recent operational inventory analysis systems was developed by the Center for Aerial Photographic Studies at Cornell University, which classifies various land use information.[3] This system, entitled the LUNR System (Land Use and Natural Resource System), was directly utilized by the New York State Office of Planning Coordination and has generated a series of reports concerning existing natural resources and land use characteristics. The resource inventory system utilized the SYMAP mapping computer routine developed by the Laboratory of Computer Graphics,

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[3]Ernest J. Cole, A Review of the New York State Land Use and Natural Resources Inventory, Center for Aerial Photographic Studies (Ithaca, N.Y.: Center for Aerial Photographic Studies, March, 1970), pp. 1-52.

Graduate School of Design at Harvard University.[4] This system utilized aerial photographs, 7½ minute U.S.G.S. quadrangle maps and ground truth points to inventory resource data, then the data was coded to Universal Transverse Mercator grid coordinates, and transposed onto data processing cards. The SYMAP computer routine was utilized to visually display information for the clients' review. Classification of data was based upon the use and need for state, regional, or local planning and development. Fifty land use areas and seventy items of point data were derived from the selected resource materials. However, the potential capacity to incorporate other land uses and point data items has not been reached in computer utilization. The computer outputs appear as tabular lists and summaries of data, or else in a graphic presentation. From these outputs, aid has been given to local planners, planning boards, and cooperative extension agents at a cost which is less expensive than if collected on an individual basis. Hence, economies of scale derived from a large data bank are possible within the LUNR system.

Further description of the LUNR system defines three major computer programs with specific uses: 1) DATALIST I, 2) PLANMAP II and 3) PLANMAP III. The DATALIST I computer program prints out a tabular listing of area or point land use data with supplemental or with combinations of data.[5] DATALIST I

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[4]Howard T. Fisher, SYMAP Mapping Technique, A Report from the Laboratory for Computer Graphics at the Graduate School of Design, Harvard University (Cambridge, Mass.: Harvard University, 1967).

[5]N.Y., Office of Planning Services, New York State Land Use and Natural Resource Inventory: What It Is and How It Is Used (Albany, N.Y.: Office of Planning Services, September, 1971), p. 10.

minimizes inaccuracies since it records and displays specific point information. Application of this program has been utilized by researchers at Cornell University to analyze watershed and land use characteristics adjacent to the Finger Lakes of New York State.[6] From this information, environmental impacts resulting from land use changes can be measured and compared from point information along watersheds.

The PLANMAP II computer program makes use of computer graphics as a device to display patterns and geographical interrelationships.[7] Ten grouping levels of information can be derived and displayed. As a result of groupings, some detail and accuracy is lost; however, a decision rule may be employed to select desired cell characteristics. Hence, locational patterns of cells can be produced reflecting variate interaction. This is an important addition to land use planning since it allows the researcher to simulate specific guidelines and land use standards. Therefore, the spatial dimension of resource analysis has been strengthened by this program. Specific application of the PLANMAP II program to outdoor recreation problems has been conducted by the New York State Office of Parks and Recreation.[8] The major objective of

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[6]David Child, Ray T. Oglesby, and Lyle S. Raymond, Jr., Land Use Data for the Finger Lakes Region of New York State, Report for the Water Resources and Marine Sciences Center, No. 33 (Ithaca, N.Y.: Cornell University, March, 1971), pp. 1-29.

[7]New York State Land Use and Natural Resource Inventory: What It Is and How It Is Used, p. 13.

[8]Stephen O. Wilson, et. al. Potential Recreation and Open Space Areas in New York State, N.Y., State Office of Parks and Recreation, Technical Paper No. 6 (Albany, N.Y.: Office of Parks and Recreation, July, 1970), pp. 16-18.

a specific study by the above agency was to indicate potential open space and recreation areas on a statewide basis. Indicator cells represented specific resource characteristic combinations yielding favorable sites for future sites.

Finally, the PLANMAP III program is a refinement and extension of the existing PLANMAP II and DATALIST I programs.[9] Its application and development has not been extensively used within the state, since experimental work is still occurring at this time. However, in general, PLANMAP III incorporates greater simulation potentials toward recreational land use planning strategies. An increased number of decision rules may be written as program statements, allowing the manipulation of more land use variables. As the PLANMAP programs become more sophisticated, we may approach optimum land use planning for outdoor recreation at the local, regional and state levels.

Further development of resource information systems has occurred within the State of Illinois. The University of Illinois at Champaign-Urbana has developed the Natural Resources Information System, (NARIS), under the ILLIAC IV Project and in conjunction with the Northeast Illinois Natural Resource Center.[10] NARIS stores and retrieves information from forty-acre tracts or quarter-quarter sections in the rectangular survey system. Data are collected for eight resources and land

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[9] New York State Land Use and Natural Resources Inventory: What It Is and How It Is Used, p. 21.

[10] Daniel Slotnick, Natural Resources Information System, Report of ILLIAC IV Project, (Champaign-Urbana, Ill.: Northeast Illinois Natural Resources Center, 1970).

characteristics: soils, geological features, ground water and surface water, forests, climate, water impoundments, topography and land use.

The outputs of NARIS fall into three areas based on specific clientele and intensity of utilization. The Inventory Listing is the first level of computer output. It simply lists the natural resource corresponding to specific identifiable tracts or quarter-quarter sections.[11] From this information listing, a simple description of the conditions related to the existing resources are presented to the user.

Secondly, the Technical Description of the recorded resource is provided in order that the user may become familiar with detailed characteristics of the resource.[12] In essence, technical descriptions serve as a library file for the analysis of individual resources.

Thirdly, the Report-Interpreter serves an interpretation function for the user of NARIS.[13] The design of this program is oriented towards the layman who may be analyzing a site for development. Whereas the technical description program is directed to scientists familiar with the detailed characteristics of a selected resource, the Report-Interpreter assists user groups in the analysis and impacts of the resource characteristics.

Extension of NARIS to the National Environmental Data

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[11]Thomas P.L. Dowell, Jr., NARIS: A Summary Report of the Natural Resource Inventory System, (Champaign-Urbana, Ill.: University of Illinois, July, 1970), p. 4.

[12]Ibid., p. 4.

[13]Ibid., p. 4.

Bank was proposed in June, 1970.[14] According to this proposal, the system structure would be expanded to a national level at an investment and operations cost of seven to ten million dollars per year. Thus far, the proposal has not been accepted. Furthermore, budgetary problems within the State of Illinois have not allowed NARIS to advance rapidly. This situation may be explained since the benefits of the system are not clearly defined to the political decision-makers.

The State of Indiana has promoted the development of the Indiana Information Retrieval System (INDIRS).[15] This is a statewide time-sharing information system consisting of socio-economic data files in conjunction with statistical and display programs. Socio-economic data are available for Indiana's ninety-two counties, two-hundred-and-seventeen selected communities, and eleven Standard Metropolitan Statistical Areas. Fourteen classes of information are available on a county basis which are derived from county census abstracts, retail trade, and Indiana school districts. The spatial dimension of the system is not uniform since information is generated from socio-economic modes such as communities, Standard Metropolitan Statistical Areas, and economic regions. The output of the information system is primarily a list of data or information statistically displayed for summary purposes. The output is primarily oriented towards users having specific training

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[14] Ibid., p. 4.

[15] Indiana Information Retrieval System, Division of Research, Graduate School of Business (Bloomington, Ind.: University of Indiana, Graduate School of Business, 1970).

in associated resource information. Further capabilities of the system have not been identified since the initial impacts of the system have not been evaluated.

The Canadian Government has initiated a spatial resource analysis for outdoor recreation oriented towards capability classification.[16] The objectives of the land capability classification were to inventory, identify, classify in relation to type, and to provide information for policies and decisions to be made by national and local governmental units. The classification was derived from a stated premise by the Canadian Government as follows:

> Basis of Classification...
> is the intensity of use or average annual total quantity of user per unit area which could be generated under perfect market conditions and sustained by an area or recreation feature.[17]

On this basis, outdoor recreational activities were selected and potential outdoor recreational sites were evaluated in relationship to the activities requirements and in conjunction with market structure. Outdoor recreational capabilities based upon user intensity, are classified in seven classes ranging from very high capability to very low capability. Class 1 lands have natural capability to attract and sustain very intensive use. Class 7 on the other hand, classifies land with practically no natural capability for any

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[16] G.A. Hills, The Ecological Basis for Land-Use Planning, Ontario, Ontario Department of Lands and Forests, Research Report No. 46, (Toronto, Ontario: Department of Lands and Forests, December, 1961), pp. 1-204.

[17] Ibid., p. 123.

popular types of recreation activity due to an almost total lack of recreation features. Benchmarks and guidelines utilizing measurement units such as lineal and aerial miles of navigable water, water temperatures and ranking qualities, slope percentages, and forested land type percentages were objectively formulated in order to classify. Subjective inputs were integrated into the system in order to identify unique outdoor recreational features. Symbols indicate the classes, dominant recreation features, and a color coding indicated the classification in map form. Legends and a narrative of up to one thousand words may occur in providing supplementary user information.

Federal agencies within the United States, specifically the Soil Conservation Service, has formulated a framework for appraising the potential of outdoor recreational developments. It has constructed guidelines based upon climate, scenery, and scenic areas, natural areas, historic areas, soils, water, wildlife, populations of people, proximity and access, and rural ownership and land-use patterns. Within each of the above areas, kinds of activities associated with each area were evaluated and numerical weights assigned to each. A higher numerical weight was given to positive climatic characteristics or a site which provided greater utilization for vacation campgrounds rather than sites which provided limited seasonal uses. The numerical rankings of the sites were accomplished through group judgement. The reliability and accuracy of site evaluation depends heavily on the knowledge of the natural resources of the area by the selected appraising panel. The composite

rankings for specific activities or area site evaluations are only indicative of the level of opportunity. Subjective analysis was also a necessary component associated with the ordinal classification scale. Application of this technique to evaluate outdoor recreation potentials has been conducted in various counties in the country. The Soil Conservation Service of Jefferson County, New York has conducted an investigation into twelve kinds of outdoor recreational developments.[18] The outputs of the study include improvements in a long-range recreation program, information generating financial needs for recreational developments, and information identifying project proposals. The study area under investigation has been appraised by the Soil Conservation Service framework. The Cooperative Extension Service of Orleans County has computed composite scores for the previously defined areas and recreational activities.[19] Identification of the recreational areas and their evaluation resulted. Air photo coverage assisted in identifying the recreational potentials and the existing activities being participated in within the county.

Land use information systems have been proposed by governmental agencies and by university researchers. Generally their

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[18]Donald J. White, An Appraisal of Potential Outdoor Recreational Developments in Jefferson County, New York, U.S., Department of Agriculture, Soil Conservation Service and Cooperative Extension Service, (Washington, D.C.: Government Printing Office, February, 1966), pp. 1-80.

[19]Orleans Recreation Committee, Appraisal of the Committee, Potential Outdoor Recreational Development in Orleans County, (Orleans County, N.Y.: Cooperative Extension Service, 1971), pp. 1-24.

success has been limited by high costs resulting from data collection, computer hardware and low user demand. To verify this point, the Environmental Data Bank, proposed in the 91st Session of Congress, was designed to collect data relevant to the environment, and to analyze legislative proposals, executive proposals, and those submitted by states in order to determine their impact upon the environment. The comprehensive analysis of environmental data planned for this board was too large an undertaking. Its weaknesses included unnecessary collection and analysis of a complete data system, rather than the use of standardized techniques of sampling and analysis which would permit comparisons; duplication of information previously collected by the Council on Environmental Quality and the Office of Environmental Quality, dependence on other agencies for information and computer facilities; storage problems; time and cost.[20] This type of land use information system failed because of its massive size, its concern for over detail, and its costs in time, labor, and hardware.

Suggested reasons for failure of land use information systems are based on low user demand.[21] These include: 1) public skepticism, 2) irrelevance of the master plan to community needs, 3) communications gap between the designer and

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[20] Environmental Data Bank, Hearings, before the Subcommittee on Fisheries and Wildlife Conservation of the Committee on Merchant Marine and Fisheries, pp. 25-26.

[21] Dwight F. Rettie, "Plans Don't Work; People Do," Elements of Outdoor Recreation Planning, edited by B.L. Driver, (Ann Arbor, Mich.: University Microfilms, 1970), pp. 299-307.

the community, and 4) non-availability of the information designer for help in application of the plan.

The data collection costs are often so high in these large land use information systems that the economies of scale obtained from high use is never realized.

Political differences between governmental bodies have induced problems in data standardization and integration. The inefficiencies of the Environmental Data Bank in part resulted from this dependence, whereby all other legislative and executive agencies had to supply their environmental facts and permit the board use of personnel and computer hardware in analyzing the information received.

Further analysis of recreational land use planning indicates that there are specific philosophies involved in individual planning methods. These philosophies may have ecologic, economic, or aesthetic themes directing land use decisions. The utilization of these philosophies has been extended to general land use models encompassing basically all types of land use. However, recreational land uses are an important portion of the general planning designs. In order to analyze recreational planning models, it is necessary to classify the models as related to the above philosophies.

Ecological land use models are based upon a knowledge of the biological productivity of natural resources. The objective of the models is to correlate the ecological base of land with a corresponding land use. From this relationship, an use-capacity can be determined which allows the renewable

resource to be in phase with the land use. In recreational land management, the physiographic and biologic features of an area must be maintained at a productive level in order to conserve the resource base. A "safe minimum standard" has to be determined in order to effectively plan recreational uses.[22] Another facet of recreational land management is the aspect of man-management. Since the ecology of an area is an important criteria in planning, man's behavior affecting the environment is the important component of land use model analysis. Selected ecological land use models will be analyzed and their applications to recreational planning investigated.

One of the early ecological recreational land use models was designed by the Ontario Department of Lands and Forests.[23] The model identified a step-wise procedure to assist in the allocation of land uses based upon ecological constraints. Eight steps have been formulated with the first step identifying the spatial pattern of the physical components; second step, presenting uses of the physical components; third step, establishing the use-capability ratings; fourth step, mapping of use-capability classes; fifth step, potential of land use; sixth step, recommendations for uses; seventh step, proposed scheduling of land uses; and eighth step, progress of land use planning recommendations. The recreational land use model

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[22] S.V. Ciriacy-Wantrup, Resource Conservation Economics and Policies, (Berkeley, Calif.: University of California Press, 1968), Chapter 18.

[23] G.A. Hills, The Ecological Basis for Land-Use Planning, p.123.

proposed by the Ontario Department of Lands and Forests can be understood from the above step-wise sequence of planning and site selection procedures.

Further construction of ecologically based planning models have been produced at the University of Pennsylvania by Ian L. Mc Harg.[24] The major objective of his model is to determine the degree of compatibility for multiple land uses based upon ecological impacts. The model identifies a matrix in which the physical requirements of land uses are aligned with the ecological constraints of the given study area. With this inventory completed, proposed land uses are compared with each other, and compatibility derived. From a matrix of compatibilities, suitable areas are located within a given study area. The matrix includes a correlation between urban, suburban residential, industrial, institutional, mining, quarrying, vacation settlement, agriculture, forestry, recreation and water management. The model identifies six recreational uses: salt water oriented, freshwater oriented, wilderness, general recreation, cultural recreation and driving for pleasure. From this identification of recreational land uses, recreational activities are located within a study area based upon their ecological constraints and their compatibility to other land uses. Again, the physical landscape is the most influential element within the ecologically based planning models.

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[24]Ian L. Mc Harg, Design With Nature, (Garden City, N.Y.: The Natural History Press, 1969), pp. 1-195.

Ecologically based models have been greatly supported in current times as a result of a recent insurgence for environmental quality. The Mc Harg model is the most recent ecological planning model. However, the Philip Lewis model, and the Angus Hills model also contribute to ecological base planning.[25] Each method utilizes the natural physiographic unit as a planning base for land use decisions.

The second philosophy is based upon economic factors concerning land use decisions. The economic objective involved in land use planning is based upon the maximization of social welfare and monetary returns from either public or private investments. This is accomplished through planning which seeks to minimize development costs, transportation costs, acquisition costs, management costs, public tax loss, or opportunity costs. Furthermore, monetary returns can be increased, by stimulating demand, providing a pricing structure which satisfies effective demand, and satisfying option demand for recreation. Generally, economic based land use models either tend to minimize distance to the market place or increase output at point of production, or minimize all transfer costs, or supply effective demand.

Simulation has been utilized to determine effective demand areas for recreation in the State of Michigan in order to plan existing and future facilities. The RECSYS--SYMAP model at

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[25]Belknap, _____ and Furtado, _____, "The Natural Land Unit as a Planning Base," Landscape Architecture, LVIII, No. 2 (February, 1968), p. 136.

Michigan State University was utilized to simulate origins and destinations of recreationists.[26] A system design utilizing electrical engineering principles helped simulate the gravitational interaction of recreationists, hence identifying potential demand areas.[27]

Econometric models have been derived to approximate recreation demand in order to plan and budget recreation facilities.[28] Given a number of predetermined variables during a given time period, economic theory is combined with statistical analysis to simulate a demand relationship for recreation. This demand relationship can then be applied to population distribution information indicating recreational planning needs. The results of this study can be applied to effectively fulfill recreational demand since the study encompassed a pricing structure.

Economic based recreational land use planning models have also been developed by the U.S. Forest Service. The economic concerns of recreational land use planning has become increasingly important since recreation is coming into conflict with other forest land uses. In a paper, George A. James stated

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[26]Michael Chubb, Outdoor Recreation Planning in Michigan by a Systems Analysis Approach, Part III, State Resources Planning Program, Technical Report No. 12, (December, 1967).

[27]John B. Ellis, Outdoor Recreation Planning in Michigan by a Systems Analysis Approach, Part I, II, Technical Report of the State Resources Planning Program, No. 1 and 7, (East Lansing, Michigan, May, 1966).

[28]Robert J. Kalter and Lois E. Gosse, Outdoor Recreation in New York State: Projections of Demand, Economic Value and Pricing Effects For the Period 1970-1985, Special Cornell Series, No. 5, (Ithaca, N.Y.: New York State College of Agriculture, 1970).

that,

> The need to gather reliable information about our recreating public - the kind and amount of use that occurs and the places where this use occurs - is urgent and critical. It will never subside. The things that we need to know a great deal about are becoming more numerous and more complex because more people engage in more activities more frequently on more developed sites and more classified areas with more kinds of facilities costing more money and occupying more land and more water under more intensive management while more stringent budgetary requirements demand more specific information to satisfy more public interest in more types of programs, coordinated with more agencies involved in more efforts.[29]

Hence, the economic impact of land use decisions affects the public and private sector, because recreation is produced by both. Recreational developments cause changes in a county's or community's infrastructure since it is necessary to supply services to an incoming transient population. As reflected by the above quotation, the adjective "more" seems to be a commonplace term in recreational planning. The economic impact of this phenomenon has to be considered, hence, researchers have devoted energies towards investigating economic relationships.

An earlier work written by Beasley concerns the optimizing of public forest recreational investment.[30] He identified recreational values derived from public investment in forested areas. The values were related to greater physical health, better mental hygiene, education and cultural effects, and

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[29]George A. James, "Inventorying Recreation Use," Recreation Symposium Proceedings, State University of New York College of Forestry, (Syracuse, N.Y., October, 1971).

[30]Ronald I. Beasley, "Some Considerations for Optimizing Public Forest Recreational Development and Value," Journal of Forestry, LIX, No. 9 (September, 1961).

the immediate satisfaction of consumption.[31] In other words, utility value is generated from participation in the recreational activities and expected future value may be realized. Further monetary benefits may be determined if prices can be attached to recreational products. If recreational products are priced, the public and private sector may be able to deliver those goods and services in which the public has truly expressed demand. Furthermore, the costs of producing recreational goods and services can be supported by the participating user groups. Consumer surplus, or the difference between total utility and total market value, gross dollar volume of business or income, monopoly revenue, or contrived scarcity, and visitor expenditure surveys all attempt to price recreation so that a monetary value can be estimated.[32]

The majority of the research directed towards recreational development have been brought to the forefront. It is necessary to ask the question, what does it cost the taxpayer to provide public recreation? In a case study conducted by Manthy and Tucker, the supply costs for public forest land recreation were analyzed.[33] The researchers simulated a supply model identifying the production costs and the consumption costs

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[31] Ibid.

[32] Wendall Beardsley, "Economic Value of Recreation Benefits Determined by Three Methods," U.S. Forest Service Research Note, RM-176, (1970).

[33] Robert S. Manthy and Thomas L. Tucker, Supply Costs for Public Forest Land Recreation, Michigan State Agricultural Experiment Station, Report No. 158, East Lansing, Michigan, March, 1972, (East Lansing, Mich.: Michigan State University, 1972).

of recreation. The production costs were cost of capital improvements including land acquisition, facility construction, and improvement and major repair expenditures. Production costs also include operating expenditures which encompass maintenance, equipment, salaries, and other operating costs. The summation of the above costs are referred to as the direct costs to the producing agency. The consumption costs to the consumer of recreation are defined into two major areas: 1) associate cost and 2) threshold cost. The associate costs include user fees, equipment costs and trip expenditures; whereas, threshold costs indicate the minimum amount of equipment necessary to recreate. The study adds a needed dimension for recreational land use planning. However, this investigator feels that the direct costs are the major costs to be considered by the community when deciding the location of prospective recreational sites, since it comprises a higher proportion of total recreational development costs.

The third philosophy of recreational land use planning is aesthetically based. With this emphasis, recreational land values are identified and utility is derived from their existence. Specific planning models such as those derived by the United States Forest Service have helped promote the aesthetic values important for the recreational experience.

Recreational aesthetics derived from the landscape indeed provides utility to the consumer. Research has been conducted to measure landscape qualities which have provided recreationists the greatest satisfaction for a single recreational experience. Shafer and Mietz attempted to quantify scenic

photographs in order to predict preferences from recreationists.[34] A landscape-preference model was developed and tested using recreationists in New York and Utah as subjects. Eight zones were defined within a landscape photograph and randomly selected day-users were asked to rank the photographs. Using this ranking procedure, landscape tastes were recorded and preferences summarized. Thus study helped gain a statistically valid estimate for recreational landscape preferences. It allowed the consumer to select that recreation output that he valued the most.

Visual analysis of the landscape becomes an important facet in evaluating aesthetic qualities. Twiss has identified six factors of observation and scenic composition which he ranked in descending order. The factors are: 1) distance 2) light 3) topographic form and contrast 4) spatial definition 5) observer position and 6) sequence.[35] Distance was divided into planes or grounds; light considered on a diurnal and seasonal basis in conjunction with direction and intensity; topographic form and contrast related to visual focal points and areas of structural landscape framework; spatial definition corresponding to a composite relationship; observer position concerning perspective; and sequence of observer positions in viewing the above factors. The research presents

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[34]Edward L. Shafer, Jr. and James Mietz, It Seems Possible to Quantify Scenic Beauty in Photographs, U.S., Department of Agriculture, U.S. Forest Service, Forest Service Research Paper NE-162, (Northeastern Forest Experiment Station, 1970).

[35]Robert H. Twiss and R.B. Litton, "Resource Use in the Regional Landscape," Natural Resources Journal, Vol 6, No. 1, (January, 1966), p. 212.

an abstract approach to visualizing scenery and can only be utilized as a framework for further classification and quantification.

An attempt to quantify scenics was formulated by Leopold in an analysis of a river valley.[36] Leopold's work was developed from a concern based upon environmental disputes in Congress. He stated that:

> The time has come when the argument of the environmentalist might best be presented by (1) separating facts from emotions in relation to the environment, and (2) by providing him with a means of quantifying his arguments: using numbers to talk about the landscape. While to some of us this may be a little like using a computer to describe Shakespeare, it seems that society still has the right to have all aspects of any proposed development represented in a way that is as objective as possible.[37]

From this basis, an analytical model was constructed evaluating the aesthetic qualities of sixteen river valleys from a forty-six factor checklist. Descriptive categories were utilized to include physical factors, such as river width; biologic and water quality factors, such as water color; and human use and interest factors, such as vistas. From the forty-six factor checklist, each river valley could be ranked by an ordinal scale to indicate relative aesthetic importance. A total uniqueness ratio was computed as the objective measure for further decision making. Hence, perceived aesthetic values viewed by recreationists gained objectivity and a definable dimension.

Landscape descriptions and inventories have become im-

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[36]Luna B. Leopold, "Landscape Esthetics," Natural History, (October, 1969), pp. 37-44.

[37]Ibid., p. 37.

portant components for land use planning and design. Litton and Twiss, in conjunction with the U.S. Forest Service, and with previous research as described earlier by Twiss, expanded upon the visual factors of scenery.[38] The simulated pictorial examples describing the visual factors of a landscape so that designs could be utilized for future recreational sites. Scenic corridors were planned with corresponding zones based upon the selected factors. Application of the visual aesthetic qualities were taken into consideration in recreational land use planning design.

The above studies have been reviewed in order to classify recreational planning land use models. In order to discuss these models it was necessary to classify them in a rational manner. However, it must be recognized that overlaps occur between models as philosophies are somewhat integrated. However, it is the author's contention that the degree of integration between philosophies has not reached a level to approach optimal planning decisions with assumed goals. It can be inferred that each model still attaches itself to a specific discipline within the scientific structure of knowledge.

In summarizing the preceeding analysis of outdoor recreational land use planning, the investigator has chosen to research the subject by: 1) analyzing governmental and institutional recreation planning, and 2) reviewing specific recreation land use models. From this analysis, inferences are

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[38] R.B. Litton and R.H. Twiss, "The Forest Landscape: Some Elements of Visual Analysis," Proceedings, Society of American Foresters, (Seattle, Wash.: 1966).

derived related to recreational land use planning in general.

First, recreation models are not linked to a decision-maker or do not allow the decision-maker to analyze tradeoffs between decisions. Although recreation models provide tradeoffs for decision-makers, most local and federal planners cannot use this service. As a result, the application of valid models is reduced, since the decision-maker is excluded from the planning process. If the planning models do not take into consideration the decision-maker, it is difficult to transfer the strengths of a model to a given client. Therefore, the optimality expressed by a land use model cannot be realized or the model is discounted by the decision-maker because he does not understand its structure or its implementation. The researcher becomes frustrated since the decision-maker does not take into account a newly discovered planning device. Also, the decision-maker feels that the researcher's model has little application since it does not relate directly to his problems. Hence, a separation between agencies, universities, researchers, and communities occurs.

It is the investigator's contention that recreation land use planning models should be designed to describe the tradeoffs or consequences of alternative decisions, rather than make a specific decision for the decision-maker. It is a researcher's function to present information in such a way that will allow the decision-maker to make a better decision. In this context, a better decision is one which more nearly satisfies the objective function as contrasted to a "less better" decision. Hopefully, the decision-maker represents

the public and reflects their priorities and community goals. It is the researcher's job to reflect the impacts and trade-offs produced by land use decisions, or, to simulate community priorities and describe the trade-offs occurring between priorities.

An attempt was made in the study described in this thesis to simulate community priorities and derive objective functions to express these priorities. The purpose of the model developed in the study was not to select a specific priority, but to select a series of priorities and then analyze their spatial interaction. The model assists the decision-maker in selecting an optimal decision, based upon the community's objective function.

Second, in order to seek an optimal solution in recreational land use planning, an interdisciplinary analysis approach must occur. In other words, it is necessary to integrate physical, economic, and aesthetic factors into an analytical framework. In such an analytical framework, community priorities may be matched to the above factors and comparisons made. An attempt to integrate these is made in the following model design. The following section of Chapter II will explicate those components to be analyzed by the model, including the physical, economic and aesthetic characteristics of Orleans County, New York. It will spell out the simulated priorities of the community. In addition, the analytical design of the model will be outlined and explained.

Proposed Outdoor Recreational Land Use Selection Model

The design of the proposed model is based upon specific assumptions as specified below. Since many recreational land uses occur and compete for space it is necessary to select a specific activity. Furthermore, various delivery systems supply recreation for various clientele. Therefore, it is necessary to define the clientele, and to identify the delivery system's characteristics. However, the model has the capability to analyze other recreation activities by adjusting its parameters. For this investigation, the author has chosen a county government as the client. The study is designed to select areas for outdoor camping, and to have the facility developed using public revenues. It can be further stated that the output of the model is a presentation of computer maps displaying feasible sites for campground development. These maps can be utilized by decision-makers in choosing the site for a local camping facility. The clientele of the new facility are the populus of Orleans County, which is represented by county government. The sources of revenues include appropriations from the county, state or federal budgets, or combinations thereof. Given these assumptions, the objectives of the model may be outlined. Later the logic used to develop the analytical framework of the model will be reviewed, and its mechanism or workings identified.

The model is based upon an objective statement, which states that in order to approach optimal recreational land

use planning, it is necessary to simulate community objective functions and linkages to the decision-makers, and to integrate the physical, economic, and aesthetic factors of land resources. The first portion of the statement relates to the theoretical concept of optimality. It is the investigator's contention that optimality is related to the priorities of the community. Therefore, if a model seeks to fulfill community priorities, we indeed approach an optimal situation. We must assume that the decision-maker represents those community priorities and that he opts to fulfill them. The fulfillment of community priorities is considered to be the goal to be maximized in this study.

Furthermore, we must also assume that the physical, economic and aesthetic elements are the resource components to be analyzed. It is from these components that the community wishes to select a product mix. Therefore, to approach optimality, an outdoor recreational land use planning model must allocate the above components in such a way that it yields an output which satisfies stated community priorities.

The model expresses trade-offs between the components of land resources and community priorities. It must be understood that as we increase the utilization of one component we must decrease the utilization of another or substitute one for the other. Therefore, as community priorities shift to a different product mix, the combination of resource inputs adjusts accordingly. A community and decision-maker must accept the fact that it is necessary to give up derived values from one resource characteristic as the community's priorities change.

Hence, in order for decisions to be made correctly, trade-offs must be expressed and weighed analytically.

The model identifies proposed community priorities as objective functions. The objective functions are derived from specific variates measuring the physical, economic, and aesthetic components. The objective functions either minimize or maximize a prescribed relationship.

In order to spatially analyze the land resources of a given area an inventory system must be constructed. Furthermore, a spatial analytical framework is necessary for solving prescribed objective functions and selecting recreational land use sites. In order to integrate the components of land resources, a simulation model must be constructed to present the objective function, integrate the components, and simulate community priorities.

The first step in constructing the proposed model was to state the objective functions. That is, the proposed community's goals are stated in an objective function format for decision-making. Based upon the components of land resources, objecitve functions are derived. It is believed that community priorities are related to land resource components. Therefore, the objective functions must reflect the physical, economic, and aesthetic components of land resources.

Remembering those previously stated assumptions, the author can identify the proposed community priorities (of the study area, Orleans County), as four objective functions. Briefly outlined, these objective functions include: 1) minimizing

property tax loss when non-marginal changes in land use occur, and lands become publicly owned; 2) minimizing development costs of proposed recreation facility; 3) minimizing total costs and 4) identifying aesthetic values in order to maximize socially perceived benefits derived from physical land resources.

The first objective function is to minimize the property tax loss resulting from a non-marginal change in land use, and the change from private ownership to public ownership. As a result of providing public recreation, existing property tax revenues derived from private utilization will be no longer available. Therefore, it may be a proposed community priority to select those sites which minimize the loss of property tax revenus to the county. This may involve the selection of sites which have lower land values and minimal capital improvements including buildings and taxable property possessions. We may equate property tax loss to opportunity cost as we analyze the non-marginal change of private use to public use.

In previous studies conducted by forest economists, opportunity cost has been utilized to measure the value of alternative uses. The concept of opportunity cost is valid only under two conditions: 1) when the resource is scarce, and 2) when the resource has alternative revenue-generating uses.[39] Opportunity costs occur when land changes use such as from commercial timber growing to public recreational

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[39]G.H. Manning, Linear Programming, Resource Allocation and Non-Market Benefits, Minstry of the Environment, Report No. 1298, (Forest Economics Research Institute: Ottawa, Ontario, 1971), p. 2.

development. Rickard, et. al. (1966) used opportunity cost to measure the value of recreation within the Umpqua National Forest in Oregon. In this study, the minimum value of recreation to its users was the present net worth of the net stumpage.[40] The cost of public recreation is the value of the harvestable timber within a site if the timber is not harvested but left for recreational purposes.

This view of opportunity cost is evident in the statement of the first objective function. That is, the function minimizes the opportunity cost in site selection by minimizing property tax loss to the county. Hence, the proposed community's priority is opted within the above objective function.

The second objective function states that in order to approach optimality in site selection, it is necessary to select those cells which minimize the development costs associated with the proposed recreational facility. Development costs vary spatially over the county and therefore, specific areas reflect higher or lower costs. Physical factors greatly influence development costs since it may be necessary to improve the physical conditions prior to the construction of the camping facilities. Further analysis of development costs identify three major areas: 1) land acquisition costs 2) drainage costs, and 3) transportation construction costs.

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[40]Wesley M. Rickard, et. al. Economic Evaluation and Choice in Old-growth Douglas-fir Landscape Management, U.S., Department of Agriculture, Forest Service, Forest Service Research Paper PNW-49, (Portland, Oreg.: Pacific Northwest Forest and Range Experiment Station, 1967), pp. 1-33.

Land acquisition costs refer to the purchasing of private properties for public utilization. Land values vary from area to area and hence acquisition costs also have spatial differentiation.

Drainage costs are directly related to geological characteristics, soil characteristics, and slope. As a result of topographic variation, soil discontinuities, and parent materials, areal variation causes drainage costs to vary within a region.

Transportation construction costs are mainly a function of distance to existing highway facilities. Physical variation also causes costs to fluctuate spatially; however, the present model is not sufficiently sensitive to reflect physical variation in transportation construction costs. Therefore, distance is the only indicator to determine transportation construction costs per cell.

The third objective function is based on minimization of total costs. These include property tax loss or opportunity costs, acquisition costs, drainage costs, and transportation construction costs. Only those areas which satisfy the minimization constraint will be selected as feasible sites to satisfy the stated community priority.

The fourth objective function is based on the identification of aesthetic values in order to maximize the socially perceived benefits derived from the physical resources. In order to evaluate the aesthetic factors an ordinal scale had to be developed to rank and classify aesthetic values. If it

is the community's priority to locate a camping facility in order to enjoy the aesthetic qualities of an area, only those areas possessing aesthetic appeal and acceptable levels of aesthetic value would be chosen as possible campsite location.

To solve the above stated objective functions, data had to be collected to reflect costs and values. In order to collect data, a spatial framework had to be formulated to reveal the variations in the components of land resources.

To serve this purpose, the Universal Transverse Mercator grid system was superimposed over the study area. As a result, the grid system delineates cells of 247.1 acres, or one-square kilometer in size. Each cell can be identified, be observed, and data recorded concerning the variables in the model. The resource inventory framework enables the investigator to spatially analyze the data, and assists in simulating the selection of feasible cells. The spatial identification of cells and associated data allows the investigator to utilize computer mapping programs to graphically display analytical land resource components.

The GRID computer program can be utilized for graphic display of data and information collected on the basis of a rectangular coordinate grid.[41] Direct application of this computer mapping routine has been utilized by the Bureau of Census of the United States Department of Commerce. Urban data were displayed for the spatial interpretation of demographic

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[41]David Stinton and Carl Steinitz, GRID Computer Program, Cambridge, Mass., 1970, (Cambridge, Mass.: Laboratory for Computer Graphics, Harvard University, 1970), pp. 1-78.

and geographic factors.[42]

With the data observed, recorded, key punched, and validated, the objective functions were mapped by the GRID computer routine. Simulation of community priorities either single or multiple therefore can be graphically displayed to the decision-maker and feasible camping sites selected, on the basis of this information.

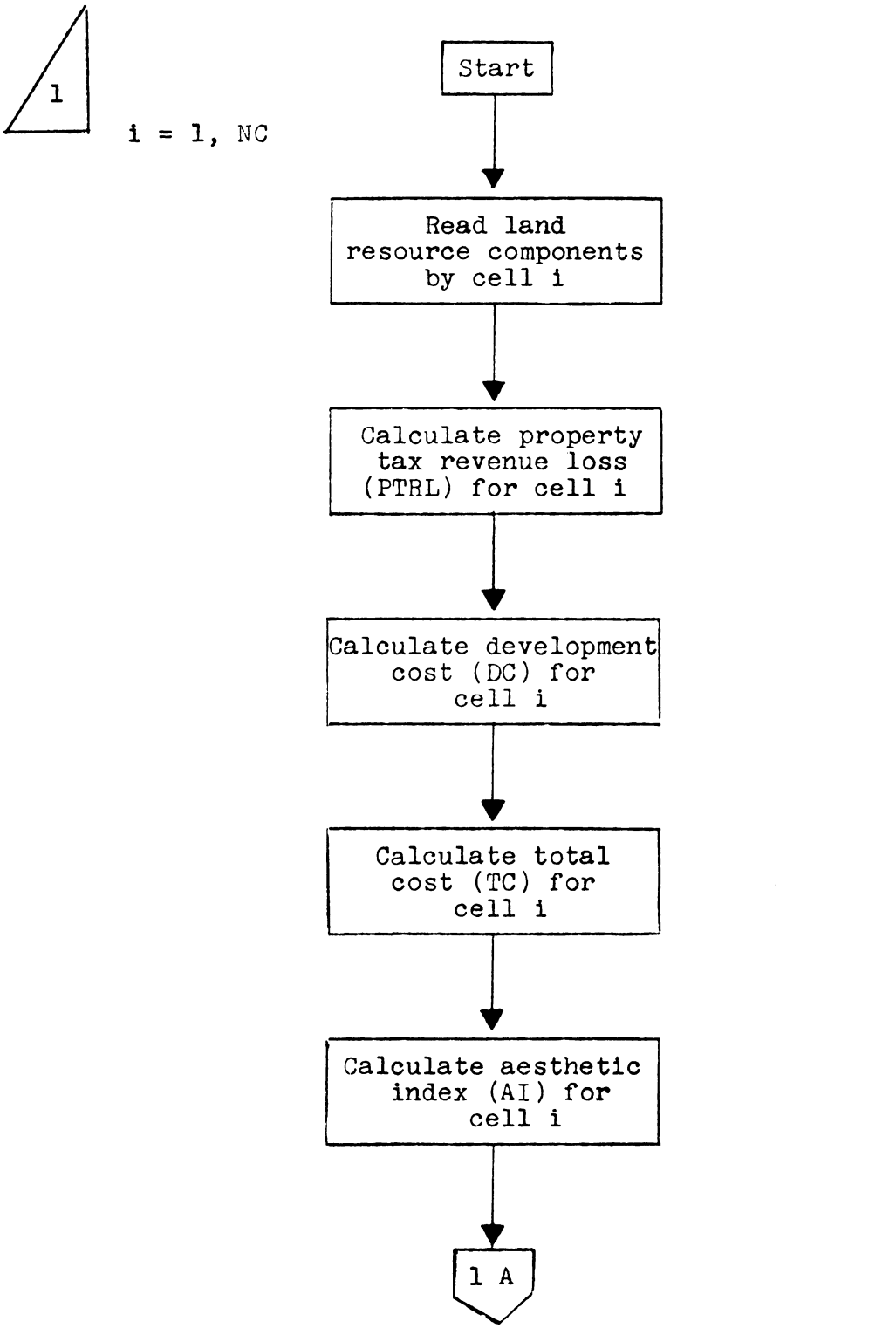
In order to present the reader with a clearer understanding of the outdoor recreational land use selection model, a flow chart was designed to describe the implicit relationships within the model. The flow chart presents a stepwise sequence to determine and select feasible sites within a study area. The flow chart integrates the resource components of the individual cells with the previously stated objective functions (Figure 1).

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[42]U.S. Department of Commerce, Bureau of Census, Census Use Study: Computer Mapping, Report No. 2, (Washington, D.C.: Government Printing Office, August, 1969).

Figure 1

Model Solution Sequence for Outdoor Recreational Land Use Selection Model



NC = number of cells within the study area

Figure 1 (cont'd)

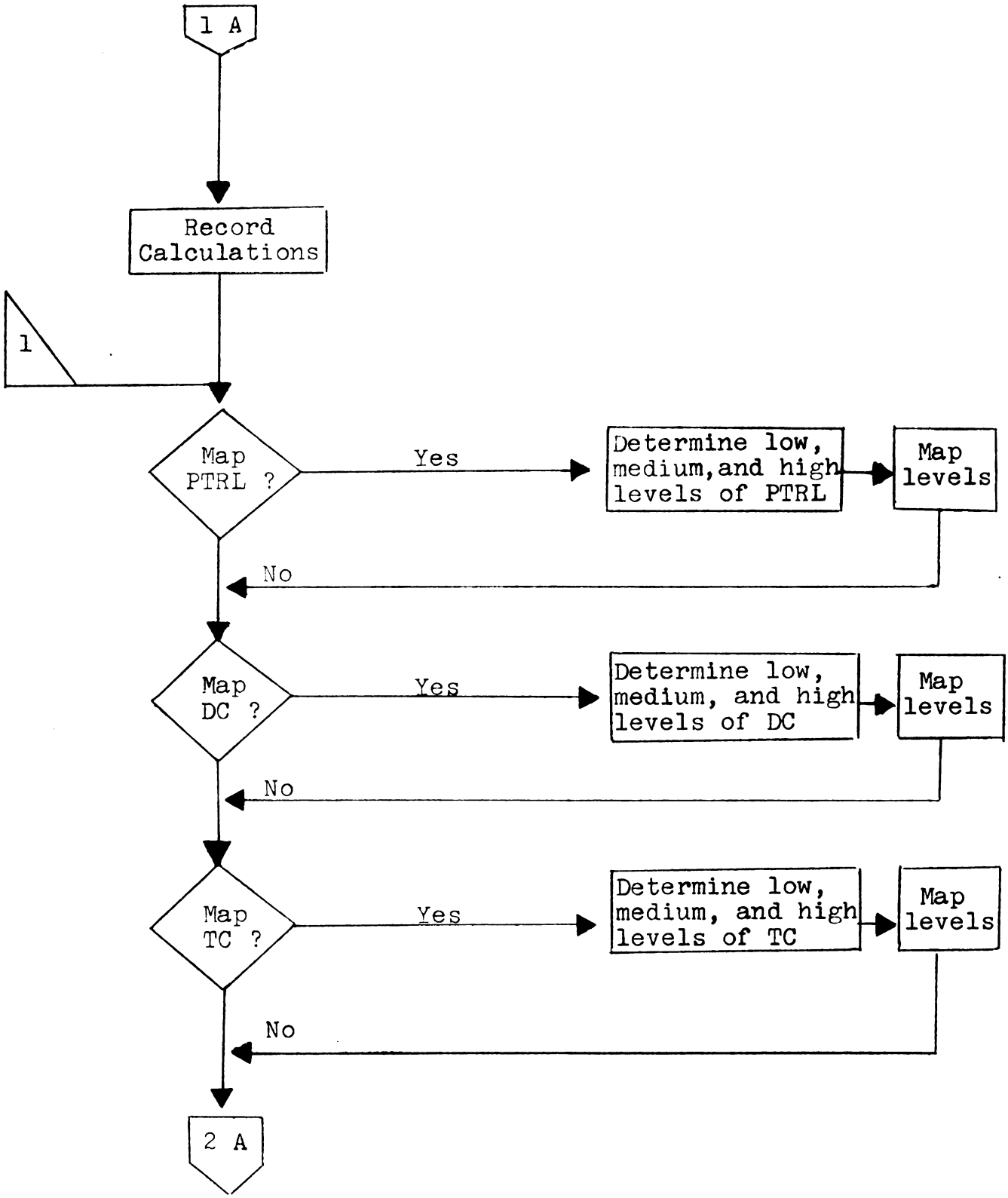
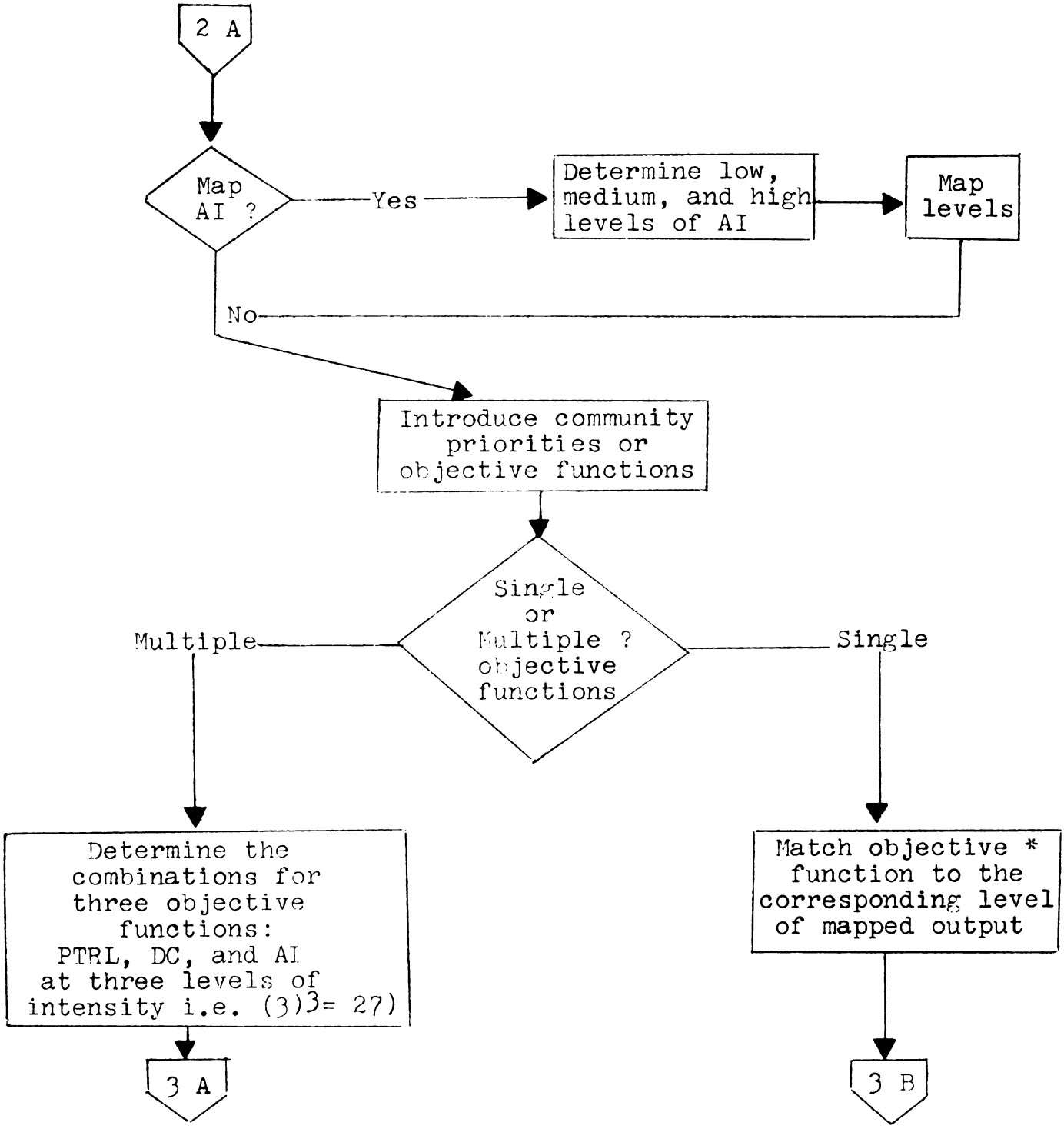
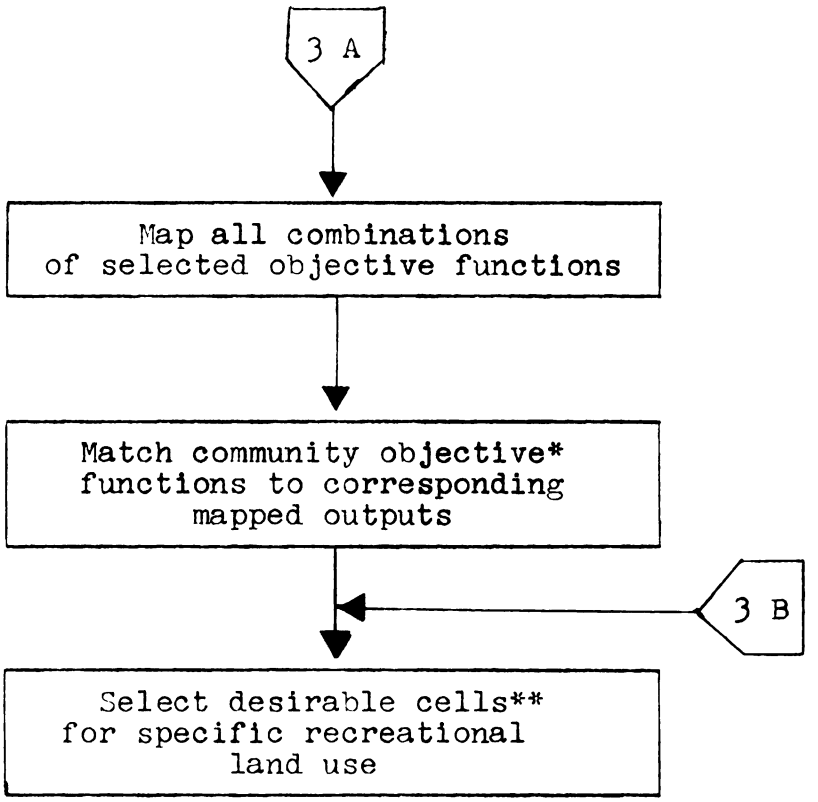


Figure 1 (cont'd)



*Role of land use planner is to match the level of mapped output with community priorities.

Figure 1 (cont'd)



**Decision-maker or decision-makers representing the community, (i.e. Orleans County), visually determine the locational tradeoffs which occur when a single objective function or objective functions are taken into consideration. From this visual locational analysis feasible cells can be selected for recreational land use.

Figure 1: Model Solution Sequence for Outdoor Recreational Land Use Selection Model

Identification of Land Resource Components

With the resource inventory framework defined, it is necessary to identify the land resource components associated with each stated objective function. Since the objective functions are the major concern of the decision-maker and the community, they will be utilized to select and identify the appropriate land resource component factors. Each component factor will be identified and associated measurement units will be determined. The sources of the measurement units will be stated and data reduction and aggregation strategies will be outlined according to specific decision rules.

The first stated objective function is to minimize the property tax loss resulting from a non-marginal change in land use and the change from private ownership to public ownership. The economic factors involved with this objective function relate to the property tax revenues associated with a given land parcel. Property tax revenues are a function of assessed land values and/or assessed values on improved lands with their corresponding tax rates per thousand dollars of assessed value. These revenues are collected by both township and county governments to support the total county's infrastructure. This information is recorded within the county tax assessor's office and all tax data in this study were collected from that office (Table 1).

Since the amount of tax revenue is based upon variations in land values and improvements, and tax rates, it is necessary to analyze these factors spatially. In order to determine spatial arrangements, the investigator must identify

TABLE 1

PROPERTY TAX REVENUE LOSS

Objective Function: Minimization of Property Tax Revenue Loss

Variables	Measurement Units for Variables	Source of Measurement Units
Assessed land value with improvements	Dollars per cell for assessed value on improved lands	Orleans County Tax Coordinating Office
Tax rates for county and townships	Dollars per thousand per cell for assessed value on improved lands	Individual school districts within Orleans County: Albion Medina Holley Lyndonville Kendall

measurement units yielding property tax revenues. The measurement units can be broken down into an assessed value per acre for land and an assessed value per acre for improvements. Within this study, the investigator has decided in order to determine total tax revenues it will be necessary to sum land, and improvement values on a per acre basis. From a per acre basis the data may be multiplied by 247.1 acres to determine the total property values on a cell basis, because each cell contains 247.1 acres.

Property tax information was gathered from land parcels or plots, each identifying ownership, utilization, acreage, assessed land value, and assessed value with improvements. In order to determine per acre values it is necessary to divide the assessed value of improved lands by the number of acres within that land parcel. Since the resource inventory system is expressed in a grid format, the investigator must determine a per acre value for each of the grid cells. However, parcels do not conform to the cell boundaries. Therefore, a smaller grid of twenty-five cells was superimposed within the original cell of 247.1 acres. From a visual count of the twenty-five smaller cells, the number of smaller cells occupied by each land parcel can be identified. Each land parcel has an assessed land value per acre. By proportionally weighting the per acre land value of each parcel, an average per acre value can be derived from the twenty-five smaller cells for each grid cell of 247.1 acres, within the resource inventory system. With an average per acre value computed, the total property tax revenue can be determined by multiplying the average per acre value by

the corresponding property tax rates for county and township, by 247.1 acres for each cell.

Property tax rates are assigned to school districts rather than township boundaries. School district boundaries were determined by contacting the individual school systems within the county. The boundaries were superimposed upon the plat maps allowing the investigator to compute the appropriate property tax revenues with corresponding plat locations. The property tax rates are derived from each proposed and accepted school district budget for a corresponding school year. Two tax rates are computed within the county for the total tax revenues. School district tax rates are computed for local school needs and individual township operation, and county tax rates are formulated for general county operations. Total property tax revenues are computed by summing school district and county tax revenues. Therefore, each cell reflects the total tax revenue loss to the county on a per year basis if a public camping recreation facility is developed.

In referring to the objective function previously stated, the cells closer to zero property tax loss therefore approach optimality in relation to the community priority. Within the model, the objective function may be calibrated to select only those cells expressing low property tax revenue loss. The output of the model is a graphic display by the GRID mapping routine of those feasible cells. The output will be classified into three cost levels of information representing low, medium, and high property tax loss. Those are mapped by computer shading techniques: low property tax loss darkest,

medium property tax loss intermediate, and high property tax loss lightest (see Table 3, p. 178 in the appendix). From this display specific cells may be pinpointed and located by Universal Transverse Mercator Grid ticks on United States Geological Survey maps or New York State Department of Transportation maps. Each cell can be identified by a latitude and longitude position. The southeast corner of the cell is represented by the latitude and longitude reference point.

The second objective function states that in order to optimize it is necessary to minimize development costs associated with the initial support of the recreation facility. As mentioned earlier in Chapter II, the investigator identified land acquisition costs, drainage costs, and transportation construction costs as the major cost areas for development. Realizing that these costs vary spatially, the investigator determined feasible measurement units for each (Table 2).

Land acquisition costs varied with location and market demands; therefore, variations with the market place caused difficulty in selecting a model indicator. Sales information collected from lands which were purchased by public agencies for recreation development could be used to estimate acquisition costs. It was assumed that sales information would reflect true market value and hence, acquisition costs for similar land could be estimated. But when sales information was lacking, the investigator utilized an adjusted full assessed value for each cell. In analyzing assessments, it was found that property was assessed at a proportion of its full value. This being the case, all assessed land values were adjusted

TABLE 2

DEVELOPMENT COST

Objective Function: Minimization of Development Cost

Variables	Measurement Units for Variables	Source of Measurement Units
Land acquisition cost	Dollars for adjusted land value with improvements per cell Equilization rate in percent per cell Sales adjustment factor per cell	Orleans County Tax Coordinating Office
Drainage cost	Dollars of tiling cost per soil association per cell	United States Soil Conservation Service United States Agricultural Stabilization and Conservation Service
Transportation construction cost	Dollars per unit distance from center of cell to nearest existing highway per cell	New York State Department of Environmental Conservation Orleans County Highway Department

by dividing the percentage of assessment, i.e. 70%, 50%, 40%, 60%. These full property values were then taken to be the acquisition cost which would have to be paid by public agencies in order to purchase property for public recreational development. Therefore, the average per acre full assessed value for each cell was multiplied by 247.1 and then divided by the appropriate percentage, thereby yielding acquisition cost.

Within the model, drainage cost was utilized to determine part of development cost. Drainage cost indicated to initial physical condition of each cell under site consideration. It indicated the drainage improvements necessary in order to make possible the development of a recreational facility. Since water supplies and sewage systems for a campground may be interactive with the natural drainage characteristics of the site, development costs tend to vary with drainage conditions. In poorly drained areas, sewage pump storage systems may have to be designed to prevent effluent from reaching streams. It is assumed therefore, that a spatial relationship occurs between the natural drainage characteristics and the investments in sewage systems. Furthermore, roads leading to and within campground areas may incur added construction costs if poor drainage occurs. Additional road fill, water sluice ways, tiling, and parallel road ditches also increase the development cost total. It is therefore assumed that drainage may be a proxy for determining one portion of development cost.

Since physical factors such as soil characteristics, geological characteristics, and parent materials affect drainage,

variations occur within the study area. The evaluation of drainage costs is a complex undertaking; however, in order to investigate recreational development on a county basis it was necessary to seek out a feasible measurement unit. It was determined that tile drainage costs would provide an appropriate drainage cost indicator. Therefore, an attempt was made to estimate tiling costs throughout the county, hoping to reflect the spatial variation of the physical factors. However, it was necessary to identify physical landscape units which could be classified by some physical criteria and correlated with tiling costs. It was decided that soil associations would be utilized to delineate areas and that tiling costs could be estimated for these soil associations. Once soil association boundaries were identified and aligned on county maps, tiling costs were estimated by analyzing tile drainage costs within each soil association. With assistance from United States Soil Conservation Service, agricultural drainage costs were reviewed and estimates formulated. Thus, drainage costs were assigned to each cell corresponding to a specific soil association. These values were utilized as a proxy in order to estimate recreation drainage costs since no specific costs were available for recreation on a county basis.

Highway transportation construction cost is the final cost recognized in this study that is included in the category of initial development cost. It is generally recognized that highway construction cost is an important factor which may

influence the location of recreation facilities. In order to estimate highway construction costs specific criteria must be established as a measurement unit. The investigator realizes that highway construction costs vary as a result of physical factors affecting construction. However, to calibrate a model and measure the variation is a difficult undertaking. Therefore, the investigator sought to evaluate construction costs on a distance basis. It was decided that these costs would be estimated by determining the distance from the center of each cell to the nearest existing highway facility. Measured distance could be multiplied by the per mile cost estimate to yield the highway transportation construction cost per cell. The per mile cost estimate was formulated through correspondence and personal discussion with personnel of the Orleans County Highway Department and the Environmental Conservation Department of New York State.

As stated previously in Chapter II, the third objective function analyzes the minimization of total cost as defined above. Therefore, a summation of property tax loss or opportunity costs, acquisition costs, drainage costs, and transportation construction costs yield the total cost represented by each cell (Table 3). The total costs will be classified into three levels of variation. Low, medium, and high cost levels will be identified within the resource inventory framework superimposed over the study area. As before, the GRID computer mapping routine was used to graphically display spatial relationships. It can be inferred that the major costs have been defined for the selection and development

of a recreation camping facility, although it is recognized that additional costs may occur during the planning and development of such facilities. The above costs were selected to represent the economic component associated with land resource developments.

The fourth objectuve function is based on the identification of aesthetic values in order to maximize socially received benefits derived from the physical component of land resources. In evaluating the aesthetic features within land resources we may be able to assign measurement units to each of the attributes so that a spatial analysis can be initiated. The investigator has isolated specific attributes which would yield a more aesthetically pleasing outdoor recreational experience for most camping families. The aesthetic values of an outdoor recreational site are related to the physical and social factors contributing to the site. The physical factors reflect a visual quality which in turn yields an aesthetic experience. Consequently, those physical factors which provide the recreationist with a visual quality at the campsite, will be those analyzed in the aesthetic index (Table 4).

TABLE 3

TOTAL COST

Objective Function: Minimization of Total Cost

Variables	Measurement Units for Variables	Source of Measurement Units
Property tax revenue loss	Dollars per cell	Orleans County Tax Coordinating Office Individual school districts within Orleans County: Albion Medina Holley Lyndonville Kendall
Development costs	Dollars per cell	Orleans County Tax Coordinating Office United States Soil Conservation Service United States Agricultural Stabilization and Conservation Service New York State Department of Environmental Conservation

TABLE 4

AESTHETIC INDEX BASED UPON PHYSICAL INDICATORS

Objective Function: Maximization of the Socially Perceived Benefits from the Identification of Aesthetic Characteristics

Variables	Measurement Units for Variables	Source of Measurement Units
Water to land relationship	Percentage of water to land per cell expressed as a weighted index	United States Geological Survey Maps, 7.5 Minute Series
Contour differential	Feet between highest and lowest contour per cell, expressed by a graduated scale	United States Geological Survey Maps, 7.5 Minute Series
Color contrast	Forest color classification per cell, expressed by a numerical index ranking by aesthetic appeal	New York State LUNR Maps Field transects Atlas of Forestry in New York State Aerial photos of Orleans County, New York Personal knowledge
Amount of forested land	Percentage of forested land per cell expressed by a graduated index	New York State LUNR Maps

Six aesthetic indicators for an outdoor camping site within the study area were identified: contour differential, amount of forested land, water to land relationship, forest color contrast, distance from pollution sources, and distance from existing and competing campground facilities. These first four physical conditions and the last two spatial distances were selected because of their direct effect upon the aesthetic value of any land resource. Only the physical indicators will be analyzed by the format outlined in Table 4; while the spatial indicators will be applied to the study area by a decision rule which will either accept or reject a cell, based on its proximity to these facilities. Each of the above factors generates its own values to the recreationists. However, it is necessary to plan for an optimal product mix of the factors to generate aesthetic attractiveness. In order to maximize the aesthetic benefits we must select those cells with the desired specific characteristics. Since there are no common measurement units such as dollars, as in the case of the first objective function, we must rank cells according to visual quality. Furthermore, it is necessary to determine which of the physical factors contributes to and indicates the highest aesthetic component. Therefore, each cell is analyzed individually and the aesthetic components evaluated. The distance indicators showing nearness to either a pollution source or a competing campground will not be ranked or placed into the following linear explicit relationship. Each cell in the study area however, will be either rejected or included within the model, based upon the nearness to the pollution

source or nearness to competing recreational facilities. Pollution sources within a given study area may be derived from manufacturing processes, waste disposal systems, agricultural feeding systems or transportation congestion. Therefore, a decision rule was established to reject all cells adjacent to or within one cell peripheral to each evaluated cell, defined as a buffer zone. The two spatial indicators affecting aesthetic attractiveness had priority over the four physical indicators outlined earlier. Therefore, those cells within the defined buffer zone will be immediately rejected within the study area and assigned a numerical value of zero. Those cells not rejected will be evaluated by ranking each physical indicator with its associated weight.

Within this model, the aesthetic indicators for an outdoor camping site within the study will be weighted and a composite ranking value will be determined. Each indicator may reflect a greater or lesser aesthetic quality, depending on the applicability of that physical factor to each of the county's 1056 cells. The physical characteristics of a county vary from region to region and so a single physical indicator is unable to represent the aesthetic qualities for the entire study area. Therefore, it is the decision-maker's function to select that indicator which most closely represents the physical characteristics of the area. For example, a study area lacking water resources would be poorly described by the aesthetic indicator showing a water to land ratio; however, contour differential may be a more appropriate aesthetic indicator for such a county. The selection, measurement, weighting, and ranking

of the major and supporting indicators are a critical step in evaluating the aesthetic land resource component.

In analyzing the study area, it was decided to utilize the water to land relationship as the major aesthetic indicator, followed by contour differential, forest color contrast, and lastly, the amount of forested land. The highest numerical weight (4) was assigned to the major aesthetic indicator, with smaller weights (3,2,1) being assigned to less important indicators. The assignment of weights to each of the aesthetic indicators was based on each indicator's ability to generate camp-related activities. Importance was determined by the variety of related camp activities, as well as their adaptability to year-round camping. A one-unit increment was chosen to reflect the relative importance for each of these aesthetic indicators. Each associated weight directly expresses the importance of that aesthetic indicator: a weight of four stands for the maximum aesthetic impact. From the indicators, measurement units were assigned and a spatial analysis formulated. A composite value is generated for each cell by summing the ranked values on a one to ten basis and multiplying each indicator by its associated weight.

An explicit mathematical relationship describing the above composite value is defined as follows:

$$AI = a_1x_1 + a_2x_2 + a_3x_3 + a_4x_4$$

Where:

AI = composite aesthetic value which is the summation of the ranked values times associated weights for a given cell.

a_1 = associated weight for amount of forested land (1).

a_2 = associated weight for forest color contrast (2).

a_3 = associated weight for contour differential (3).

a_4 = associated weight for water to land relationship (4).

x_1 = ranked value on a one to ten basis for amount of forested land aesthetic indicator for a given cell.

x_2 = ranked value on a one to ten basis for forest color contrast aesthetic indicator for a given cell.

x_3 = ranked value on a one to ten basis for contour differential aesthetic indicator for a given cell.

x_4 = ranked value on a one to ten basis for water to land relationship as an aesthetic indicator for a given cell.

The associated weight of four was assigned to that indicator showing the relationship between amount of water to land, as the investigator felt it most important in the aesthetic index, and because the Genesee/Finger Lakes Regional Planning Board defined the optimal camping site as having a fifty percent water to fifty percent land relationship.[43] Firstly, the percentage of water to land area found within any cell helps determine the variety of related camp activities available to the recreationist. For cells having adequate water resources (about 50% water to 50% land area) a wide range of sporting activities exists: boating, fishing, swimming, canoeing, and skiing. The balance betwen water to land percentages is assumed to be optimal at fifty percent, because in cells having excessive amount of water resources, (greater that 50%) onshore developments of recreational facilities are assumed to

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[43]Genesee/Finger Lakes Regional Planning Board, Attractiveness Components (Rochester, N.Y.: Genesee/Finger Lakes Regional Planning Board, 1970), Appendix E, p. 15-16.

be more costly and tends to restrict land based recreationists. In addition, the water to land percentage affects the number of microhabitats available for wildlife, including land and water species. Water microhabitats encourage feeding, nesting, and breeding of waterfoul, which permits shelter for migratory birds as well as learning opportunities for the inquisitive recreationist. The water to land relationship of any cell has climatic influence over the area due to the cooling effects of sea breezes and to the seasonal modifications in temperature caused by water's high specific heat. From the decennial census of U.S. climate, published by the Genesee/Finger Lakes Regional Planning Board, a comparison of temperatures of towns near Lake Ontario to those towns inland reflects these moderating effects on climate. These data for Sodus, on Lake Ontario, and for Dansville, located inland, are descriptive of the number of days per year when temperatures exceeded ninety degrees or were below freezing.[44]

	Annual Number of Days	
	Temperatures $\geq$ 90' F.	Temperatures $\leq$ 32' F.
Dansville	28	148
Sodus	10	135

The second most important contributor to the aesthetic index was the contour differential for the study area. It was given an associated weight of three in the composite index because of its prospective impact on four environmental conditions:

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[44] Genesee/Finger Lakes Regional Planning Board, Physiographic Features: Regional Inventory and Analysis, Technical Report No. 1 (Rochester, N.Y.: Genesee/Finger Lakes Regional Planning Board, October, 1969), p. 64.

visual expanse and depth of landscape; microhabitats for wildlife; vegetative covering; and temperature contrasts. Within any cell, the differences found in land relief permit either a feeling of openness or one of isolation. The hill and lowland dominating a rolling topography allow extensive visual depth or range of sight on the summit, and also allow seclusion in the valley between. It is assumed that, a greater difference in relief, permits the recreationist to enjoy greater visual contrast in his surroudings. Secondly, the lowlands permit seclusion and protection for wildlife species. The variation in relief directly affects the kind of vegetation able to grow in an area. Also, in cells with greater contour differential, sun angle and air drainage patterns often induce larger contrasts in diurnal temperatures. Although contour differential is a major factor influencing the ecological, meteorological, and biological patterns of a region, it is nonetheless, less important than water to land relationship in the composite aesthetic index because there are fewer land-based activities available to the recreationist, resulting from only relief change. For example, experiences available to the camper vary from season to season, but are strictly land-based: winter - tobogganning and cross-country skiing; spring - hiking and nature studies; summer - hiking and motorbike scrambles; fall - hunting.

The forest color contrast dominating a landscape offers the recreationist a visual attractiveness year round. The peak beauty depends upon the variety of species in the area, but usually maximum contrast occurs during the fall season.

Forest color contrast ranked only an associated weight of two on the composite aesthetic index because it was less significant in offering year round appeal, and because it generates fewer recreational activities than the other physical factors, including water to land relationship or contour differential. The contrast of colors in a mixed deciduous-coniferous or purely deciduous stand of trees is most intense in autumn, and offers less color appeal during other seasons. It can be recognized that the mixed deciduous-coniferous forest cover type varies in color contrast during the year; however, its potential to generate color contrast over a full year period is feasible. The recreational activities associated with forest color contrast include hunting, hiking, color tours, and photography.

The last physical factor analyzed by the aesthetic index was given the smallest associated weight, one. The investigator felt that the amount of land which is forested (acreage) per cell was not indicative of the characteristics of the class of forest type found in the area, and was less able to show attractiveness of an area, when compared to forest color contrast. In addition, the diversity produced by forest color contrasts attracts more recreational activities than does the sheer percent of forested land, because the forest cover could be unsuited to land recreation. For the aesthetic index, the percent of area in any cell devoted to forest cover was ranked less important than the type of forest cover in that cell, since forest type is indicative of the physical characteristics of the soil, and the type of drainage and topography

of the cell. In effect, forest color contrast is more apt to contribute to a greater number of camp-related activities for the recreationist. An example of landscape features indicative of a pine/spruce mix with deciduous trees such as beech, red maple, and white birch would be a well drained soil with a 2 to 8 percent slope.

The measurement units for each aesthetic indicator and their sources are outlined in the following discussion. The water to land relationship is the most important aesthetic indicator within the study area. The investigator assumes the ratio, 50% water to 50% land, is the ideal percentage for campsite development, as well as ample water surface for recreational activities. Any ratio greater than 50% restricts land-resource based activities, as camping. A value lower than 50% water to 50% land reduces aesthetic value gained from water-based recreation, as user density by recreationists increases. Therefore, the highest rank (10) was assigned to cells having a water to land ratio of 50:50. U.S. Geological Survey Maps were used as the information base for the measurements of water to land areas. From these area measurements percentage values indicating water to land relationship were calculated.

The second most important aesthetic indicator included in the index is contour differential. The use of contour differential determines the visual contrast, depth, and scenic expansion within each cell. It must be recognized that extreme physical differences in topography can be a constraining factor in the development of a recreational site. Nonetheless, the investigator has decided to select those cells with the greatest

contour differential because of the correlation of depth contrast and scenic dimension to aesthetic appeal of such landscapes. It is hoped that this decision rule will indeed yield the most aesthetic sites. The measurement of contour differential greatly depends upon the scale of the cell area. Since the measurement area is individual cell units of 247.1 acres in size, it was decided to measure the difference or relief between the highest contour line and the lowest within each cell. Cells with the greatest contour differential received the highest rank (10); while those cells having no change of relief were ranked lowest (0).

Third in importance is forest color contrast. The investigator classified forest cover type into deciduous, coniferous, mixed deciduous and coniferous, and brushland-swampland. It was decided that since a mixed deciduous and coniferous forest stand yields the greatest color contrast on a full year basis, this type would provide the superior aesthetic experience to the recreationist. Deciduous forest cover type was assumed to provide the second best color contrast, and coniferous provided the third best color contrast. The least color contrast and the poorest generator of aesthetic appeal in general was found in the brushland-swampland classification. It is recognized that brushland is a product of abandoned agricultural land, cut over timber stands; and that swampland is a product of a high water table. Brushland-swampland has been included within the classification since it does comprise a share of the forest cover within Orleans County.

It is difficult to assign a precise measurement unit for the forest color contrast indicator; therefore, personal and qualitative decisions entered into the rankings. Selected cells were surveyed and transected by the investigator to validate presupposed forest cover types. From the transects, forest dominance was determined from the samples which supported previous personal knowledge. Hence, through the use of aerial photographs, direct observation transects, and existing LUNR information concerning forested areas, the investigator ranked each cell on its aesthetic merits based on forest color contrast. Forest classification was based upon observations of the dominant species in the forest canopy. Forest categories were ranked from zero to ten, based on the potential to produce seasonal varieties of color, and the duration of a single vegetative color.

The least important aesthetic indicator within the study, contributing to the aesthetic index was the amount of forested land per cell. It was recorded as percentage categories (0%, 1-10%, 11-25%, 26-50%, 51-100%), which reflected the proportionate part of each cell covered by woodlands. The information was obtained from a land use study based on LUNR data.[45] From these data, it was possible to locate specific cells and record a ranking to indicate aesthetic importance. Higher percentages of forested land yielded a higher aesthetic value on a per cell basis.

In order to incorporate the above aesthetic indicators

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[45] Genesee/Finger Lakes Regional Planning Board, Orleans County Land Use and Inventory Analysis (Rochester, N.Y.: Genesee/Finger Lakes Regional Planning Board), p. 15.

into a composite index, it was necessary to classify each physical factor analyzed (amount of forested land, forest color contrast, relief, and water to land ratios), and then to assign a ranking value (from 0 to 10) to each classification level. It was necessary to derive a common measurement unit for each of the aesthetic indicators so that a composite index could be produced for each cell. The measurement units of the aesthetic indicators were in non-compatible forms as raw data, as shown by the following: the water to land relationship was measured as percentage of area covered by each: contour differential was expressed in feet; forest color contrast was measured by the dominant vegetative type; and the amount of forested land was measured by a percentage. For this reason, the integration of raw data into a composite aesthetic index would have been meaningless.

The ranking values of amount of forested land (Table 5) and the water to land relationship (Table 6) were based on percentage categories, so that equal intervals were assigned to each category. The ranked values ranged from zero to ten for each aesthetic indicator. The rank of zero reflected the minimal percentage for each category (zero percent); whereas, the highest rank (ten) was assigned to the percentage category reflecting the maximum aesthetic appeal for that aesthetic indicator. Those percentages intermediate to the above extremes were ranked according to the number of categories within each of the indicators. For example, since Table 5 lists five percentage categories for forested land, the interval chosen was 2.5 units, in order to equally distribute the range

TABLE 5

AMOUNT OF FORESTED LAND

Percentage of Cell Devoted to Forested Land	Associated Weight	Ranking Value
50-100	1	10.0
25-50	1	7.5
10-25	1	5.0
1-10	1	2.5
0	1	0

TABLE 6

WATER TO LAND RELATIONSHIP AESTHETIC INDICATOR

Water to Land Relation Percentage	Associated Weight	Ranking Value
50, 50	4	10
40, 60	4	8
30, 70	4	6
20, 80	4	4
10, 90	4	2
0, 100	4	0

of values from zero to ten among the selected percentage categories of forested land (Table 5). In a similar way the range of values from zero to ten was dispersed among the six selected percentage categories of water to land, by using two-unit intervals for those categories between the extremes (Table 6). The ranking values for each grouping showing relief were linear, and were based on a single unit interval, where each ranking value increased by one unit, as the relief increased by ten feet (Table 7). The ranking value units assigned to the forest color contrast classes were not mathematically derived, because the categories were based on forest type, not on a quantitative value. Instead, that classification group showing the best color variety on a year round basis was assigned the highest rank value of ten; and the forest type generating the minimal color appeal was arbitrarily earmarked for the lowest ranked value, zero. Those classes falling in between were given a proportionate rank, based on their relative color appeal (Table 8).

With the objective functions of the community stated, the land resource components identified, the resource component factors defined, and measurement units assigned for the aesthetic indicators, with their source located, it was then feasible to apply the model for the selection of an outdoor recreation facility. As stated previously in Chapter II, the objective functions indicate the priorities involved with the selection of an outdoor recreational site. Application of the outdoor recreational planning model to Orleans County is hoped to produce a simulated locational decision for such a campground

TABLE 7

CONTOUR DIFFERENTIAL

Contour Differential	Associated Weight	Ranking Value
100	3	10
90	3	9
80	3	8
70	3	7
60	3	6
50	3	5
40	3	4
30	3	3
20	3	2
10	3	1
0	3	0

TABLE 8

FOREST COLOR CONTRAST AESTHETIC INDICATOR

Forest Type	Associated Weight	Ranking Value
Mixed deciduous and coniferous	2	10.0
Deciduous	2	6.6
Coniferous	2	3.3
Brushland-swampland	2	0

facility.

Prior to the application of the proposed model, it will be necessary to analyze the physical and socio-economic characteristics of the study area. From this analysis, a profile can be constructed so that the reader can become familiar with the research area. Furthermore, the rationale determining the selection of resource component factors can be validated. Therefore, Chapter III will outline the characteristics of Orleans County and prepare the reader for the application of the outdoor recreational planning model.

CHAPTER III

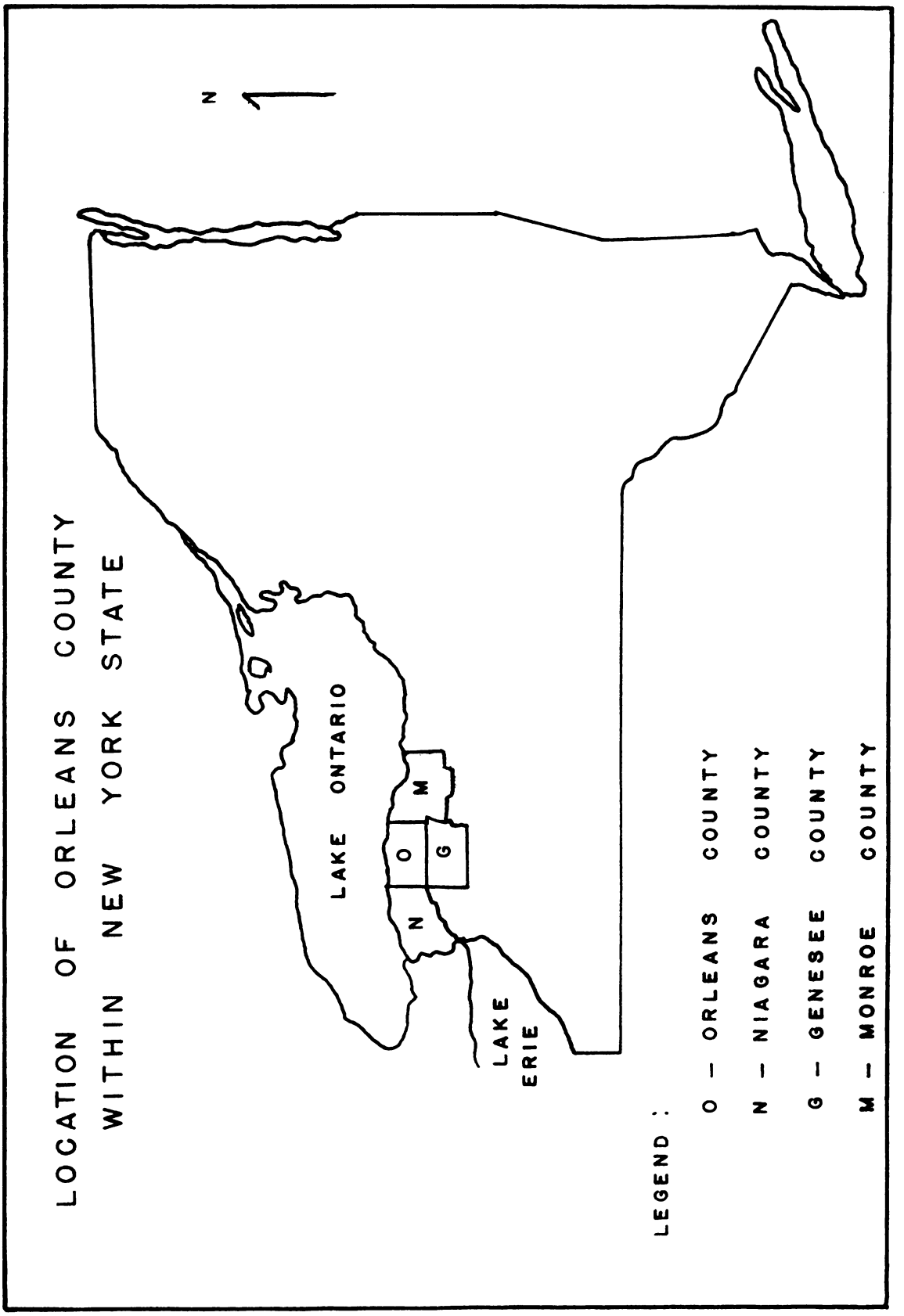
A PHYSICAL, ECONOMIC, AND DEMOGRAPHIC PROFILE OF THE SELECTED STUDY AREA: ORLEANS COUNTY, NEW YORK

As the invesigator proceeds with the construction and application of the planning model, it is necessary to analyze the existing land use, as well as the physical, and demographic characteristics within the selected study area. The selected study area, Orleans County, New York, is positioned within the northern portion of Western New York, bounded on the north by Lake Ontario, on the east by Monroe County, on the south by Genesee County, and on the west by Niagara County (Figure 2).

The physical characteristics of Orleans County have been identified by various studies: U.S.D.A. Soil Conservation Services Soil Survey, technical reports concerning physiography, climate and drainage gathered by the Genesee/Finger Lakes Regional Planning Board, U.S. Geological Survey Maps ($7\frac{1}{2}$-minute series). From a review of these studies, a physical description can be presented. Orleans County lies within the Ontario Lowland which is underlain by Silurian rock strata. Within this lowland, two sub-regions separate the study area into two distinct regions. However, a third possible region can be defined which lies between the two distinct regions. This third region could be labeled as a transition zone since distinguishing characteristics are apparent. The transition zone is characterized by the extension of the Niagara Escarpment which appears within the county. The rock outcrops

Figure 2

Location of Orleans County Within New York State


LOCATION OF ORLEANS COUNTY
WITHIN NEW YORK STATE
N
LAKE ONTARIO
LAKE ERIE
O
N
G
M
LEGEND :
O – ORLEANS COUNTY
N – NIAGARA COUNTY
G – GENESEE COUNTY
M – MONROE COUNTY

include Medina sandstone, and Lockport dolomite, which have had some impact upon an earlier quarrying industry and recently on highway construction. The soils vary in depth as a result of the variation in the depth of the parent bedrock from the surface. Therefore, variations in soil characteristics are common within this transition zone, which separates the major sub-regions.

Within the Ontario Lowland the two regions include the Lake Ontario Plain and the Southern Ontario Plain.[46] The regional boundary separating the Lake Ontario Plan and the Southern Ontario Plain is the former shoreline of glacial Lake Iroquis and the Niagara Escarpment area. North of this shoreline the Lake Ontario Plain predominates whereas, the Southern Ontario Plain lies southward. The major physical differences between these two regions are reflected in the slope of the land, and the associated soil characteristics. In the northern region, lacustrine sediment deposits dominate the soil profile and result in a low slope percentage classification (range of 0 to 8%). Whereas, in the southern region, glacial till creates a landscape of a gently rolling nature (range of 3-25%).

Surface water drains in a northeasterly direction emptying into Lake Ontario. The drainage system within Orleans County is a part of the Lake Ontario West Basin.[47]

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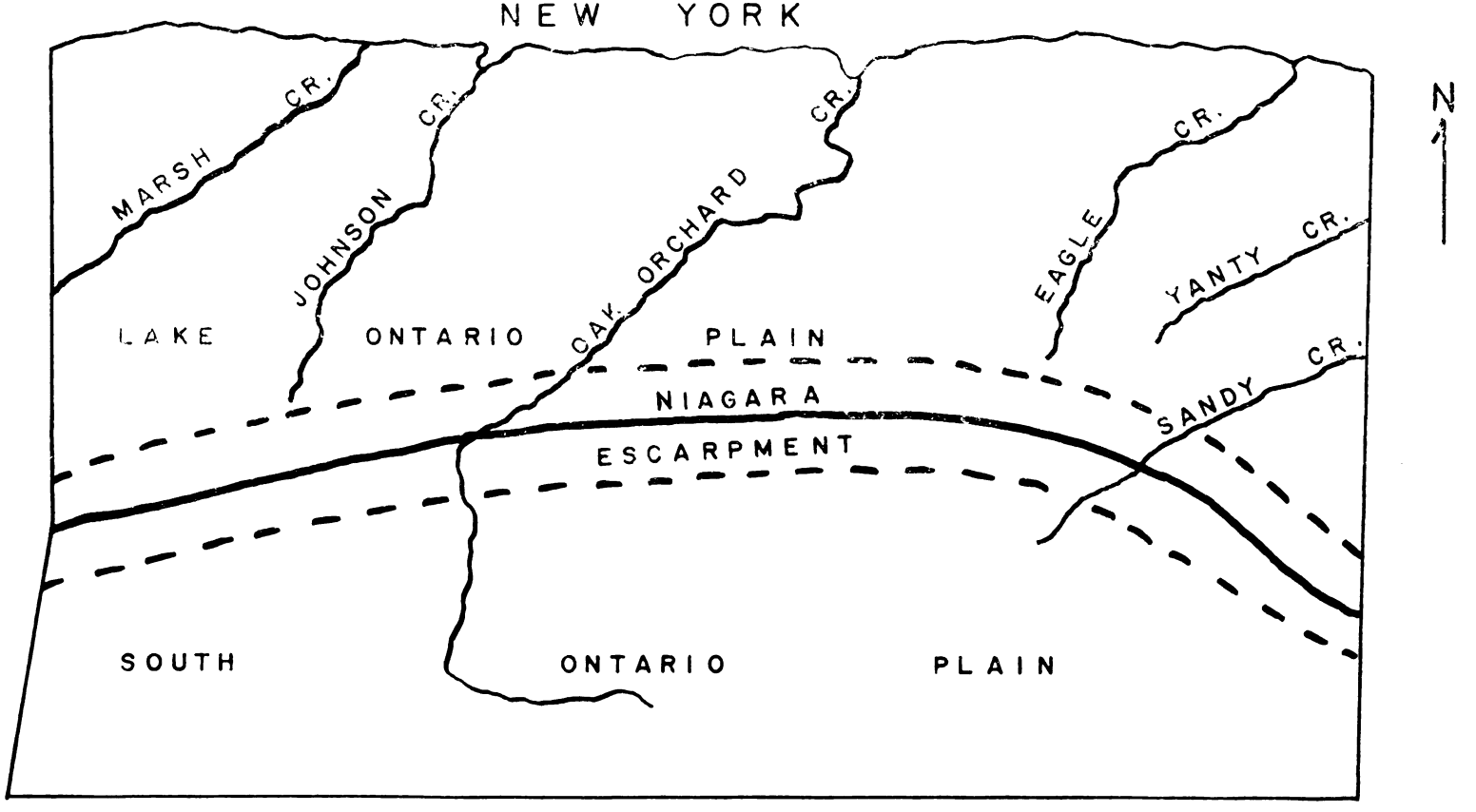
[46]Genesee/Finger Lakes Regional Planning Board, Recreational Attractiveness Components (Rochester, N.Y.: Genesee/Finger Lakes Regional Planning Board, 1970), Appendix E, p. E15.

[47]Genesee/Finger Lakes Regional Planning Board, Drainage: Regional Inventory and Analysis (Rochester, N.Y.: Genesee/Finger Lakes Regional Planning Board, October, 1969) Report No. 2, p. 20.

Figure 3

Map of Physiographic Regions and Drainage Systems of Orleans County, New York

PHYSIOGRAPHIC REGIONS AND DRAINAGE SYSTEMS OF ORLEANS COUNTY, NEW YORK



The lowlands are cut by six drainage systems: Oak Orchard Creek, Johnson Creek, Marsh Creek, Bald Eagle Creek, Yanty Creek, and Sandy Creek.[48] The individual streams do not carry a large volume of water since differences in relief are moderate over the total stream system. The major stream, Oak Orchard Creek, shall be used as an illustrative example. The stream's gradient was calculated using U.S. Geological Survey Maps, 7½-Minute Series. It was found to have an average drop of 15.5 feet per mile. This relationship may clearly indicate that the flow of water within the major stream has a moderate water flowage. From an analysis of streams and rivers conducted by the New York State LUNR inventory system, it was estimated that there are 541.6 lineal miles of shoreline adjacent to the streams and rivers of the study area.[49] This total represents an important component in estimating the potential for recreational development. However, it should also be pointed out that water quality of the streams and rivers may induce a constraining factor for development resulting from bacterial counts, sedimentation, and biochemical oxygen demands.

The climate of the study area is moderated by Lake Ontario which influences the growing season. Mean annual temperatures range from a low of 23.6 degrees F. in January, to a high of 70.3 degrees F. in the month of July, with the annual average

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[48] Orleans County Development Committee, Orleans County, New York: Overall Economic Development Program, (Albion, N.Y.: Orleans County Development Committee, September, 1969), pp. 3-4.

[49] Genesee/Finger Lakes Regional Planning Board, Parks, Recreation and Open Space in Orleans County: Inventory and Analysis (Rochester, N.Y.: Genesee/Finger Lakes Regional Planning Board, 1971), p. 38.

temperature approximating 47 degrees F.[50] As a result of Lake Ontario's moderation effect upon temperatures, the growing season is extended to 160 frost-free days. This phenomenon has promoted specific types of agricultural land uses, mainly fruit and vegetable production.

The mean annual precipitation data for Orleans County was recorded at one climatic station, Albion. It represents a ten-year period of rainfall observations. The average annual precipitation is 30.68 inches. From analysis of monthly means, it can be shown that the maximum periods of rainfall are Fall (September) and Spring (April-May).[51]

The natural forest cover dominating the study area is divided into two major associations: 1) Elm-ash-red maple, and 2) maple-beech-birch. The associations occupy 20,500 and 20,600 acres respectively, within the county's total land area of 253,400 acres.[52] However, other species are found within the county such as aspen, hemlock, sugar maple, white pine, red pine, oak, white cedar, black cherry, and basswood. Remanents of the original forest cover are found within farm woodlots, which average 15 acres in size, as well as in swampland areas, which have never been successfully cleared nor developed.

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[50]Orleans County Development Committee, Economic Development Program, p.5.

[51]Genesee/Finger Lakes Regional Planning Board, Physiographic Features: Regional Inventory and Analysis, p. 68.

[52]Ronald H. Ferguson and Carl E. Mayor, Timber Resources of New York State, U.S. Department of Agriculture, Forest Service, Resource Bulletin NE-20, (Northeast Forest Experiment Station, 1970).

These geographical characteristics have encouraged the development of an agricultural economy, which began with the first settlers, and has continued to the present time. An analysis of the existing land use situation results in the identification of the major types. The following land use types have been classified by a land use inventory conducted by the New York State LUNR (Land Use and Natural Resource) System. Within the inventory, six types of land use were assigned and measurements were taken within each county.

The following is an analysis of existing land uses within Orleans County. Categories included: 1) residential lands, 2) commercial lands, 3) industrial-extractive-transportation lands, 4) public-outdoor recreation lands, 5) agricultural-inactive lands, and 6) forestlands-water areas - wetlands.[53] The representation of this information is presented in Table 9.

Agricultural lands which are either extensive, intensive, or inactive comprise the greatest percentage of land use within the county, 69.6%. Forestlands, water areas, and wetlands make up the next major component of land within the county, constituting 26.7%. These combined land uses comprise 96.3% of Orleans County's land. As a result of this concentration, it was decided to utilize the above combined land uses to evaluate the county's resource components. In other words, those areas comprising either agricultural lands, inactive lands,

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[53] Genesee/Finger Lakes Regional Planning Board, Orleans County Land Use: An Inventory and Analysis, (Rochester, N.Y.: Genesee/Finger Lakes Regional Planning Board, 1970), pp. 4-16.

TABLE 9

COMPARISONS OF LAND USES OF ORLEANS COUNTY

Land Classification	Percent*
Residential lands	1.7%
Commercial lands	0.3%
Industrial-extractive-transportation lands	0.8%
Public-Outdoor Recreational lands	0.9%
Agricultural-Inactive lands	69.6%
Forest Lands-Water Areas-Wetlands	26.7%
Total	100.0%

*Orleans County, New York State, LUNR System, 1970.

forested lands, water areas, and wetlands were analyzed within the outdoor recreational selection model. The remaining 3.7% was deleted from the model since the land categories involved were not conducive to a public recreational development such as camping because of their urban locations.

As the study proceeds, it is necessary to analyze the economic sectors within the study area. The county has remained a leading producer of agricultural products within the region. Agricultural employment in Orleans County has shown the smallest decline over the past ten years, when compared with the decline in the surrounding seven-county region: Genesee, Livingston, Monroe, Ontario, Seneca, Wayne, and Yates. Farms have produced the highest average sales when compared with those in the surrounding seven-county area; and the county has become the leading vegetable producer in the region. From Table 10 various agricultural activities have been ranked by comparing Orleans County to the eight-county region.

By comparing the distribution of employment within the eight-county region, employment seems to be concentrated in certain sectors of the economy. From Table 11, the importance of agriculture to Orleans County's economy is evident. Therefore, agricultural lands are an important resource input within the county's economy. It is on these lands that this analysis concentrates in evaluating potential for public recreational development. Therefore, as non-marginal changes of land use occur, we must be aware of the economic impacts and tradeoffs.

TABLE 10

MEASURES OF AGRICULTURAL ACTIVITY
ORLEANS COUNTY, 1964

Measurement Units	Orleans County	Rank in Eight County Region*
Percent of land in farms	64.4%	2 nd
Acres per farm	171.6 acres	3 rd
Sales per farm	$17,739.00	1 st
Sales per capita	$470.00	2 nd
Employees and proprietors per 1,000 population	[illegible]	2 nd
Percent of income from farms (1967)	12.0%	1 st

*Genesee/Finger Lakes Regional Planning Board, Economic Analysis: Regional Summary and Orleans County Profile, Technical Report No. 2 (Rochester, N.Y.: Genesee/Finger Lakes Regional Planning Board, October, 1969), p. 1.

Definition: Eight-county region consists of: Genesee, Livingston, Monroe, Ontario, Orleans, Seneca, Wayne, and Yates Counties.

TABLE 11

PERCENT DISTRIBUTION OF EMPLOYMENT WITHIN ORLEANS COUNTY, AND ITS RANK IN THE NEIGHBORING EIGHT-COUNTY AREA: 1968

Categories of Employment	Orleans County	Rank in Eight-county Region*
Non-Agricultural Wage and Salary Workers (except Domestics, Family Workers, and Self-employed)	66.7%	8 th
Manufacturing	19.4%	7 th
Non-manufacturing	47.3%	7 th
Domestics, Family Workers, and Self-employed	11.1%	4 th
Agricultural employment	22.2%	1 st
Persons Involved in Labor Disputes	0.0%	

*Genesee/Finger Lakes Regional Planning Board, Economic Analysis: Regional Summary and Orleans County Profile, 1970.

The population of Orleans County is described as a dominantly white, lower-middle class, rural society, About 67% of the people live on rural lands or farms; the remaining 33% find shelter in two urban centers, Medina and Albion. The 1967 population density for Orleans County was eighty-six people per square mile.[54] Negroes make up 4.3% of the population, and are the only racial minority in the area. The remaining 95.7% are white persons of native stock (77.6%) or of foreign stock (22.4%).

The educational achievements of individuals vary widely. A minority (5.8%) completed less than five years of school. This group is most often represented by migrant black farm laborers. More than one-third of the population (34.1%) have completed high school and/or advanced schooling. Nonetheless, the median school years completed by adults in Orleans County was 9.9 years.

Closely aligned with these educational patterns are the average annual incomes of residents within the study area. The median income in 1967 was $5,608 per family. Nearly one-fifth of the people (18.5%) earned less than $3,000 per annum. Thirteen percent of the population earned more than $10,000 per year. These two groups representing the extremes in income, symbolize the educational extremes, (low income group has a median of 5.8 school years, and the highest income group has completed high school and additional college training). To assist those low income members of society, public assistance is provided 1,558 residents or 4.5% of the population.

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[54] County and City Data Book, 1967, U.S. Department of Commerce, Bureau of Census, (Washington, D.C.: Government Printing Office, 1967), pp. 252-253.

The demographic profile of the study area reveals that the urban population is located in two major centers positioned along the Erie Barge Canal. The villages of Medina and Albion have total 1970 populations of 6,338 and 5,078 respectively.[55] If we compare the total population of the county, 34,588, with the urban population centers of Albion and Medina, 11,416, it is seen that approximately 23,172 people are distributed over a predominantly rural landscape. Therefore, Orleans County is basically a rural economy. In analyzing county population data from 1960 to 1970, it can be concluded that the study area has experienced a slight growth rate of 1.26% or 429 people.[56] However, new job opportunities within all sectors of the economy have not kept pace even with the small population growth rate. Therefore, a net out-commutation of working people has occurred within Orleans County. This observation can be supported by analyzing the commuting patterns of the study area. From commuting statistics within the eight-county region, 28.9% of the employed civilians traveled outside Orleans County for employment.[57] This percentage was the highest value within the eight-county region for out-commutation. Furthermore, the in-out commutation ratio of 1:6 indicated that

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[55] Buffalo Evening News Almanac and 1972 Fact Book, (Buffalo, N.Y.: Buffalo Evening News, 1972), pp. 129-130.

[56] Genesee/Finger Lakes Regional Planning Board, Parks, Recreation and Open Space in Orleans County, pp. 20-22.

[57] Genesee/Finger Lakes Regional Planning Board, Economic Analysis: Regional Summary and Orleans County Profile, Technical Report No. 2 (Rochester, N.Y.: Genesee/Finger Lakes Regional Planning Board, October, 1969), p. 107.

for every one person traveling into Orleans County for employment, six persons traveled outside the county for employment.[58] A major function of Orleans County is now to serve as a bedroom community. Only the agricultural sector has remained a viable industry within the area; however, as mechanization increases, the labor to capital ratio decreases, resulting in umemployment or labor shifts to other industries. Also contributing to this situation is the fact that gains in productivity of labor have also resulted in a reduction of the labor force in producing the same agricultural production. If Orleans County continues to serve a resident function for commuters, the need for recreational planning and the preservation of open space may increase.

Major transporation modes within the county include rail, highway, and water. Rail facilities located throughout the county do not have a main-line status, since the Rochester-Niagara Falls link is only a freight branch-line. Highways provide the major mode of transportation within the county as well as important linkages to adjacent areas, including Rochester to the east, and Buffalo and Niagara Falls to the west. The principal east-west routes are State Route 31 and United States Route 104. State Routes 98 and 63 provide for north-south movements. The New York State Department of Transportation has recently completed the Lake Ontario State Parkway paralleling Lake Ontario from Rochester west to Lakeside State Park. This parkway serves as a linkage for commuters traveling

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[58] Ibid., p. 108.

to and from Rochester, and to link a major population center with recreational facilities. Water tranportation is limited to recreational use of the Erie Barge Canal. The competition of other modes has reduced the effectiveness of the canal as a major economic contributor to the study area.

Recreational opportunities within the study area vary from small village parks to the federally owned Iroquois National Wildlife Refuge. New York State is currently developing two state public recreation areas named Oak Orchard State Park, a marina based recreation type, and the Lakeside Beach State Park, a water and land based recreation type. Swimming, camping and picnicking are common activities at Lakeside Beach State Park, on the shoreline of Lake Ontario. Neither park has been completed, so recreational opportunities to area residents have not reached their designed potential. The last link of the Lake Ontario State Parkway has been scheduled to open February 16, 1973, which will enable greater utilization of the Lakeside Beach State Park during the 1973 season. Nature-oriented recreational activities are provided for by the Iroquois National Wildlife Refuge and the Oak Orchard Game Management Area.

Private recreation enterprises are unequally distributed within the county and in conjunction with major population concentrations. Golf courses, conservation clubs, a few campgrounds, and rod and gun clubs dominate the private organization of recreational activities. However, the spatial arrangement of these enterprises does not allow equal access to these recreational services, for the residents of all communities.

In summarizing the major physical, economic and demographic characteristics descriptive of Orleans County a brief list will suffice:

1) Orleans County is located within the Ontario Lowland, wherein three definable sub-regions exist:

a) Lake Ontario Plain

b) Southern Ontario Plain

c) Niagara Escarpment Area

2) Each of the above sub-regions were formed by varying geologic processes (either lacustrine deposition in the north, or glacial deposition of till and outwash in the south). The resulting physiographic differences in soil types, slopes of land and drainage patterns produced variations in land use within Orleans County.

3) The climate of the study area is moderated by Lake Ontario's effects on temperatures and precipitation. As a result specific agricultural enterprises are located adjacent to the large water body. The moderation effect has increased the number of frost-free days within the growing season for that latitude to 160 days.

4) Agricultural land use dominates the land area within the county, occupying 69.6 percent of the total area.

5) Population has grown at a rate of 1.26 percent over a ten year period.

6) Transportation within the county is based on highway surface capabilities for the supplying of production firms and the distribution of products to local and regional

markets.

7) Recreation opportunities within the study area are varied: however, an unequal distribution of these activities does not allow equal access to all residents.

8) Orleans County does not have a balanced economy, and as a result, a net out-commutation has occurred. This situation has induced a change in land use patterns and encouraged the development of bedroom communities.

The outdoor recreation selection model for public camping was designed and calibrated according to these physical and socio-economic characteristics of Orleans County. In Chapter IV, application of the model to a locational problem within the county, will be described.

CHAPTER IV

APPLICATION OF THE OUTDOOR RECREATIONAL SELECTION MODEL WITHIN ORLEANS COUNTY, NEW YORK

After having outlined the planning model and described the study area, we can operationally apply the model. For the model's application, it is necessary to outline the community priorities and their associated objective functions, the variables, measurement units, and data sources. Finally, the inventory system and the developed land use decision rules must be placed in perspective in order to understand the planning procedural framework. Therefore, this chapter will discuss the application of the selection model and provide the reader with its output derived from an analysis of Orleans County, New York. A stepwise sequence will be presented to link the model's framework and output for community decision-making.

One objective function of the community considered in this study was to select a campsite facility within Orleans County by minimizing the loss of revenue normally generated by property taxes. Three variables were considered for each of the privately owned land parcels within the study area: 1) assessed land value, 2) assessed land value with improvements and 3) both county and township tax rates.

The sources of the assessed land values, with and without improvements, were the records available at the Orleans County Tax Coordinating Office, Court House, Albion, New York. To

obtain data on the third variable, each school district within the study area was contacted. From maps and tables forwarded from Albion, Holley, Kendall, Lyndonville, and Medina School Districts, the tax rates were identified, and mapped.

The calculation of a per acre assessment on land, and on land with improvements was necessary for each private land parcel because their boundaries do not coincide with school district nor township boundaries. Both per acre values (land and improved land) for each farm were applied to a county map, where they were used to compute a mean assessed land value for each cell, and a mean assessed land value with improvements for each cell.

A mean assessed land value per acre and assessed land value per acre with improvements was computed for each of the approximately 1056 cells of the study area in a five step method:

1) computation of per acre assessed values for land alone, and for improved land for each farm.

2) location and plotting of farm values on a gridded map of the area: total acres per farm; per acre assessed land value, (L); per acre assessed land value with improvements, (L.I.).

3) division of each cell into smaller units by placing a transparent 25 sub-cell gridwork overlay on it.

4) estimation of the number of sub-cells occupying each farm within a given cell.

5) computation of a weighted mean for improved and unimproved assessed land values for a given cell.

By using the sample cell as the unit of analysis, the

sequences of computations used for each of the 1056 cells in the study area of Orleans County to achieve cell means can be explained in detail.

First Step:

1) Computation of a per acre assessed land value, and per acre assessed improved land value for each farm in the cell:

A. Record the acreage, total assessed land value and land value with improvements:

Sample Design of Tax Record:

Owner	Acres	Assessed land value	Assessed improved land value
Farm A	85	$ 4,100.00	$ 4,100.00
Farm B	112	5,760.00	12,980.00
Farm C	175	8,510.00	14,000.00
Farm D	73	2,920.00	12,000.00

B. Compute a per acre assessed land value by division: (Figure 4).

$$\text{Per acre assessed land value} = L_{\cdot(\text{farm})} = \frac{\text{Assessed land value of farm}}{\text{Acres within farm}}$$

Example: $L_{(\text{Farm B})} = \frac{\$\ 5,760.00}{112} = \$\ 51.42$

C. Calculation of a per acre assessed land value with improvements: (Figure 4).

$$\text{Per acre assessed land value with improvements} = L.I._{\cdot(\text{farm})}$$

$$L.I._{(\text{Farm B})} = \frac{\$\ 12,980}{112} = \$\ 115.89$$

The per acre assessed value of Farm B with its

improvements, as drainage, buildings, etc., is larger than the unimproved lands.

The per acre values, L. and L.I., for farms A, C, and D were figured in a similar way to produce the values recorded on the sample cell (Figure 4).

Second Step:

The second step in the method was to locate the land parcel (farm) within the county, and to record the L. and the L.I. values, and total acreage in the appropriate cell. The tax record was the primary source of locational data, as each parcel was identified by its road name and direction (eg. Marshall Road, East). When a single owner held more than two farms on the same road, a secondary reference was used to help locate that farm. The Atlas and Plat Book of Orleans County, New York contained two indices that helped to identify the farms. By use of the Index of Owners and Index of Residences, as well as acreage of each farm listed on these plat maps, the researcher was able to locate all the land parcels on the gridded map of the study area.

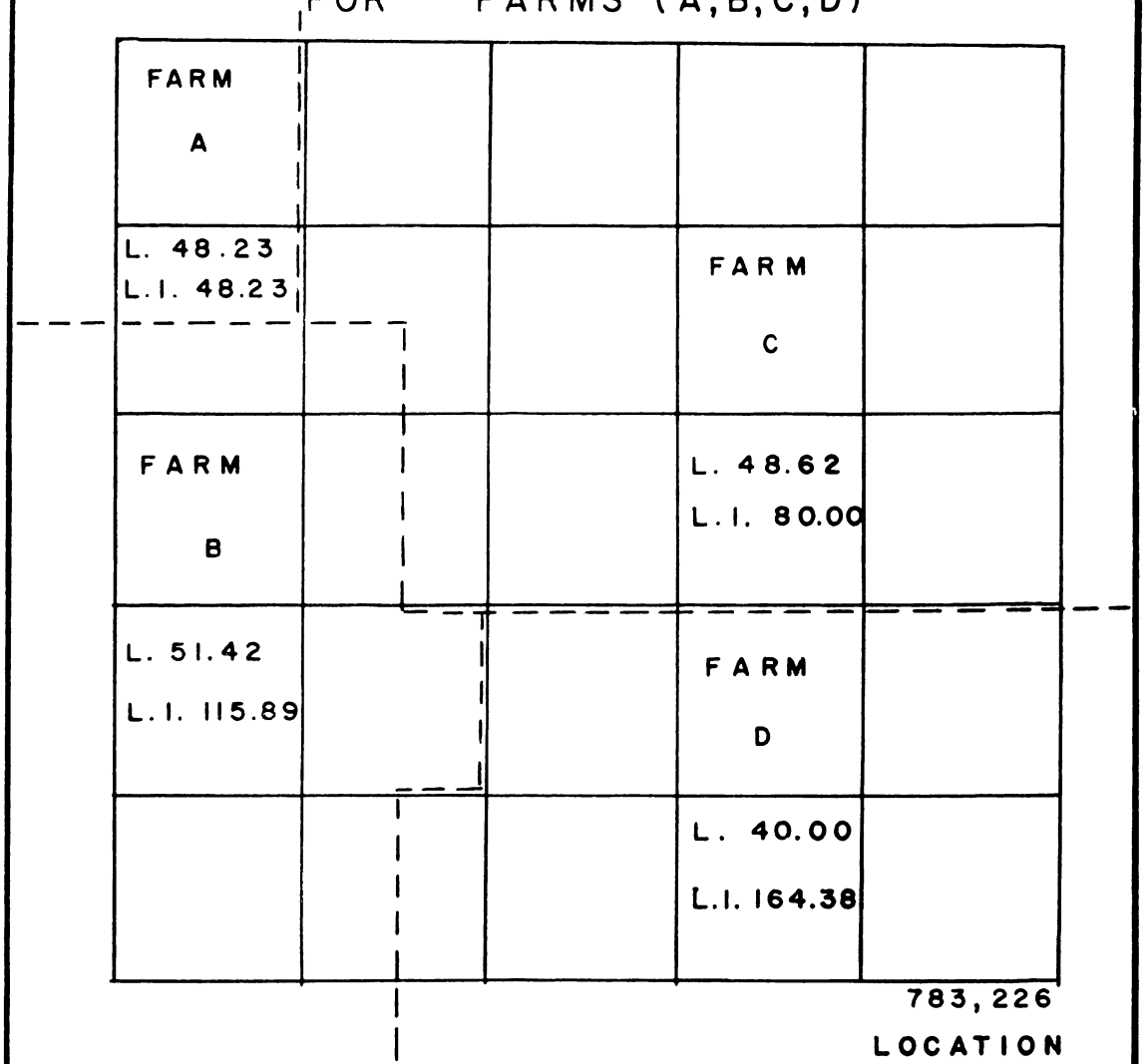
Third Step:

The need for dividing each of the county's cells (one square kilometer each) into 25 equal-sized smaller sub-cells became evident once all the farms were plotted. Since most cells were a collection of farms, whose boundaries were not congruent with the superimposed grid, but rather projected into neighboring cells. Each cell was subdivided into 25 sub-cells (5 X 5), to help compute a weighted average for each cell's per acre land value (see Figure 4).

Figure 4

Per Acre Land Value and Per Acre Land Value with Improvements For Farms (A,B,C,D)

PER ACRE LAND VALUE AND PER ACRE LAND VALUE WITH IMPROVEMENTS FOR FARMS (A,B,C,D)



LEGEND:

———— CELL BOUNDARIES

— — — — FARM BOUNDARIES

L. — PER ACRE ASSESSED VALUE

L.I. — PER ACRE ASSESSED VALUE WITH IMPROVEMENTS

Fourth Step:

In order to estimate the number of sub-cells occupying each individual farm lying in-part, or in-whole, within a given cell, a visual count was made to the nearest quarter of a sub-cell. It must be pointed out that measurement error has occurred in estimating the number of sub-cells within each farm.

For Sample Cell, 783,226, the estimated number of sub-cells occupied by the four farms is shown below:

Farm	Number of Sub-cells
A	1.50
B	5.75
C	11.25
D	6.50
Total cell area =	25.00 sub-cells, Cell 783,226.

Figure 4 displays the number of sub-cells occupying each individual farm within Sample Cell, 783,226.

Fifth Step:

The computation of a weighted mean (for assessed land values) on improved and unimproved lands was figured for each cell by the following equations:

$$\overline{L.C.} = \frac{SC_A(L._A) + SC_B(L._B) + SC_C(L._C) + SC_D(L._D) + ..SC_N(L._N)}{25}$$

$$\overline{L.I.C.} = \frac{SC_A(L.I._A) + SC_B(L.I._B) + SC_C(L.I._C) + SC_D(L.I._D) + \ldots SC_N(L.I._N)}{25}$$

Where:

$\overline{L.C.}$ = weighted mean assessed land value for any cell.

$\overline{L.I.C.}$ = weighted mean assessed land value with improvements for any cell.

$SC_{A,B,C,D,...N}$ = number of sub-cells in respective farms in any cell

$L._{A,B,C,D,...N}$ = per acre assessed land value for each respective farm

$L.I._{A,B,C,D,...N}$ = per acre assessed land value with improvements for each respective farm.

Computation of the weighted mean assessed land value and weighted assessed land value with improvements for sample cell, 783,226 is illustrated below.

$$\overline{L.C.}_{(783,226)} = \frac{1.50(\$48.23) + 5.75(\$51.42) + 11.25(\$48.62) + 6.50(\$40.00)}{25}$$

$$\overline{L.C.}_{(783,226)} = \$\ 47.00$$

$$\overline{L.I.C.}_{(783,226)} = \frac{1.50(\$48.23) + 5.75(\$115.89) + 11.25(\$80.00) + 6.50(\$164.38)}{25}$$

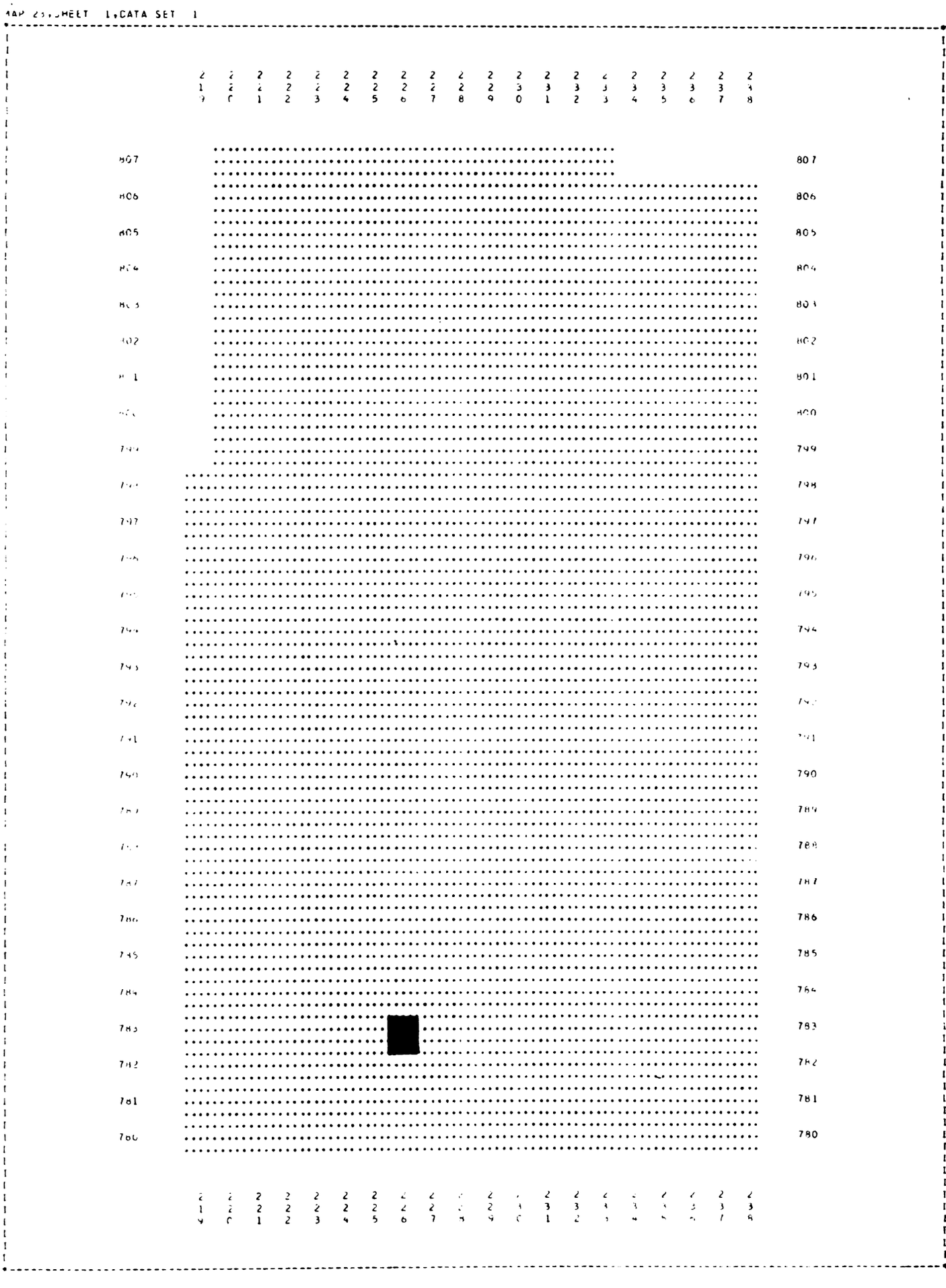
$$\overline{L.I.C.}_{(783,226)} = \$\ 108.29.$$

Figure 5 locates sample cell 783,226 within Orleans County.

Similar computations were done for all cells within the county. The results were recorded as per cell mean assessed land values and per cell mean assessed land values with improvements. The application of these per cell means included use in

Figure 5

Location of Sample Cell, 783,226, Within Orleans County, New York


MAP 23, SHEET 1, DATA SET 1
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determining property tax revenues, and acquisition cost. Furthermore, these cell means were mapped by the computer routine as shown on pp. 170-77 of the appendix. However, the direct use of these means for recreational planning was limited since they were not directly linked to a specific community objective function.

With the cell means computed, the researcher can begin to analyze the first objective function, which is to minimize property tax revenue loss.

To determine the total property tax revenue loss from each of the cells within the study area it was necessary to multiply the per acre assessed land value with improvements by the number of acres in that cell (247.1 acres), and then by the corresponding tax rates (based on a thousand assessed evaluations). The equation below illustrates this relationship for the sample cell:

$$PTRL_{(783,226)} = \overline{L.I.C.} \quad X \quad 247.1 \quad X \quad TR$$

Where: PTRL = property tax revenue loss for the sample cell

$\overline{L.I.C.}$ = average assessed land value with improvements, per acre, within the sample cell

247.1 = number of acres within each cell

TR = corresponding tax rates for county and township for the sample cell

For the sample cell cited, the property tax revenue loss based upon current millage rates of $ 43.00 per thousand assessment of improved lands yields.

PTRL = ($108.29) X (247.1) X (0.043) = $ 1,150.61

This value of $ 1,150.61 is the amount of property revenue generated by the sample cell to the county and township governments. This is the value cost to the study area if a non-marginal change occurred resulting from a shift of private agricultural use to a public recreational development. This value also may be referred to as the opportunity cost of such a land use change within Orleans County.

Therefore, to minimize the property tax revenue loss, or opportunity cost, it is necessary to select those cells which generate less property tax. The output of the objective function can be visualized within the computer maps, on pages 178-81, within the appendix. Those cells having a property tax revenue loss between $ 152.14 and $ 3434.76 are within the category for a lower revenue loss. They appear in the areas of lightest shading on the computer map, pp. 179-80 in the appendix. Therefore, these cells should be considered for feasible sites, if the objective function is to be satisfied.

A second objective function was to select a campsite facility within Orleans County by minimizing the initial development cost. The initial development cost is that cost outlay necessary to: 1) acquire the cell for public recreation (acquisition cost), 2) provide adequate drainage (drainage cost), and 3) link the cell to an existing highway facility (transportation construction cost). It is these variable costs that the investigator has chosen to analyze and assign to the initial development costs of a public campground facility. In order to determine the initial development cost for the individual cells, it is necessary to analyze the variables and

their measurement units.

The methods utilized to measure the individual variables are presented below. As before, a stepwise procedure will serve as a framework for explanation in conjunction with mathematical equations.

The first variable to be discussed within the computation of the initial development cost is acquisition cost. Acquisition cost was determined by two approaches within the study area: 1) average recorded sale value per acre, and 2) an adjusted average improved land value per acre. Both approaches were utilized within the study area to estimate the market value. Acquistion cost per acre was based upon the per acre recorded sales value or the per acre adjusted average on improved lands. Once per acre costs were computed, the total acquisition cost per cell could be calculated by multiplying per acre costs by 247.1.

The first approach was to acquire the average recorded sale value on a per acre basis for lands purchased for public recreational developments. It was assumed that the acquisition cost for converting privately owned lands into publicly owned areas was a reflection of true market value. Hence, market value would directly relate to the acquisition cost of individual cells. Based upon this premise, data were acquired for transactions which reflected changes from private agricultural use to public recreational use. Within the study area, public recreational land purchases have occurred adjacent to the shores of Lake Ontario. The purchases occupy cells: 806,236; 806,238; and 806,239. These cells are the only land areas that

have been purchased from private owners for public recreational development within the county. However, sales information from other counties similar in nature could have been incorporated into the existing sales information, but such data were not included in this study. The per acre value on improved lands within these cells represent sales averages computed by New York State on 640 acres of Lakeside Park land, and are recorded in the Transaction Office of the County Clerk, Court House, Albion, New York. The acquisition cost of fruit land per acre had a mean sales value of 875 dollars; open land had a mean sales value of 300 dollars per acre. Fruitland includes acreage devoted to orchards producing apples, cherries, and peaches. A sales adjustment factor (SAF) was computed using the cells adjacent to and occupying the Lakeside Park area along Lake Ontario's shores. The sales adjustment factor is a multiplier derived from the relationship between the adjusted assessed land values with improvements for each cell, and the average recorded sales value of lands within an individual cell. The sales adjustment factor was used wherever sales information could be obtained with regards to purchases of private lands for public recreational development. Data gathered within the cells occupying the public recreational facility yielded a per acre assessed mean value on improved land of $ 152.20; and an average recorded sales value of $ 300.00 per acre. From these data a sales adjustment factor was computed by the following equation:

$$SAF = \frac{ARSV}{\left(\frac{\overline{LI}}{ER}\right)} = ARSV \cdot \left(\frac{ER}{\overline{LI}}\right)$$

Where:

SAF = sales adjustment factor

ARSV = average recorded sales value per acre on improved land for cells 806,236; 806,238; and 806,239.

$\overline{LI}$ = average improved land value per acre

ER = equalization rate per cell

The sales adjustment factor was 1.97 for the data analyzed within the 640 acre parcel. The sales adjustment factor was utilized for all cells adjacent to Lake Ontario, excluding the State-owned 640 acre parcel. The sales adjustment factor was utilized for those cells similar to these lands purchased by the State for Lakeside Park, along Lake Ontario's shore. Therefore, all cells adjacent to Lake Ontario, excluding the parkland itself, were adjusted by a sales factor of 1.97. Acquisition costs for each of these cells was computed by using the equations below:

1) $AC_i = ARSV \times 247.1$

2) $AC_i = \frac{\overline{LI}_i}{ER_i} \times SAF \times 247.1$

Where:

AC_i = acquisition cost for each cell

$\overline{LI}_i$ = average improved value per acre for each cell

ER_i = equalization rate per cell

SAF = sales adjustment factor

247.1 = number of acres per cell

i = 1, 2, 3 ... n

n = all cells adjacent to Lake Ontario

Acquisition costs for the remaining cells in Orleans County not adjacent to Lake Ontario were computed by an alternative technique as sales data was lacking for those lands.* The following equation was used to calculate acquisition costs for cells not bordering Lake Ontario:

$$AC_i = \frac{\overline{LI}_i}{ER_i} \quad X \quad 247.1$$

Where: AC_i = acquisition cost per cell

$\overline{LI}_i$ = per acre average improved land value for each cell

247.1 = number of acres per cell

i = 1, 2, 3 ... m

m = all cells within the county not adjacent to Lake Ontario

In discussing development costs for a public recreation facility, a second variable was included. This variable was the drainage cost on a per cell basis, which depends to a great extent on the major soil association within that cell. Drainage costs were estimated from consultation with the Soil Conservation Service staff and were based upon farm records showing drainage potential for each soil association, and therefore, is a proxy measurement of cost for the adequate drainage necessary for the construction of a recreational facility.

Soil associations were chosen to reflect possible tiling costs for each cell, as each association is an aggregation of soil properties unique to that kind of soil. The similar soil

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*Alternative technqiue discussed on pages 50-52.

characteristics of soils within any given association include: slope (percentage); silt and clay (percentage); depth of water table (feet); depth of bedrock (feet). Those associations with low percent slopes (0 to 2 percent); high amount of lacustrine silts and clays (50 to 100 percent); and high water table display higher drainage cost estimates due to their restrictive drainage capabilities.[59] In contrast, associations having gently sloping to moderately steep areas, 3 to 15 percent, deep sands and gravels, and a low water table reflect a low drainage cost estimate.

Table 12 represents each soil association classified within Orleans County; the per acre tiling cost, and the drainage cost per cell. The estimated drainage cost per cell was calculated by using the equation below:

$$DRC_i = ATD_i \times 247.1$$

Where: DRC_i = drainage cost per cell

ATD_i = average tiling cost per association per cell

247.1 = number of acres per cell

i = 1, 2, 3 ... t

t = all cells within Orleans County

The tiling cost per acre varies from twenty dollars to five-hundred dollars, so that the estimated tiling cost of some cells is as low as $4,942 (eg. Arkport-Galen Association) and others peak at $123,550 (eg. Odessa-Lakemont Association) for a cell of equal area. These tiling costs do not take into consideration the economies of scale that can be reached if larger areas

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[59] G.E. Miller, L.M. Turk, H.D. Foth, Fundamentals of Soil Science, (New York, N.Y.: John Wiley and Sons, Inc., 1964), p. 48.

TABLE 12

TILING COSTS OF SOIL ASSOCIATIONS
WITHIN ORLEANS COUNTY

Association	Per Acre Cost	Cost Per Cell
Muck	$ 200	$ 49,420
Lockport and Elmwood	300	74,130
Colonie-Elnora	280	69,188
Palymra, Arkport and Colonie	20	4,492
Arkport-Galen	20	4,492
Odessa-Lakemont	500	123,550
Ontario and Lima-Kendais	280	69,188
Farmington and Brockport	300	74,130
Hilton-Appleton and Clarkson	280	69,188
Alton and Colonie	20	4,492
Galen-Janius and Elnora	280	69,188
Lucas, Collamer and Hilton	$ 280	$ 69,188

are drained. Nevertheless, the dollar amounts represent a relative difference in estimating drainage cost. It must be recognized, as drainage techniques are improved, that cost savings may be realized. The spatial variation of drainage cost reflects the physical characteristics of the land; hence, this variable is a major component within development cost of a public recreation facility.

The third variable, which is a part of the development cost, is the construction cost of a road linking each cell's geographic center to the nearest existing road. Based on Soil Conservation Service contractural estimates, the New York State Department of Environmental Conservation designed transportation construction cost estimates for public access roads to recreational facilities. From information obtained from the Department of Environmental Conservation, a ten foot wide public access road with two feet shoulders cost an average of 29,000 dollars per mile to construct. This estimated cost included removal of top soil, the shaping of lateral ditches, placement and grading of a six inch gravel fill. Estimation of transportation construction costs for any cell was based upon the 29,000 dollar/mile value supplied by the New York State Department of Environmental Conservation. The researcher developed a table showing the construction cost (dollars) per unit distance (1/8 inch map intervals) for use on the New York State Department of Transportation 7½-Minute Series Planimetric Maps. The map scale of one mile for each two-and-five-eighths inches of map surface was used on the transportation planimetric maps. The road building costs were figured for a sequence of map distances using one-eighth

TABLE 13

TRANSPORTATION CONSTRUCTION COST SCALE

Linear Distance from Cell's Center to Nearest Road on 7½-Minute Topographic Maps	Cost from Center of Cell to Nearest Road
1/8 inches	$ 1,380.95
1/4	2,761.91
3/8	4,142.86
1/2	5,523.81
5/8	6,904.76
3/4	8,285.72
7/8	9,666.67
1	11,047.62
1 1/8	12,428.57
1 1/4	13,809.53
1 3/8	15,190.48
1 1/2	16,571.43
1 5/8	17,592.38
1 3/4	19,333.34
1 7/8	20,714.29
2	22,905.24
2 1/8	23,476.19
2 1/4	24,857.15
2 3/8	26,238.10
2 1/2	27,619.05
2 5/8	29,000.00
2 3/4	30,380.96
2 7/8	31,761.91
3	33,142.86

inch intervals (see Table 13). This transportation construction cost scale (Table 13) was developed from the relationship that one mile of gravel road costs 29,000 dollars to construct, and is represented on the maps by two-and-five-eights inches. The road construction cost per one-eighth inch of map distances was calculated to be $ 1,380.95. By using this transportation cost scale, construction costs could be obtained from the center of the cell to the nearest existing road. The geographic center of each cell was identified by the intersection of diagonal lines constructed between opposite corners. In order to estimate the road construction cost for each cell, the investigator followed the stepwise sequence below:

1) measured the distance from the center of the cell to the nearest highway (to nearest 1/8th of an inch).

2) located this distance on Table 13, left column.

3) recorded the matching construction cost in dollars.

The transportation construction cost equation is shown below:

$$TCC_i = D_{ir} \times CD_i$$

Where: TCC_i = transportation construction cost per cell

D_{ir} = linear distance from center of cell i to the nearest existing road, r

CD_i = cost per mile for selected type of public access road, i.e., $ 29,000 per mile

i = 1, 2, 3 ... t

t = all cells within Orleans County

The development cost per cell includes the summation of acquisition cost, drainage cost, and transportation construction cost. The following equation reveals their relationship:

$$DC_i = (AC_i + DRC_i + TCC_i)$$

Where: DC_i = development cost per cell

AC_i = acquisition cost per cell

TCC_i = transportation construction cost per cell

DRC_i = drainage cost per cell

i = 1, 2, 3 ... t

t = all cells within Orleans County

Therefore, to minimize development cost it is necessary to select those cells by a visual analysis of the corresponding computer maps, within the range of zero to $ 133,289.44 or, the lighter shading (see pp. 186 to 189 in the appendix). It is these cells which therefore should be considered as feasible cells for the second objective function to be satisfied. From the lower level cells selected by satisfying the second objective function, one can then return to the individual cell data to obtain specific information.

The third objective function which may be considered high priority by a community is the minimization of the total costs. Total cost is the selection of those cells which minimize all the defined cost areas within the model. As previously stated in Chapter II, there are other cost areas not included within the model. Also, measurement units necessary to spatially analyze supporting resource components may be lacking. A discussion of other cost areas will be found in Chapter V. There are four cost areas which contribute to the total cost for providing a public recreation facility: acquisition cost, drainage cost, transportation construction cost and property

tax revenue loss. The equation below expresses the relationship among these cost factors, and may be considered the third objective function:

$$TC_i = (AC_i + DRC_i + TCC_i + PTRL_i)$$

Where:
- TC_i = total cost per cell
- AC_i = acquisition cost per cell
- DRC_i = drainage cost per cell
- TCC_i = transportation construction cost per cell
- $PTRL_i$ = property tax revenue loss per cell
- i = 1, 2, 3 ... t
- t = all cells within Orleans County

As before, three levels were mapped by the GRID computer routine within the study area. Total cost per cell was calculated for each cell. A range in total cost (dollars) was determined for each of the three mapping levels. The low total cost, medium total cost, and the high total cost ranges were each represented by different shadings, shown on Table 6, pp. 190-193. Those cells reflecting low total cost would be selected in order to satisfy this objective function. Those cells ranging from zero to $ 136,622.75 or cells of lighter shading were selected as feasible sites for the public camping facility.* (See pages 191 to 192 in the appendix.)

The fourth objective function in this study simulates a community priority designed to identify those physical factors

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*Those lands with zero total cost reflected lands already developed in Iroquois National Wildlife Refuge.

in the environment which would maximize the socially perceived benefits offered by the land resource and associated aesthetic appeal. The researcher has identified four physical factors relating to the aesthetic components of land resources. Also, he has isolated two external factors affecting the aesthetic attractiveness of a proposed site: nearness from an existing and competing recreational camping facility, and proximity to a pollution source are integrated into the model. Distance from a pollution source or an existing recreational facility is the primary measurement unit indicating aesthetic quality for the latter factors. As previously stated, the evaluated cell is rejected if a pollution source or a competing recreational facility is located adjacent to the cell.

The four physical factors indicating aesthetic attractiveness are: 1) water to land relationship, 2) contour differential, 3) forest color contrast, and 4) amount of forested land.

The aesthetic index was a composite or collection of quantitative information reflecting measurement units of the specific resource, as well as its associated weight ($a_1 \ldots a_4$), which was determined by its ability to generate related camping activities. Because the index represented the effects of four physical criteria on aesthetic value, the index was assumed to be additive.

The individual physical factors were assigned measurement units: 1) water to land relationship as percentage, 2) contour differential as feet, 3) forest color contrast as vegetative type dominating the canopy, and 4) amount of forested land as percentage.

A classification scheme was developed in order to rank the incremental levels of measurement of each aesthetic indicator. The scheme used values from zero to ten to represent various measurement levels.

The water to land relationship for each cell was determined in a stepwise sequence outlined below:

1) A cell grid-work, using one-square kilometer cells as the unit, was superimposed on the United States Geological Maps, 7½-Minute Series, utilizing Universal Transverse Mercator Grid lines to determine cell boundaries.
2) Over each 247.1 acre cell, a twenty-five sub-cell grid was superimposed.
3) A tabulation was made for each cell listing the total number of sub-cells covered by water bodies, and the total number represented by land surfaces.
4) A percentage was computed yielding a water to land relationship, as shown by the following equation:

$$\text{Percent of water} = \frac{\text{Number of sub-cells water}}{25} \times 100$$

$$\text{Percent of land} = (100\%) - (\text{Percent of water area})$$

5) A ranking value (0 to 10) was assigned to each cell based on its water to land relationship, Table 6, p. 70.

Contour differential, the second physical factor essential to developing an aesthetic index, was likewise calculated by a stepwise sequence.

1) A cell gridwork, using one-square kilometer cells as the unit, was superimposed on the 7½-Minute Series, of

the United States Geological Maps of Orleans County, where Universal Transverse Mercator Grid Ticks determine cell boundaries.

2) The lowest and highest contours were located and recorded for each cell.

3) The contour differential per cell was found by subtracting the lowest contour from the highest contour for the cell.

4) From the list of contour differentials figured for all cells in the study area, the maximum contour differential for any one cell was found to be 100 feet.

5) A classification was established for the contour differential using 10-foot intervals. Ten-foot increments of contour differential were equated to one unit of increased ranking, Table 7, p. 72.

Forest color contrast was derived from an analysis of forest cover types within Orleans County, New York. A classification scheme was designed which yielded four generalized classes of forest cover: 1) deciduous, 2) coniferous, 3) mixed deciduous and coniferous, and 4) swampland-brushland.

From the four generalized classes of forest cover, methods were sought to determine dominance within the cells. Figures 6, 7, 8 and 9 represent the four classes of forest cover species. As illustrated in Figure 6, the dominant species in the deciduous forest cover type include beech, maple, elm, and white ash. Figure 7, typifying the coniferous forest, contains species of white, red and scotch pine. Hemlock may be included

as defined by Ferguson and Mayer.[60] The mixed deciduous-coniferous forest type, Figure 8, includes hemlock and white pine, in addition to sugar maple, beech, and yellow birch. Figure 9 symbolizes those cells showing the brushland-swampland type of forest cover. Willow, cedar, thorn-apple, cottonwood and white ash are dominant in this area.

Measurement sources were selected and various degrees of error were experienced in attempting to determine the classes of forest cover on a per cell basis. Information concerning forest cover types was not available on a cell basis nor was information available in a form which allowed the investigator to spatially analyze the county in the desired degree of intensity. The major problem was that information concerning forest cover types was not available on a scale which was congruent with the 247.1 acre cell size used in this research. Therefore, various sources of data had to be integrated into an approximation of forest cover classes. Sources of data to measure the dominance of forest cover were derived from the Atlas of Forestry of New York, aerial photographs, observation transects of individual cells, New York State LUNR maps, and personal knowledge of the study area. The following stepwise procedure was utilized to approximate the classification of forest cover:

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[60]Ronald H. Ferguson and Carl E. Mayer, Timber Resources of New York State.



Figure 6: Deciduous Forest Cover Class, Orleans County, New York



Figure 7: Coniferous Forest Cover Class, Orleans County, New York



Figure 8: Mixed Deciduous-coniferous Forest Class, Orleans County, New York



Figure 9: Swampland-brushland Forest Class, Orleans County, New York

1) It was recognized that not all cells were occupied by forested land. Therefore, only cells which had at least twenty-five percent of their area occupied by forested land were analyzed. This was determined from New York State LUNR maps containing the percent of forested land per cell.
2) Cells 803,229; 803,246; 798,251; 783,223; 784,236; and 787,254 were surveyed by transecting them. These specific cells were selected from the county's total cell population because they displayed both a minimum twenty-five percent forest-cover acreage, and matched one of the sub-regions identified by the Atlas of Forestry of New York State.
3) For the six cells, dominance was estimated by counting the number of trees belonging to the forest type within the overstory, along a transect, and parallel to it ten feet on either side. Dominance is defined as the greatest number of trees belonging to a forest type within the overstory.
4) Each cell was classified as one of the four forest cover categories, based on percentage of forest species. That is, cells were ranked according to the dominance of either deciduous, coniferous, mixed-deciduous and coniferous, or swampland-brushland.
5) Aesthetic rankings were determined for each of the four forest-cover classifications, based upon their potential for generating forest color contrast on a total year

basis. The color potential for each category of forest cover was based upon three factors: 1) the number of different vegetative colors produced during the year, 2) the intensity of color (assuming that oranges and reds are more vivid than yellow, greens and browns) and 3) the duration of the color theme. The mixed-deciduous and coniferous type received the maximum value of ten, because autumnal contrasts of green needles with red, orange, and yellow hues produces the brightest scheme, and even during winter and spring the presence of the pines and hemlock tinge the forested area with green. The second most pleasing color contrast was assigned to deciduous areas (6.6), where green dominates both spring and summer; the autumn's multi-colors generate a wide color array, and only winter has darkened colors. The coniferous areas were assigned a ranked value of 3.3 because of their yearly color consistency. Least appealing, aesthetically, was the swampland-brushland type of cover. Although color contrasts do occur within swampland-brushland species, that category was assigned a value of zero based upon the following limitations: 1) color contrasts are usually non-vivid browns-yellow hues in autumn, or monochromatic during spring and summer; 2) reduced accessibility to view the vegetation because of poor drainage, and 3) immature stand of trees. Decimal values of 6.6 and 3.3 reflect the distribution of the rank values, ranging from zero

to ten, among the four types of vegetative cover. (A spread of ten rank units over four categories, separated by equal values, creates this decimal situation for deciduous classification, as well as the coniferous type, as 10 ÷ 3 = 3.33...) The aesthetic rankings are shown in Table 8.

The fourth physical factor, amount of forested land, is the final remaining aesthetic indicator within the composite aesthetic index. The amount of forested land was derived from existing percent categories of forested land within each cell. The information was obtained from a land use study originating from LUNR data.[61] On the LUNR map each cell was ranked in one of five categories, based on percentage of its own forested land. Higher percentages of forested land yielded a higher aesthetic value on a per cell basis. The percentage of forested land was ranked between zero and ten, as illustrated in Table 5, p. 69. Decimal values indicate arbitrary assignment of a range of ten, equally distributed among the number of percentage categories of forested land.

The objective function relating to the aesthetic value of each cell has been previously outlined and discussed. The composite index, which was derived, indicates a summation of those four physical factors most responsible for any cell's total aesthetic value. Hence, the highest composite total identifies those cells which have the greatest potential contribution

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[61]Genesee/Finger Lakes Regional Planning Board, Report Prepared for the Orleans County Planning Board, Orleans County Land Use: An Inventory and Analysis, (Rochester, N.Y.: Genesee/Finger Lakes Regional Planning Board, 1970), p. 15.

toward a pleasing aesthetic appearance and a high value.

As before, a computer mapping routine generated a visual display of the value of the objective function, allowing the decision-maker to select those cells with the highest composite score. Therefore, the high level cells ranging from 47.8 to 71.70 or, dark shading were selected to satisfy the so stated aesthetic objective function. (See pages 194-197 in the appendix.)

The analysis of the preceding objective functions to simulate community priorities has been discussed and its application outlined. Individual maps have been produced reflecting property tax revenue loss, development cost, total cost, and a composite evaluation of aesthetic characteristics. Each map reflects a single objective function on various levels of intensity. The individual maps presuppose that the community's priority is based upon a single resource component. Therefore, under this assumption, the objective functions could be stated and mathematical equations derived. Even though a community may establish a priority for a specific objective function or resource component, it may also wish to include and rank other objective functions or resource components accordingly.

In order to include the major resource components within the planning model, to simulate community priorities, an analytical framework must be established. The investigator has chosen to map three of the established objective functions in combination. Property tax revenue loss, development cost, and the composite aesthetic index were selected as the major

decision variables in establishing the major combinations. Since each of the three variables was mapped at three levels of intensity, a combination mapping output would yield twenty-seven individual maps. These computer maps would express the possible combinations necessary to simulate the various rankings and alternatives of the selected objective functions, for a decision-maker within a community. The various combinations are expressed by the following tabular relationships in Table 14, p. 128.

Each of the combinations expressed in Table 14 is represented by a computer map within the appendix (pp. 198-305). These maps are read in combinations for three objective functions, each expressed at one of three levels of intensity. The objective functions are mapped in the same order for all twenty-seven computer maps: firstly - property tax revenue loss; secondly - development cost; and lastly, rank on aesthetic index. The three levels of intensity used for mapping each objective function include low, medium and high values, denoted as L, M, and H in each map title.

Each map is mapped at two levels, where level one represents rejection of those cells unlike the specified combinations, and level two represents acceptance of those cells fitting the required objective function combinations. For example, the 594 cells at level one did not match the requirements of low property tax revenue loss, low development cost and low aesthetic index; whereas, the county's remaining 462 cells did have low property tax revenue loss, low development cost and

TABLE 14

COMBINATIONS OF RANKED OBJECTIVE FUNCTIONS

Objective Functions: 1) Property tax revenue loss
2) Development Cost
3) Aesthetic Index

Rankings of each function: H = high; M = medium
L = low

A. TWO LEVEL: Property Tax Revenue Loss interacting with Development Cost

		Property Tax Revenue Loss		
		L	M	H
Development Cost	L	LL	LM	LH
	M	ML	MM	MH
	H	HL	HM	HH

B. THREE LEVEL: Combinations of Property Tax Revenue Loss-Development Cost interacting with Aesthetic Index

		Aesthetic Index		
		L	M	H
Property Tax Revenue Loss-Development Costs	LL	LLL	LLM	LLH
	LM	LML	LMM	LMH
	LH	LHL	LHM	LHH
	ML	MLL	MLM	MLH
	MM	MML	MMM	MMH
	MH	MHL	MHM	MHH
	HL	HLL	HLM	HLH
	HM	HML	HMM	HMH
	HH	HHL	HHM	HHH

low aesthetic index values, and therefore, were mapped at the second level (Table 8, pp. 198-201 in the appendix). Shadings of two intensities were used to identify these two levels: accepted cells appeared in darker tones, rejected cells appeared in lighter tones.

These ranked combinations of objective functions, (as shown by the computer maps on pp. 198-305), helped identify specific cells which matched their criteria, and thereby enabled the decision-maker to pick ones which would comply with the priority alternatives established by the community. Table 15, p. 130, lists the computer maps, the combinations of objective functions which were mapped, in addition to the frequency of cells accepted at level two, and rejected at level one.

Certain conclusions can be drawn from the frequency of cells mapped at these combinations. Firstly, there is a direct correlation between property tax revenue loss and development cost per cell. That is, cells having a low property tax revenue loss usually have a smaller development cost, and visa versa. The computer maps displayed in Tables 8, 9, and 10 in the appendix substantiate this by showing 462 cells, 338 cells, and 17 cells in Orleans County having both a low property tax revenue loss and a low development cost. Table 32 also isolated ten more cells in Orleans County which had a high development cost and a high property tax revenue loss. The direct relationship between property tax revenue loss and development cost is further substantiated by the cell frequencies on computer maps 20 and 21, each showing

TABLE 15

FREQUENCY OF CELLS MAPPED AT THREE LEVELS OF INTENSITY FOR THREE OBJECTIVE FUNCTIONS

Appendix Table Number	Combinations of Objective Functions Mapped	Frequency of Cells Level 1 (Rejected)	Level 2 (Accepted)
8	LLL	595	462
9	LLM	718	338
10	LLH	1039	17
11	LML	955	101
12	LMM	980	76
13	LMH	1049	7
14	LHL	1056	0
15	LHM	1056	0
16	LHH	1055	1
17	MLL	1053	3
18	MLM	1052	4
19	MLH	1056	0
20	MML	1040	16
21	MMM	1040	16
22	MMH	1056	0
23	MHL	1053	3
24	MHM	1055	1
25	MHH	1056	0
26	HLL	1056	0
27	HLM	1056	0
28	HLH	1056	0
29	HML	1056	0
30	HMM	1056	0
31	HMH	1056	0
32	HHL	1046	10
33	HHM	1055	1
34	HHH	1056	0

sixteen cells having medium valued property tax losses and medium development costs. These findings appear true in most cases, since the model utilized assessed land values to compute both the per cell property tax revenue loss and the per cell estimated acquisition cost. Estimated acquisition cost is one of three components of the development cost per cell. (See pp. 114-115, where development cost includes the summation of acquisition cost, drainage cost and transportation construction cost.)

Variations in this direct relationship between property tax revenue loss and development cost per cell would be caused by other large development costs as drainage cost or transportation construction costs. The LML combinations (Table 11) and LMM mappings (Table 12 in the appendix) both illustrate a digression between low property tax revenue loss and a medium development cost. For those 101 cells (LML) and 76 cells (LMM) within Orleans County having larger development costs than property tax revenue losses, perhaps poor drainage and high transportation costs were the cause for this variation.

Conclusions regarding the aesthetic index were less obvious than the direct relationship between property tax revenue loss and development cost. After surveying the frequency of cells in Table 15 though, it was noted that there were fewer cells having a high aesthetic ranking in conjunction with a low property tax loss and low development cost (17 cells), than there were cells having a low aesthetic appeal, along with

low property tax revenue loss and low development cost (462 cells). That trend was also recognizable in the frequencies for mapped combinations of low property tax revenue loss and medium development cost: only seven cells had high aesthetic appeal, whereas 101 cells had a low aesthetic rank (Tables 11 and 13 in the appendix).

The mapped combinations which showed low property tax revenue loss, low development cost and high aesthetic index (Table 10, in the appendix) will be explained in the conclusions chapter to follow, because they comply with the selected objective functions of this research, and represent those cells most suited for the campsite location. The county's ten cells which have least adaptability for a potential campsite would be those having high property tax revenue loss, high development costs and low aesthetic index. Such cells will be identified and explained in Chapter V.

CHAPTER V

RESULTS

An attempt has been made to develop a planning tool to assist community decision-makers in selecting feasible sites for a public recreational development. The model simulates hypothetical community priorities through the use of objective functions. Each objective function represents a hypothetical community priority. However, it may be recognized that each objective function realistically identifies specific physical, economic and aesthetic resource components of a study area, and these components may be incorporated in the desires of the community. Measurable variables have been assigned to the resource components so that a spatial evaluation may be made. From the spatial evaluation of individual cells, specific sites may be selected in order to satisfy the stated objective functions. Furthermore, various combinations and various rankings of decision variables yield a spatial array of feasible sites. From this spatial array, cells indicating a specific preference can be located within the study area. As we change community preferences, or change priorities, the spatial array of desirable cells also changes. Thusly, locational tradeoffs are visually portrayed. A visual analysis of the combination maps generated by the GRID computer routine expresses the locational tradeoffs.

The model exhibits considerable merit as a preliminary screening device for planning purposes. The strengths of the model can be discussed in relation to the individual objective functions simulated for Orleans County. Computer maps as shown in Tables 1 through 7 (pp. 170 to 197 in the appendix) illustrate single objective functions, or a component thereof, each at three levels of intensity (low, medium, and high).

Computer map 3 (Table 3 in the appendix) is a simulation of the first objective function, property tax revenue loss. It shows an absolute range of values from $ 152.14 per cell to $ 9,999.99 per cell. Three levels of intensity were established, as illustrated on page 181 of the appendix, in order to categorize each cell. Cell groups included in the display were: 1) 961 cells were selected representing low property tax revenues (ranging from $ 152.14 to $ 3,434.76 each); 2) 43 cells were chosen as medium property tax losses (ranging from $ 3,434.76 to $ 6,717.37); 3) 11 cells of high property tax value were selected (ranging from $ 6,717.37 to $ 9,999.99); and 4) 41 cells had no property tax value since they occupied federal and state properties.

The second objective function, development cost, is represented by Map 5, (Table 5 in the appendix). These range from zero development cost dollars (no existing cells) to an upper development cost of $ 399,868.38 (810 feasible cells). The middle range in development cost was $ 133,289.44 to $ 266,578.88 per cell, where 230 cells from the county qualified. The high range for development cost was $ 266,578.88 to $ 399,868.38 per cell. Sixteen cells were selected from the county in this category.

Total cost was the third objective function, which was simulated for Orleans County (see Map 6, Table 6 in the appendix). The total cost range for the study area was from zero dollars to $ 409,868.25 per cell. Categories of cells and their total cost for recreational development include: 1) 824 cells at values from zero to $ 136,622.75 (low); 2) 216 cells at ranges between $ 136,622.75 and $ 273,245.50 (medium); and 3) 16 cells ranging from $ 273,245.50 to $ 409,868.25 (high).

The fourth objective function displayed on Map 7 (Table 7 in the appendix) reflects the aesthetic index. It was a composite score ranging from zero to 71.70. The range of low values was zero to 23.90, in which 595 cells complied. Medium value range, from 23.90 to 47.80, generated 436 cells from the county. The high aesthetic range included values from 47.80 to 71.70; twenty-five of the county's cells were designated in this category.

Computer Maps 1 and 2 (Tables 1 and 2 in the appendix) were included because the mean per acre assessed land values were important in the estimation of per acre acquisition costs, as well as the calculation of per cell development costs.

Those maps simulating a single objective function, (maps 3, 4, 5, 6 and 7) did not effectively isolate cells at three levels of intensity. This resulted from an analysis of too few levels for each objective function. Also, there was an unequal distribution of tax revenues for all cells within each category, resulting in the greatest cell frequency in the low-valued category.

The effectiveness of a single objective function, based

upon a single community priority, can be strengthened if we can isolate a fewer number of feasible cells. The decision-maker can increase the sensitivity of the model, when dealing with a single objective function, by merely increasing the number of levels. This may be a solution for the use of single objective functions. However, as we increase the number of mapping levels, and integrate or combine objective functions, difficulties arise. The difficulty stems from the total number of combinations possible in simulating multiple objectives. As we increase by one additional level of intensity, the number of combinations increases exponentially. The result is an extensive array of theoretical combinations. For example, at two levels of intensity for each objective function, four objective combinations are possible (2^2). Whereby, the addition of a third function produces twenty-seven feasible combinations (3^3). Table 14, p. 128 illustrates this exponential relationship between the number of levels of intensity and the resulting number of combinations produced. Because the number of combinations of objective functions increases exponentially with greater number of levels, a greater number of alternatives become available to community decision-makers.

For the above reason, it was decided that the mapping of objective function combinations at three levels of intensity would offer the decision-maker an operable number of alternatives. From these alternatives or twenty-seven feasible combinations generated (3^3), the decision-maker selects those combinations which best reflect the priorities of the community. With those combinations selected, the decision-maker can

therefore scan the mapping sequence and isolate those maps generating the desired combinations. The cells either accepted or rejected within each combination map can be pinpointed on map surface and their grid locations identified. Those cells accepted by the computer routine for matching the objective function combinations, will be mapped in a darker shade. Those cells represent those combinations in which the community has identified as being more optimal. Each cell therefore becomes a feasible location for a public recreational facility, i.e., a campground. For example, the seventeen cells of darker shading shown on Table 10, pp. 207-8 , are the areas selected for a potential campground, assuming the county's priorities include low property tax revenue loss, low development cost, and high aesthetic appeal.

From the application of the model to Orleans County specific recommendations can be made concerning the selection of feasible sites. As we view the various combinations of objective functions mapped, specific combinations tend to support a community's overall preference. Mainly, a rational decision-maker would select that combination which incorporates low property tax revenue loss, low development cost and a high aesthetic index. This combination (LLH) satisfies the individual or single objective functions previously established by the model. These single objective functions: to minimize property tax revenue loss from the acquisition of private land by the public sector, to minimize development cost of a recreational facility, and to derive the maximum benefits socially perceived from the aesthetic qualities in nature are

incorporated within this combination. These objective functions are integrated within the LLH combination.

The researcher concludes that those cells accepted by the computer routine isolating the LLH combination should be selected as feasible cells for a campground. In referring to Table 10 on pages 207-208, seventeen out of the 1,056 cells were accepted to represent the LLH combinations. Cells 806,242; 806,252; 804,242; 803,227; 803, 238; 803,239; 803,240; 802,238; 801,238; 799,233; 796,230; 795,252; 795,253; 793,252; 792,225; 788,225; and 784,236 were selected as feasible sites for a campground. This array of cells can be visualized on pages 206 to 209 in the appendix. Page 207 represents the eastern-half of Orleans County, whereas page 208 represents the western-half of Orleans County.

In analyzing the selected LLH cells, some observations can be made about their location. Many of them are equally distributed throughout the county; however, there is a group of cells positioned within the Township of Carlton, which reflects a pattern. These cells are aligned with Oak Orchard Creek following its course from Waterport to Point Breeze on Lake Ontario. These cells generate relatively low property tax revenues, a low development cost, and highly contribute to aesthetic appeal because of their proximity to water. Furthermore, these cells represent variations in elevation associated with the stream's eroding action; hence, adding to the aesthetic qualities of the selected feasible cells. It is this array of cells that the researcher has isolated and highly

recommends that a site be selected for a public campground facility, if sufficient demand exists.

The locations of individually scattered LLH cells in the county are less easy to define than is the cluster of cells near Oak Orchard Creek in the Township of Carlton (Table 10). Yet, most scattered LLH cells contain a creek and are traversed by at least one highway (eg. 803,227; 799,233; 796,230; 804,242; 795,252; 795,253). The listing below helps to substantiate this grouping of LLH cells within Orleans County:

Cell	Creek or River	Road(s)
803,227	Johnson's Creek	Yates Center Road; Blood Road
799,233	Oak Orchard River	Kenyonville Road
796,230	Oak Orchard River	Ridge Road
804,242	Beardsley Creek Marsh Creek	Marsh Creek Road
795,252	Sandy Creek, East Sandy Creek, West Sandy Creek	Ridge Road, Groth Road
795,253	East Sandy Creek	Ridge Road

The location of three more individual LLH cells was bordering a lake. Cells 806,242 and 806,252 (Table 10 in the appendix) were located on the shoreline of Lake Ontario. In addition, each was adjacent to the Lakeshore Parkway and had secondary roads crossing them too. Another scattered LLH cell, 792,225, bordered the east end of Glenwood Lake near the village of Medina. That cell also had a road for transportation purposes. The location of LLH cell, 793,252, in the Township of Murray

was unique, for the Erie Barge Canal cut through the southwest corner of the cell.

Table 16 summarizes the major economic, physical and aesthetic data available for the seventeen LLH cells selected by the GRID routine as potential campground locations. Each cell was accepted because it fit the objective of this study: low property tax revenue loss, low development cost and high aesthetic appeal. Analysis of data from the LLH cells (Table 16) can more clearly illustrate this relationship:

1) Tax revenues generated by LLH cells remain small ($ 566.93 per cell as minimum and $ 3,337.59 per cell as a maximum). Selection of such cells would keep the losses down.

2) The development costs of such cells were relatively low and included acquisition cost, transportation construction costs and drainage costs. The dollar ranges for each of these expense areas were relatively low, which helped keep development costs down. For example:

   a) acquisition costs per cell ranged from a minimum value of $ 8,901.77 to a maximum of $ 95,414.30.

   b) road costs for cells having roads through their centers was zero, with one road transportation cost ranging upward to $ 690,476.00.

   c) low drainage costs per cell were reflected by a cost range between $ 4,942.00 and $ 69,188.00.

3) The total aesthetic index ranged from a low of 48 to a high of 71.7, which indicated lands of a high aesthetic

TABLE 16

ECONOMIC, PHYSICAL AND AESTHETIC DATA
FOR ORLEANS COUNTY'S LLH CELLS

Cell Location	Per Acre Assessed Value	Per Acre Full Assessed Value	Total Tax Revenue	Acquisition Costs	Transportation Construction	Drainage Cost	Forest Cover Rank	Topographic Rank	Water to Land Relationship	Forest Color Contrast	Total Aesthetic Index
806,242	$38.37	$ 76.57	$ 757.20	$61,103.75	$138.095	$69,188	5.0	3	6	6.6	51.2
806,252	37.74	37.74	1,014.62	55,670.70	828,572	69,188	5.0	1	8	6.6	53.2
804,242	24.45	85.05	841.05	34,452.23	138,095	69,188	7.5	6	8	6.6	70.7
803,227	30.22	90.02	1,129.10	34,221.45	276,191	69,188	7.5	3	6	6.6	53.7
803,238	50.70	136.55	1,350.34	55,313.95	138,095	69,188	7.5	5	4	6.6	51.7
803,239	73.28	148.30	1,466.53	60,073.66	138,095	69,188	7.5	5	6	6.6	59.7
803,240	44.86	92.75	917.20	37,571.36	552,381	69,188	5.0	5	6	6.6	57.2
802,238	22.21	57.33	566.93	23,223.34	276,191	69,188	7.5	9	6	6.6	71.7
801,238	38.76	126.81	1,254.02	51,388.44	0	69,188	5.0	1	8	6.6	53.2
799,233	28.42	96.73	1,213.26	36,215.12	690,476	74,130	5.0	2	6	6.6	48.2
796,230	43.14	254.85	3,337.59	95,414.30	0	4,942	7.5	4	4	6.6	48.7
795,252	45.07	107.69	2,080.39	73,917.22	276,191	4,942	10.0	4	4	6.6	51.2
795,253	48.32	129.69	2,505.39	89,017.77	552,381	4,942	10.0	3	4	6.6	48.2
793,252	39.09	87.47	1,689.77	60,038.44	690,476	4,942	10.0	3	6	6.6	56.2
792,225	37.62	110.30	1,444.52	41,295.65	138,095	74,130	7.5	5	8	6.6	67.7
788,225	49.26	87.44	1,293.14	34,295.90	0	74,130	5.0	4	4	6.6	55.2
784,236	$34.09	$118.07	$1,379.40	$48,625.17	$138,095	$69,188	10.0	6	0	10.0	48.0

appeal. Individual rankings for the aesthetic indicators were generally high, which caused large composite scores for these aesthetic indices. The four aesthetic factors listed for LLH cells showed ranges as follows:

a) percent forest cover (5.0-10.0)

b) contour differential (1 - 9)

c) water to land relationship (0 - 8)

d) forest color contrast (6.6 or 10.0)

Each cell can be isolated and individually analyzed in order to determine which specific cell would be most suitable for development. As stated previously, it is not the purpose of this model to select a specific cell; but rather, to present an array of feasible cells, from which the decision-maker can ultimately determine the site.

It is also recommended that cells representing the HHL combination, high property tax revenue loss, high development cost and low aesthetic value, shown in Table 32 on pages 294 to 297, not be chosen as feasible cells for the development of a campground. This combination of objective functions yielded ten out of 1,056 possible cells within Orleans County. These cells complied with HHL characteristics. The grid coordinates of the HHL cells include: 800,226; 792,240; 783,248; 782,240; 782,247; 782,248; 781,248; 780,237; 780,248; and 780,249. By locating these cells on the computer maps, a clustered pattern occurs within the southeast portion of the county, page 296.

In analyzing this clustered pattern by the use of supportive materials, such as the Orleans County plat maps,

U.S. Geological Survey Maps, and the Soil Conservation Survey Maps, an understanding of this pattern can be reached. Cells 783,248; 782,247; 782,248; 781,248; and 780,249 occupy muckland situated in the Township of Clarendon. Other HHL cells with similar swampland or muckland characteristics include two scattered in the south central part of Orleans County. Both cells 782,240 and 780,237 occupy muckland or swampland in the Township of Barre. Muckland reflects high property tax revenus, due to intensive vegetable farming, high development cost, because poor drainage results from high organic content within the soil. Furthermore, transportation construction costs are higher resulting from poor drainage and unstable road foundations. Aesthetic values are not generated within this area since there is little topographic variation, no substantial areas of water-based recreation, and minimal forest color contrast. To help substantiate these conclusions, Table 17 below provides economical, physical and aesthetic data pertaining to the county's ten HHL cells.

High property tax revenues generated from intensive vegetable farming on muckland are illustrated in Table 17 by the column labeled "Total Tax Revenue." Seven of the ten HHL cells analyzed produce more than nine thousand dollars per year in taxes.

The probable cause of high development costs in these muckland cells may be explainable by:

1) the presence of high drainage costs, which may be attributable to organic soils, impervious sub-strata,

TABLE 17

ECONOMIC, PHYSICAL AND AESTHETIC DATA
FOR ORLEANS COUNTY'S HHL CELLS

Cell Location	Per Acre Assessed Value	Per Acre Full Assessed Value	Total Tax Revenue	Acquisition Costs	Transportation Construction	Drainage Cost	Forest Cover Rank	Topographic Rank	Water to Land Relationship	Forest Color Contrast	Total Aesthetic Index
800,226	$180.58	$967.70	$9,999.99	$367,874.88	$ 690,476	$ 4,942	2.5	1	0	0	5.5
792,240	67.94	769.36	7,075.85	301,760.10	138,095	69,128	0.0	3	0	0	9.0
783,248	561.00	651.21	9,078.77	287,346.41	414,286	49,420	2.5	0	0	0	2.5
782,240	500.00	651.50	7,611.40	268,309.42	138,095	69,188	2.5	2	0	0	8.5
782,247	685.08	799.56	9,341.17	329,285.47	276,191	49,420	0.0	0	0	0	0.0
782,248	651.20	727.51	9,999.99	321,013.79	1,519,048	49,420	0.0	0	0	0	0.0
781,248	651.20	727.51	9,999.99	321,013.79	138,095	69,180	5.0	0	0	6.6	18.2
780,237	122.88	734.18	8,577.34	302,359.80	2,071,429	69,180	2.5	2	0	0	8.5
780,248	651.20	727.51	9,999.99	321,013.79	828,572	69,188	0.0	0	0	0	0.0
780,249	651.20	727.51	9,999.99	321,013.79	966,667	69,188	0.0	0	0	0	0.0

flatness of the landscape, and lack of natural streams.

2) large road construction costs ($ 138,095 - $ 2,071,429) which may be generated by poor drainage, general absence of roads through the muckland areas, (only two cells referenced as HHL had any road) and unstable road foundations.

3) excessive acquisition costs, where eight of the ten HHL cells noted exceed $ 300,000 each.

Muckland-swampland, which has dominated the HHL cells in Orleans County, produced very small total aesthetic index values (zero in four cells; 18.2 in one cell). Topography varied little in these lowlands, as six of the ten cells had no relief change, and a rank of zero. The rank of zero for all ten cells in the Water to Land Relationship Column of Table 17 indicates that there were no identifiable bodies of water (eg. rivers, creeks, lakes or canals). Only HHL cell 781.248 had sufficient forest cover to provide moderate color contrast. All remaining HHL cells had either no forested area (zero rank), or less than 10% of their area forested (rank of 2.5). With the absence of hills, lakes or streams for water recreation, and noticeable forest cover, all HHL cells had little or no aesthetic appeal.

Cells 800,226 and 792,240 were both accepted by the outdoor recreation land use selection model as HHL cells, yet neither is muckland nor swampland. The low aesthetic appeal may be due to the absence of streams and other bodies of water, the small contrast in topography (ten feet for cell 800,226 and

thirty feet for cell 792,240), and the near absence of wooded area which could generate little or no color contrast. Cell 800,226 represents flat, fertile farmland, in the Township of Yates, southeast of the village of Lyndonville (Table 32). Perhaps its high development cost resulted from a large acquisition cost and a large road transportation construction cost. The cell has two roads, one forming its southern boundary, the second serving the southeast corner of the cell. Cell 800,226 has a large transportation construction cost estimate because its existing roads are near the cell's boundary and the cell's center is the basis of calculating construction cost. The high property tax revenue generated in cell 800,226 is attributed to its intensive use in vegetable production. The location of the other scattered HHL cell, 792,240 is bordering the village of Albion, where there is no forested land, no body of water, and only a network of highways. The high development cost of cell 792,240 may be due to the high acquisition cost. These ten HHL cells should not be considered for recreational development in Orleans County.

It can be recognized that a decision-maker may wish to select cells based upon other alternative combinations of objective functions. The land use selection model developed in this research offers this option and should be considered if valid reasons dictate that cells of the LLH combination are proven to be unsatisfactory. However, it is the recommendation of this study that the LLH cells match community priorities and have the potential to fulfill the desire of the camper within Orleans County, New York.

CHAPTER VI

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

This research project has been designed to develop a recreational planning model for the selection of feasible recreational sites. An inventory information system was constructed and data collected to evaluate Orleans County's resources. By use of an information inventory system, feasible sites can be selected based on community priorities. The community priorities or objective functions indicated which resources either economic, physical, or aesthetic, or various combinations thereof were important to that community. The objective functions were used to simulate decisions of the communities. Their decisions were simulated through the use of computer mapping techniques and were visually displayed. By establishing hypothetical objective functions and by ranking their individual importance for the community, optimal criteria were formulated for the selection of individual cells. It was the researcher's assumption that those cells complying with low property tax loss, low development cost, and high aesthetic index would most nearly represent community optimality. Therefore, through computer simulation techniques

those cells fulfilling the desired criteria were mapped and their locations analyzed. From 1056 cells within the study area of Orleans County, 17 cells were chosen as feasible sites. These cells were individually analyzed to determine if the model indeed did choose the feasible sites based upon community priorities. From the analysis, it was validated that those cells did fulfill the hypothetical objective functions.

In evaluating the feasible sites selected by the model, it can be shown that each of the seventeen LLH cells did fulfill the model's criteria (see pages 137-142). Furthermore, by visiting each selected cell it was found that many either contained an outdoor recreational facility or are adjacent to a cell containing a developed recreational site. The following cells indicate the validity of the selection model:

-cell 806,242, site of undeveloped Oak Orchard State Park, a marine type park for boating, picnicking and gamefields;

-cell 806,252, a feasible site adjacent to the Lake Ontario Parkway, a scenic drive from Rochester to Lakeside Beach State Park;

-cell 803,227, adjacent to public golf course and to Johnson's Creek;

-cell 803,238, contains subdivided tracts for recreational cottages;

-cell 803,239, adjacent to Oak Orchard River with subdivided tracts for recreational cottages;

-cell 803,240, contains subdivided tracts adjacent to a country club;

-cell 802,238, contains portion of Lake Alice, with subdivided shoreline having developed cottages;

-cell 801,238, contains Lake Alice with developed recreational cottages;

-cell 799,233, Oak Orchard River widens and meanders through the cell, undeveloped but having the potential for camping and boating;

-cell 796,230, contains portion of Oak Orchard River and tributaries, undeveloped but having potential for camping and canoeing;

-cell 793,252, contains private recreational development with swimming and picnicking;

-cell 792,225, adjacent to Glenwood Lake and Medina Conservation Club, with nature trails, picnicking, campsites, and recreational vehicle trails; and

-cell 784,236, contains future site of Barre Rod and Gun Club, with outdoor activities.

From the seventeen LLH cells selected by the model, thirteen cells exhibited either an existing recreational facility under present use, or are planned for recreational development, or exhibit recreational potential.

From the development of and the application of the simulation model, conclusions and recommendations can be derived.

Conclusions

The model exhibits both strengths and weaknesses in the direct application as a planning tool for the selection of a public recreational facility, a campground. A major weakness within the model's design is the mapping output of the single objective functions. Specifically, with three mapping levels utilized, (low, medium, high), generating a large range of values within each group, a large number of cells were selected within each group. As a result, the single objective function maps reduced their utilization as compared to the multiple-objective function maps.

The model could have been made more selective if an increased number of mapping levels would have been assigned in the mapping procedure of single objective functions. It must be recognized however, that as we transfer the increased number of mapping levels of the single objective functions to the mapping of multiple-objective functions that the number of combination maps increases exponentially. This increase may add increased costs and evaluation time for the decision-maker in his cell selection procedure, since the number of alternatives also increases exponentially.

The model is a preliminary screening device to facilitate the selection of feasible campground sites. The model is not calibrated to select a specific site for the decision-maker, or the community, because the model cannot differentiate between similar cells where each cell relates to a range of values rather than individual cell values. This limitation resulted

from the use of three levels of intensity for each objective function. The wide range of values at any one level contributed to the model's inability to isolate a specific cell from the array identified for matching community priorities. Thus the model selects a group of cells with like characteristics, all supporting a specific objective function, but no individual cell is isolated. The model could have been made more discriminating by increasing the number of levels of intensity in the mapping sequence.

The application of the model as a planning tool is directly related to the size of the study area, the amount of detail available at a specific level, the size of the cell sampling unit, and measurable variables available to the decision-maker. The size of the study area dictates the degree in which data can be utilized effectively. Therefore, if the planning area was a township or municipality, data could reflect greater detail. In contrast, if a county or multi-county unit was selected as the study area, greater aggregation of data would occur. The aggregation process tends to reduce the amount of micro-information which can be stored within a sampling unit such as the individual cells. Furthermore, as we reduce the amount of micro-information which can be stored, greater aggregation error occurs.

The measurement of economic, physical, and aesthetic characteristics of each cell greatly depends upon the measurable variables available to the researcher. Information is not available at all sampling levels for all resource components within the study area. Therefore, the aggregation of data is

not derived from the same levels of intensity and measurement units have various degrees of precision. Deviations in the intensity of data can be shown by examining two variables and their data sources. A comparison between property tax revenues per cell and the estimated drainage costs per cell can be related to the specific problem. The number of observations taken within Orleans County to determine property tax revenues per cell were greater than the number of observations to estimate drainage cost. Approximately four thousand land parcels were observed to determine property tax revenues. In contrast, twelve soil associations were the basis for estimating the drainage costs per cell. As a result, the density of spatial data utilized for cost information estimates differed. Furthermore, information was not equally distributed within the study area, since standardized measurements have not occurred over a geographic region. Known micro-information from a specific area often is discarded because of the scarcity of micro-information from adjacent areas. Therefore, we have a tendency to analyze only that information which is available on a uniform basis for all segments of the region.

Another weakness of the model is its lack of sensitivity in measuring some physical characteristics precisely. For example, drainage costs were computed from agricultural tiling estimates based upon each cell's dominant soil association (Table 12). As a result, minute physical variations influencing drainage within each cell were not considered. If the study

area had been smaller than Orleans County, soil series and associated types could be utilized and more precisely measured, to determine drainage costs.

It must be also pointed out that the development of the aesthetic index to determine the most pleasing site for campers was constructed on a judgement basis. Its rationale was based upon the researcher's perception of optimal resource characteristics. The major objective of the researcher was to select sites based upon a diversity of outdoor recreational activities associated with camping. However, it may be necessary to determine various preferences of specific camping groups in order to further perfect the selection model.

A weakness of the planning model is the implicit assumption that campground demand was equal for all cells inventoried. Demand was assumed to be equal since the population was basically rural with an average of 86 people per square mile.[62] Furthermore, the total population of the two villages, Albion and Medina, was of relatively small size (11,416 people) when compared to the larger rural population of 23,172 people.[63]

If larger urban centers occur in other planning areas, there would exist a distinct difference in the demand for campground development. Application of this research model to an area with unequal demands should be accomplished by integrating demand measurements into each cell's location.

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[62] County and City Data Book 1967, p. 252.

[63] Buffalo Evening News Almanac and 1972 Fact Book, pp. 129-130.

Lastly, the use of linear distances for figuring transportation construction costs was a weakness inherent in the model. The values were based on a constant cost per unit distance supplied by the N.Y.S. Department of Environmental Conservation (Table 13). It must be recognized that this cost is an average value per mile, based upon a specific road type. Physical variations in soils, in parent material, in slope, and drainage patterns within individual cells have generated deviations in construction cost estimates, from the suggested New York State average. The model is not calibrated to reflect these physical discrepancies leading to possible differences in roading costs for secondary gravel roads.

The model provides the decision-maker with an analytical framework to align community priorities with resource components of individual sites. The output of the model is a display of these objective functions produced by computer mapping. The analytical framework allows the decision-maker to integrate the economic, physical, and aesthetic characteristics of a study area for planning purposes. The framework serves as a screening device to isolate groups of feasible sites in order to satisfy specific alternative community objective functions as shown in the appendices.

The model presents an array of feasible sites which can be indivudally evaluated in conjunction with information recorded within the original data file. In addition, the decision-maker may wish to use other data sources (e.g., the nearness of the proposed site to population centers) in order to facilitate a

single selection from the preliminary data array.

The simulation model has application within other planning regions depending upon the clientele and their prescribed objectives. Other county units may utilize the analytical framework to solve similar problems. However, different land use characteristics in other counties must be considered and their values inserted into the model to reflect the structure and organization of resources in that area. Nevertheless, the model has the capability of being applied within other planning regions. Multi-county units and other population centers may apply this model to their own resource problems.

The selection of feasible sites for other recreational land uses can be made by measuring different economic, physical, and aesthetic variables within a given area. Also, the community priorities concerning a different recreational land use may be adjusted within the selection procedure. Even though the variables and the community priority may differ, the model still offers the capability to select feasible sites. For example, if the recreational land use was golfing, substitutions such as the importance of topography rather than water to land relationship (used for camping) may be made.

In this study, the author has utilized a county as the spatial unit to simulate community priorities. A cell size of 247.1 acres was used as a resource inventorying framework for this study, in part because the New York State Land Use and Natural Resource System utilized the same cell size for inventorying county resources. Because of the congruency of cell

boundaries in the LUNR system and that chosen by the investigator for Orleans County, a recognizable integration of planning data is possible for the study area. Expansion of the proposed model resulting from its integrative properties allows future investigators to strengthen its applicability to planning. It must be recognized that the degree of integration allowable by the model depends upon many factors: 1) the time available for research, 2) monetary constraints, 3) the objective of the study, 4) the clientele, and 5) the need for additional variables as the use of the model is expanded. However, the proposed model is flexible enough to allow further modifications to fit a different problem context.

In comparing the cost of producing planning maps used to locate feasible campground sites, it is found that the proposed land use selection model developed in this thesis is economically feasible. By comparing the computer method versus the manual method within defined cost areas (total, fixed, and variable costs), the economic feasibility of the planning technique can be illustrated. In calculating the costs for the computer and the manual methods, it is assumed that fixed costs are common for both techniques. These fixed costs involve the collection, recording and plotting of raw data. Therefore, a data file had to be organized and prepared for both techniques. This could be considered the major fixed cost. Since 770 man-hours, at $3.50 per hour, were devoted to developing the information data file, the fixed cost equaled $2,695.

FC = Man-hours X hourly rate

FC = 770 X $3.50

FC = $ 2,695.00

However, as we look at the variable costs of producing the planning map sequence, by both computer and manual techniques, we discover large differences in preparation costs. The estimated variable costs for the manual method were $ 990.50, based upon 283 man-hours of labor at a work rate of $3.50 per hour. The estimated variable costs of the computer maps were only $34.00. This figure was based on a rate of $1.00 per computer map estimated by the Genesee/Finger Lakes Regional Planning Board.

In analyzing total cost of map production by both techniques, the equation below was used:

TC = 770 ($3.50) + 330 ($3.50)

TC = $ 2,695.00 + $ 990.50

TC = $ 3,685.50

TC = total cost

Map production via the manual method had a total cost of $ 3,685.50; whereas, the computer method cost a total of $ 2,729.00.

From this cost information, it may be concluded that the computer method of producing the sequence of maps used in this planning model was more economically feasible.

The simulation model visually portrays possible results of decisions made by the community. Since each cell is identified by locational coordinates, supplementary or complementary information may be integrated for analysis. The computer maps

visually illustrate locations and locational tradeoffs resulting from changes in community priorities. Therefore, the model's presentation to planning committees, agencies, and decision-makers can facilitate analysis of locational tradeoffs. Computer maps may be viewed individually or in groups. Using these generated maps as a tool, decisions can be made by planning groups, or else individual decisions can be simulated. The visual display provides maps highlighting the area's resource base, and permits community planners a clearer understanding of the physical, economic, and aesthetic characteristics of their region. Property tax revenues, development cost, total cost, and aesthetics have been evaluated to assist communities in inventorying the resource components of their area. It is believed that the resource components of the selected study area were reflected in the variables and associated measurement units. Hence, the economic, physical and aesthetic characteristics of the area can be integrated into the decision-making and planning process.

Within the model, a complete enumeration of all cells within the study was presented. The surveying of all possible sites within the study area allowed a partial inventory of the economic, physical and aesthetic characteristics. The value derived from a complete evaluation of the county's resources tended to reduce the amount of bias since each cell was equally considered as a feasible site.

If a county's land area is not uniformly inventoried to reflect the economic, physical and aesthetic concerns of its

population, effective planning can not occur. A single objective function, property tax revenue loss, may not be reflected in other planning techniques. It is necessary to evaluate all feasible sites selected by a random sample design, in order that the economic, physical, and aesthetic concerns of the population may be considered in planning. Site selection bias is reduced by the fact that economic, physical and aesthetic concerns of a population are considered. In order to accomplish this, a uniform evaluation of the total study area is manditory. As we examine the objective functions we find that equal consideration is given to each. Other preliminary site selection techniques as air photos and field reconnaissance methods only partially evaluate the county's resources. A major weakness of these methods is that they do not reflect the economic aspects of land value and property taxation. In addition, air photos may not show current land use patterns, as aerial field reconnaissance occurs less frequently than tax revisions. This study used the grid cell as a preliminary screening device instead of the air photo field reconnaissance techniques because: 1) feasible sites are more easily located on a grid system, 2) ease of updating planning information resulting from computer capability, and 3) summarization of micro-information by measures of central tendency for individual cells is made possible by the grid system

However, aerial photographs complement the use of the grid inventory system. Detailed land use information exposed

by air photos may be transposed onto the grid framework. Therefore, the strengths of both techniques can be coordinated within a planning method. Preconceived knowledge or images of certain sites may directly influence the decision-maker, or planner in his or her selection procedure. It is hoped that by evaluating all possible sites and presenting the economic, physical and aesthetic data for each site, the decision-maker will obtain a comprehensive analysis of the county's resources assisting him in an unbiased decision.

Furthermore, the evaluation system formulates a framework in which spatial information such as aerial photographs, soil surveys, property plat data, and distance relationships can be integrated into a framework which has coordinate location. It must be recognized that errors occur as one incorporates this information into a prescribed geographic unit. These errors occur from round-off, measurement, and aggregation procedures. Within this study, economic data extracted from individual farms were transferred onto the prescribed grid. Measurement error resulted from the transferral of data from ownership boundaries to grid boundaries. Measurement error also resulted from the transferral of physical boundaries developed by soil characteristics into the 247.1 acre cell framework.

The investigator recognizes that error does occur; however, the system has the potential to reduce bias in site selection, to integrate eonomic, physical and aesthetic information, to facilitate the expansion of further information into the framework from other sources. The grid used is also

congruent with the existing LUNR System within New York State and corresponding satellite control points.

Recommendations

In incorporating demand within the analysis of feasible recreational sites, future researchers may wish to establish attractiveness indicators for feasible sites based upon nearness to population centers. Demand may increase in more urbanized areas, when compared to a rural county where this model was tested. Public opinion concerning the type of recreational facility desired may be an important facet of recreational demand for any study area. Through the use of opinion polls and community discussions, future researchers may be able to ascertain this element of human demand, before making specific decisions on the kind of recreational facility to be developed. Public opinion polls may also reveal specific preferences with regards to aesthetic criteria calibrated within the planning model, to select specific sites from a feasible array.

It is recommended that future researchers develop a classification system based upon individual outdoor recreational facilities. The rationale for this suggestion is that the data file may also be applicable to the selection of feasible sites for activities besides campgrounds, such as a public or private golf course, leisure home developments, ski areas and wildlife sanctuaries.

It may also be recommended that an updating system be

initiated in order to keep pace with land use changes and property tax revisions, including assessments and taxing rates. Updating must occur on a yearly basis in order for a county to assess the tradeoffs from non-marginal land changes.

As we analyze the alternative feasible sites selected by the model, it may be necessary for future researchers to construct a more detailed development cost framework. This detailed cost framework should include the actual cost of constructing a campground facility, including the water, septic, parking, and internal transportation system for the full year operation of that facility. It is recommended that once this cost analysis has been made for each alternative site that future researchers may indeed select an optimal site.

It is recommended that this information system could be used as a part of a multiple-use system since the data collected can be used for other locational decisions. Furthermore, it is difficult to rationalize an investment of time and money in constructing such a system for one locational decision. This data file could be part of a regional system, such as those constructed by regional planning boards. It is therefore recommended that this extension of the model is worthy of future investigation.

This researcher contends that the grid inventory system has great potential for recreational resource planning. However, it must be pointed out that there is a need to intensify and improve the measurement procedures in order to reduce aggregation and measurement errors. Then, a viable resource evaluation system will be developed and made applicable for planning.

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APPENDIX

APPENDIX

Table 1 : Mean Per Acre Assessed Land Value, Orleans County, N.Y.

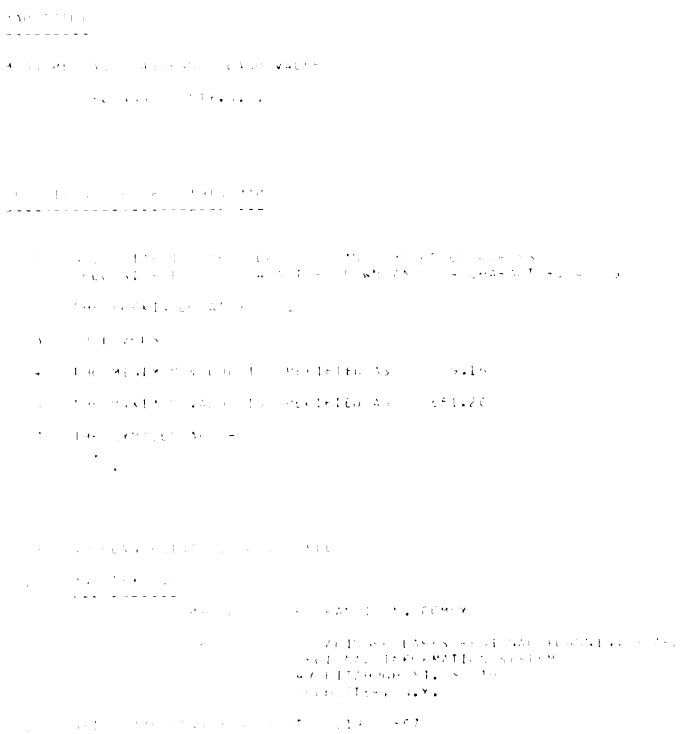


Table 1 (cont'd.)

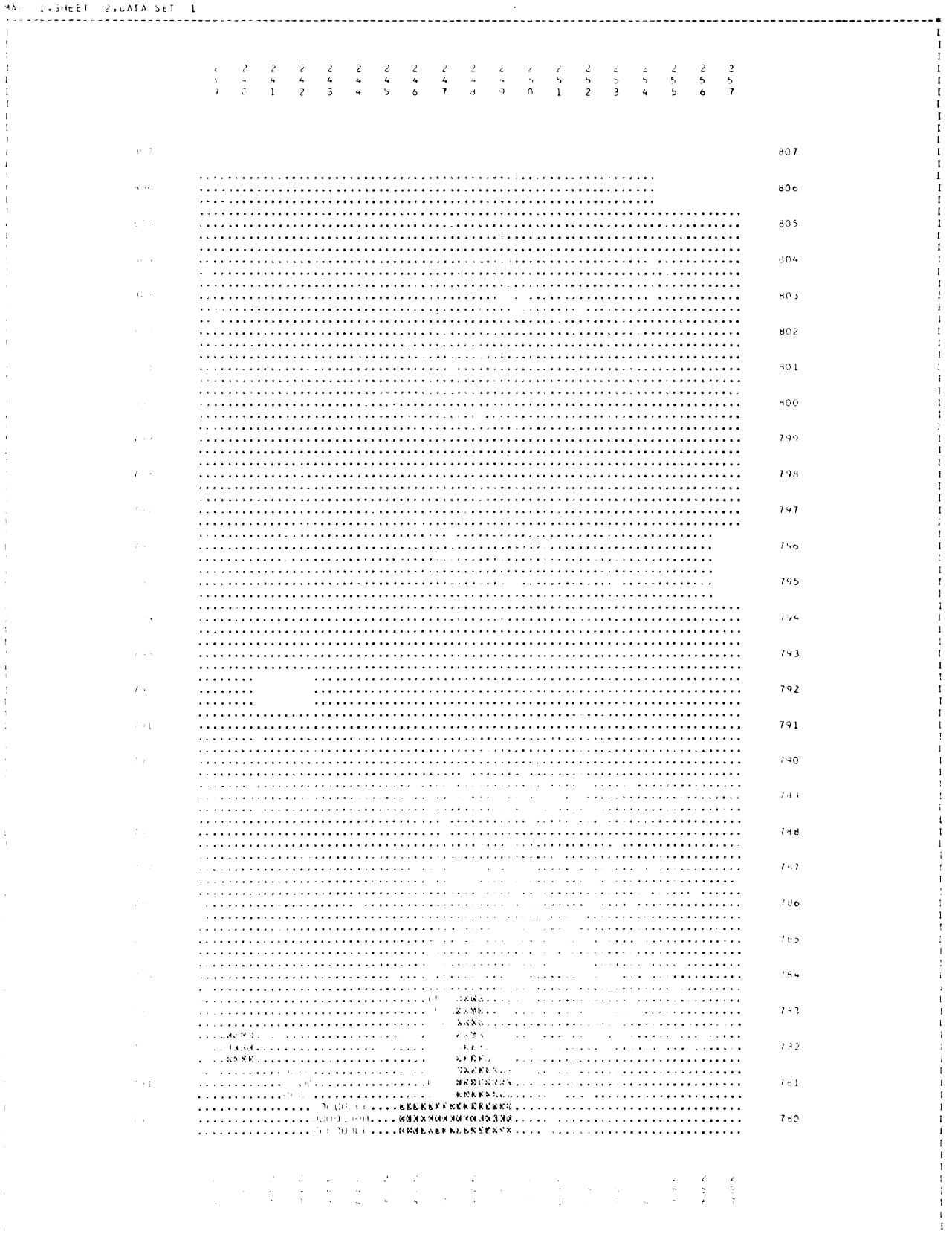


Table 1 (cont'd.)



Table 1 (cont'd.)

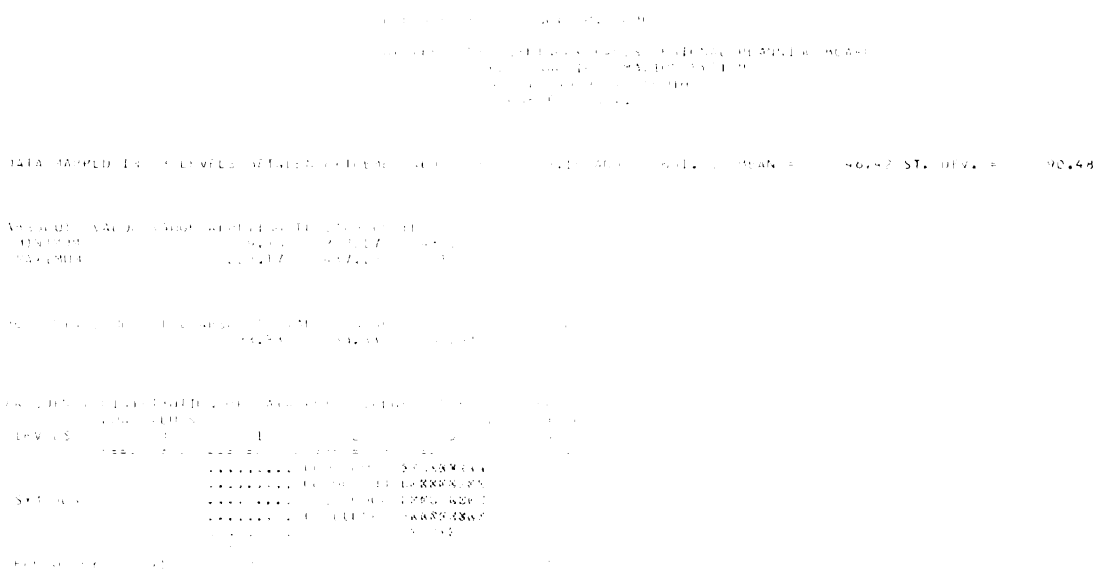


Table 2 : Mean Per Acre Assessed Land Value With Improvements, Orleans County, N.Y.

[illegible]

MEAN PER ACRE ASSESSED LAND VALUE WITH IMPROVEMENTS

[illegible] ORLEANS COUNTY NEW YORK

[illegible]

[illegible]

- THE MINIMUM CASE IS REPORTED AS 12.13
- THE MAXIMUM CASE IS REPORTED AS 967.70

Table 2 (cont'd.)

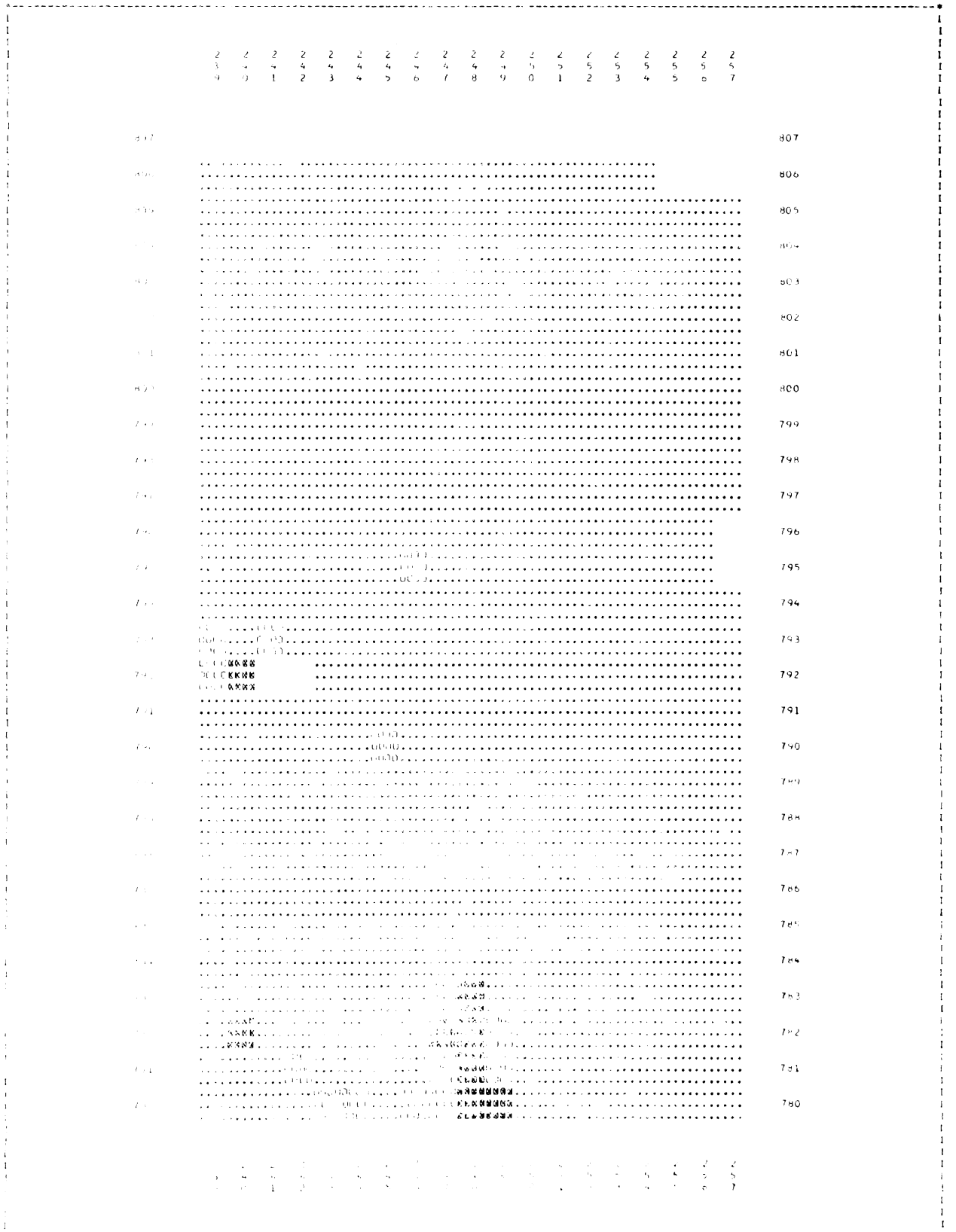


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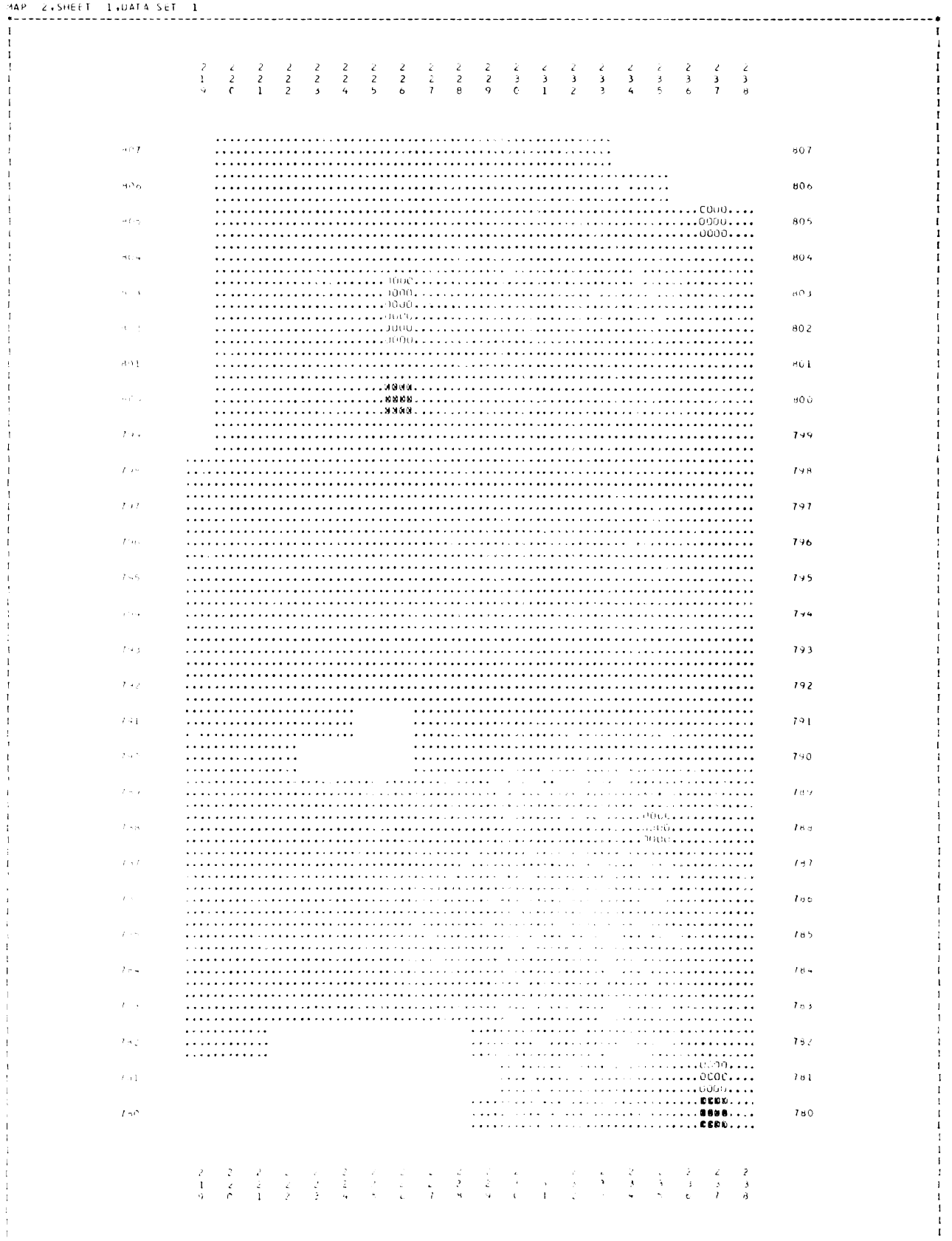


Table 2 (cont'd.)

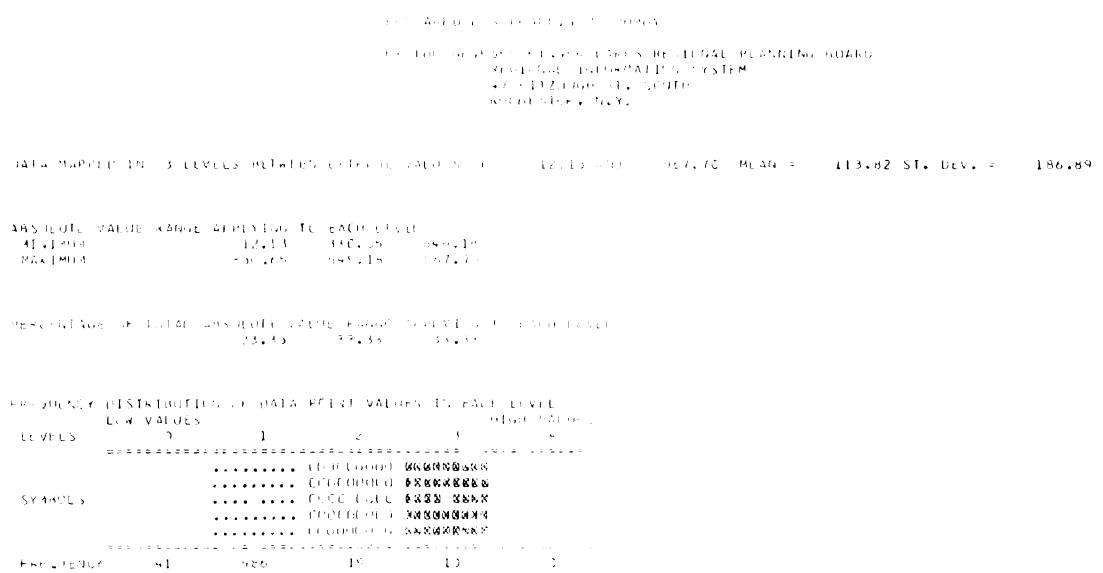


Table 3 : Property Tax Revenue Loss Per Cell, Orleans County, N.Y.

Table 3 (cont'd.)

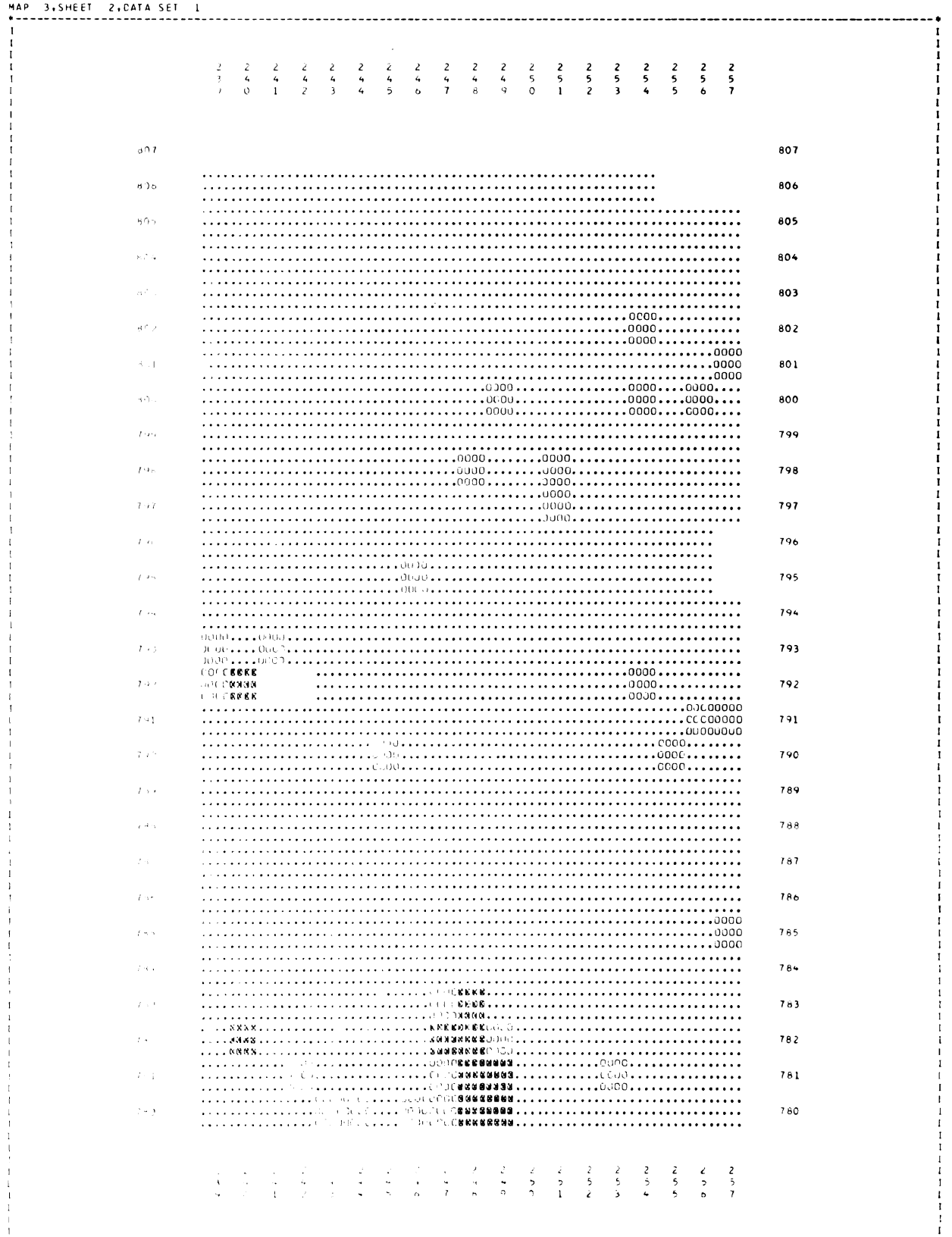


Table 3 (cont'd.)

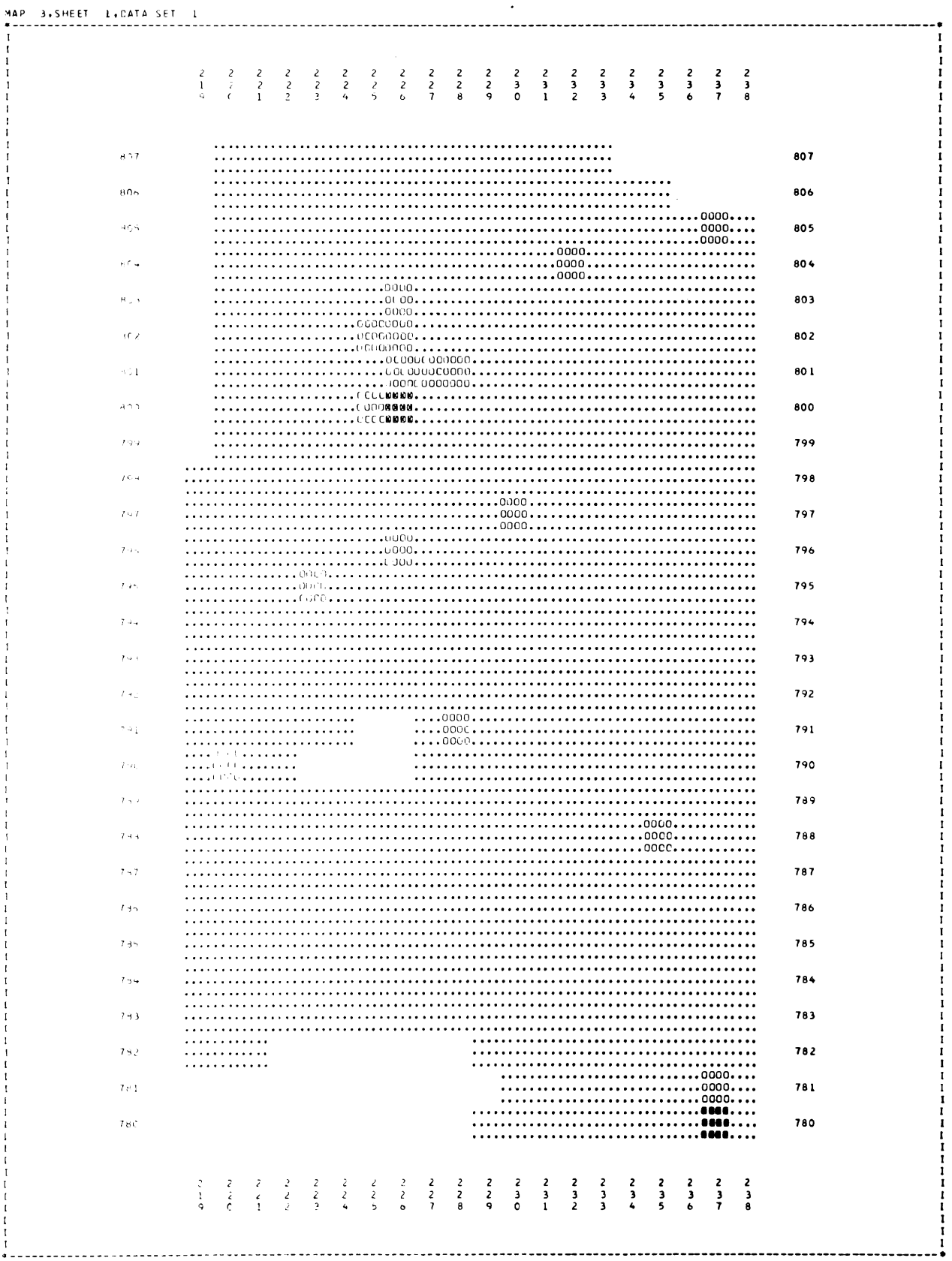


Table 3 (cont'd.)

PREPARED FOR FRANCIS M. DOMCY

BY THE GENESEE/FINGER LAKES REGIONAL PLANNING BOARD
REGIONAL INFORMATION SYSTEM
47 FITZHUGH ST. SOUTH
ROCHESTER, N.Y.

DATA MAPPED IN 3 LEVELS BETWEEN EXTREME VALUES OF 152.14 AND 9999.99 MEAN = 1519.46 ST. DEV. = 2457.94

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

MINIMUM	152.14	3434.76	6717.37
MAXIMUM	3434.76	6717.37	9999.99

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

	33.33	33.33	33.33

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

	LOW VALUES				HIGH VALUES
LEVELS	0	1	2	3	4
SYMBOLS		.....	CCCCCCCCC	#########	
		.....	CCCCCCCCC	#########	
		....	CCCC CCCC	#### ####	
		.....	CCCCCCCCC	#########	
		.....	CCCCCCCCC	#########	
FREQUENCY	41	961	43	11	0

Table 4 : Acquisition Cost Per Cell - Orleans County, N.Y.

Table 4 (cont'd.)

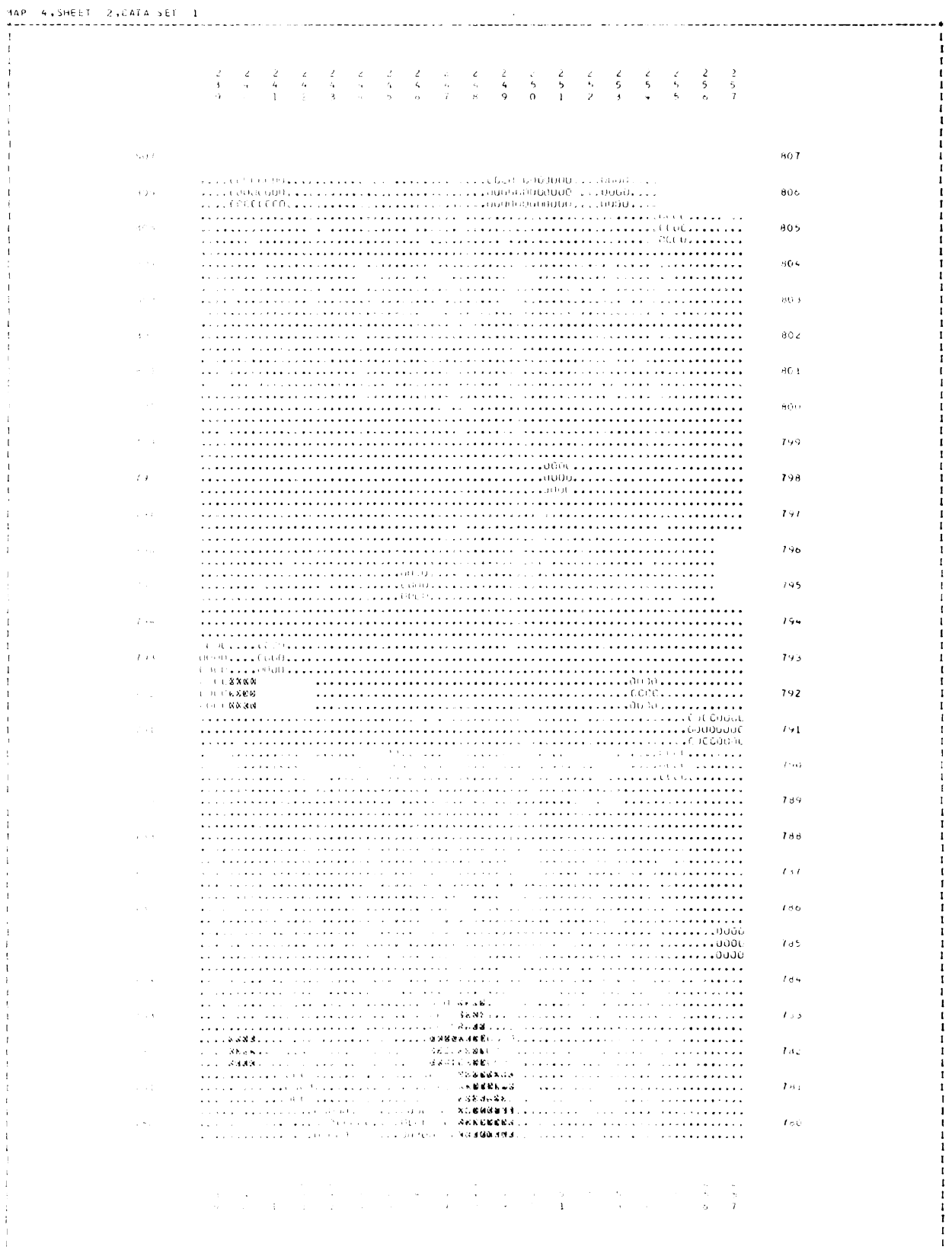


Table 4 (cont'd.)

MAP 4,SHEET 1,DATA SET 1

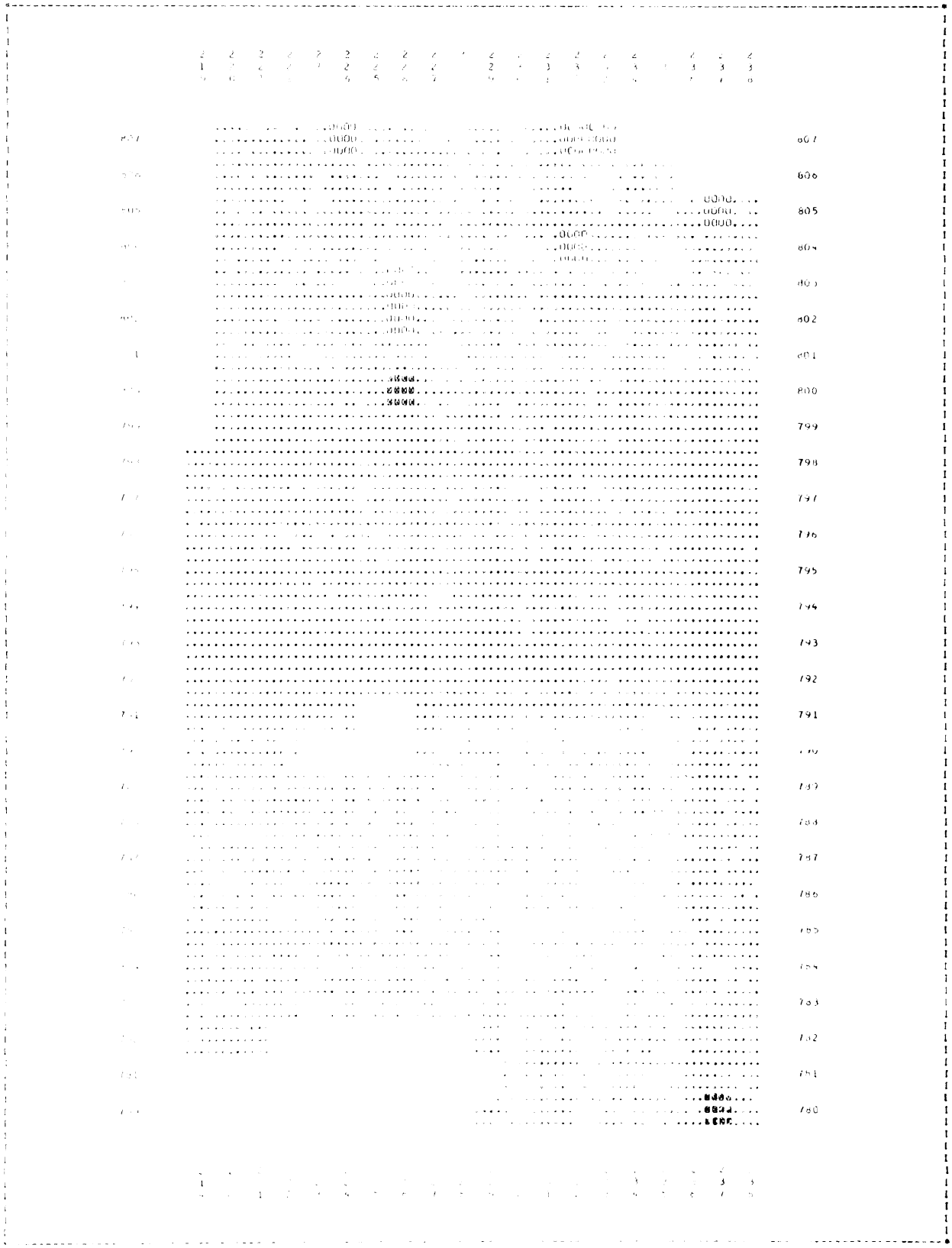


Table 4 (cont'd.)

PREPARED FOR FRANCIS M. DOMOY

BY THE GENESEE/FINGER LAKES REGIONAL PLANNING BOARD
REGIONAL INFORMATION SYSTEM
47 FITZHUGH ST. SOUTH
ROCHESTER, N.Y.

DATA MAPPED IN 5 LEVELS BETWEEN EXTREME VALUES OF 4541.39 AND 367874.88 MEAN = 51069.11 ST. DEV. = 83211.38

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

MINIMUM	4541.39	125652.50	246763.63
MAXIMUM	125652.50	246763.63	367874.88

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

33.33	33.33	33.33

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

LEVELS	LOW VALUES 0	1	2	3	HIGH VALUES 4
SYMBOLS		..... CDDDCDDDD			#########
		..... CDCCCCCDD			#########
		.... CDDD DDLD			#### ####
		..... CDDDCDDDD			#########
		..... CDDDCCDDD			#########
FREQUENCY	41	970	34	11	0

Table 5 : Development Cost - Orleans County, N.Y.

Table 5 (cont'd.)

MAP 5;SHEET 2;DATA SET 1

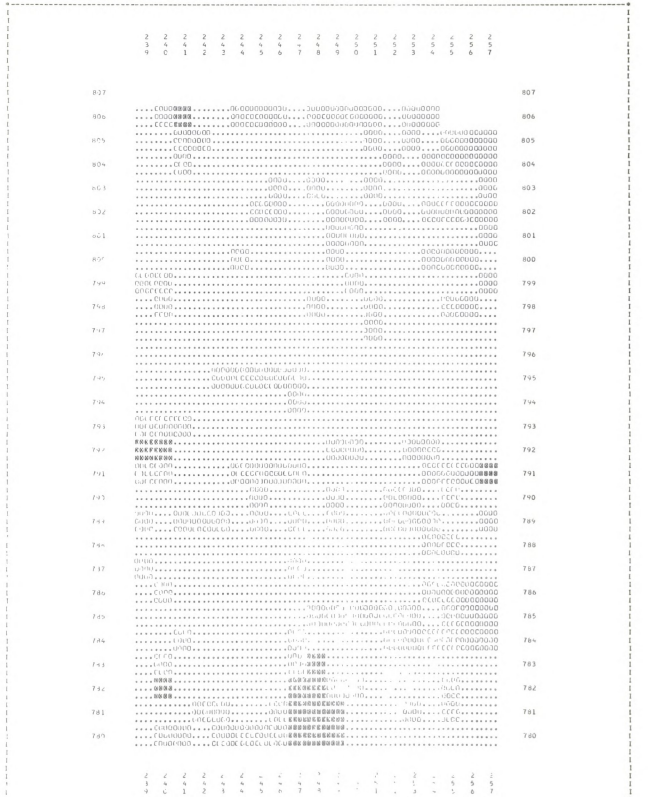


Table 5 (cont'd.)

MAP 5,SHEET 1,DATA SET 1

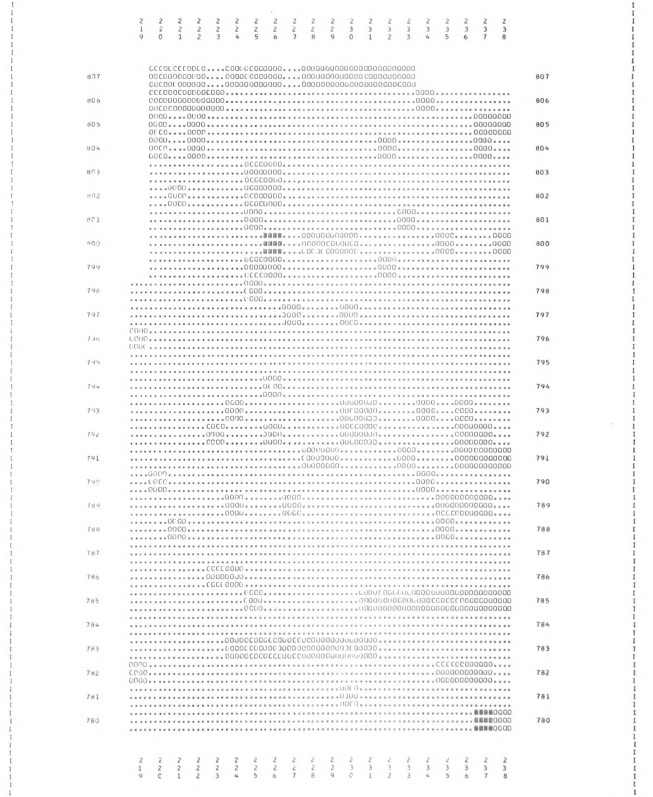


Table 5 (cont'd.)

PREPARED FOR FRANCES M. DIMDY

BY THE GENESEE/FINGER LAKES REGIONAL PLANNING BOARD
REGIONAL INFORMATION SYSTEM
47 FITZHUGH ST. SOUTH
ROCHESTER, N.Y.

DATA MAPPED IN 3 LEVELS BETWEEN EXTREME VALUES OF 0.0 AND 399868.38 MEAN = 113710.31 ST. DEV. = 108978.19

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
MINIMUM 0.0 133269.44 266578.88
MAXIMUM 133269.44 266578.88 399868.38

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
33.33 33.33 33.33

FREQUENCY DISTRIBUTION, OF DATA POINT VALUES IN EACH LEVEL

LEVELS	0	1	2
SYMBOLS	.	HOLOHOOOU	EE
	.	OCCCCC3OC	##
	.	JCOC COOO	#### ####
	.	U JCOOOWU	##########
	.	OWUOOOOOU	##########
FREQUENCY	310	230	16

Table 6 : Total Cost - Orleans County, N.Y.

MAP TITLE

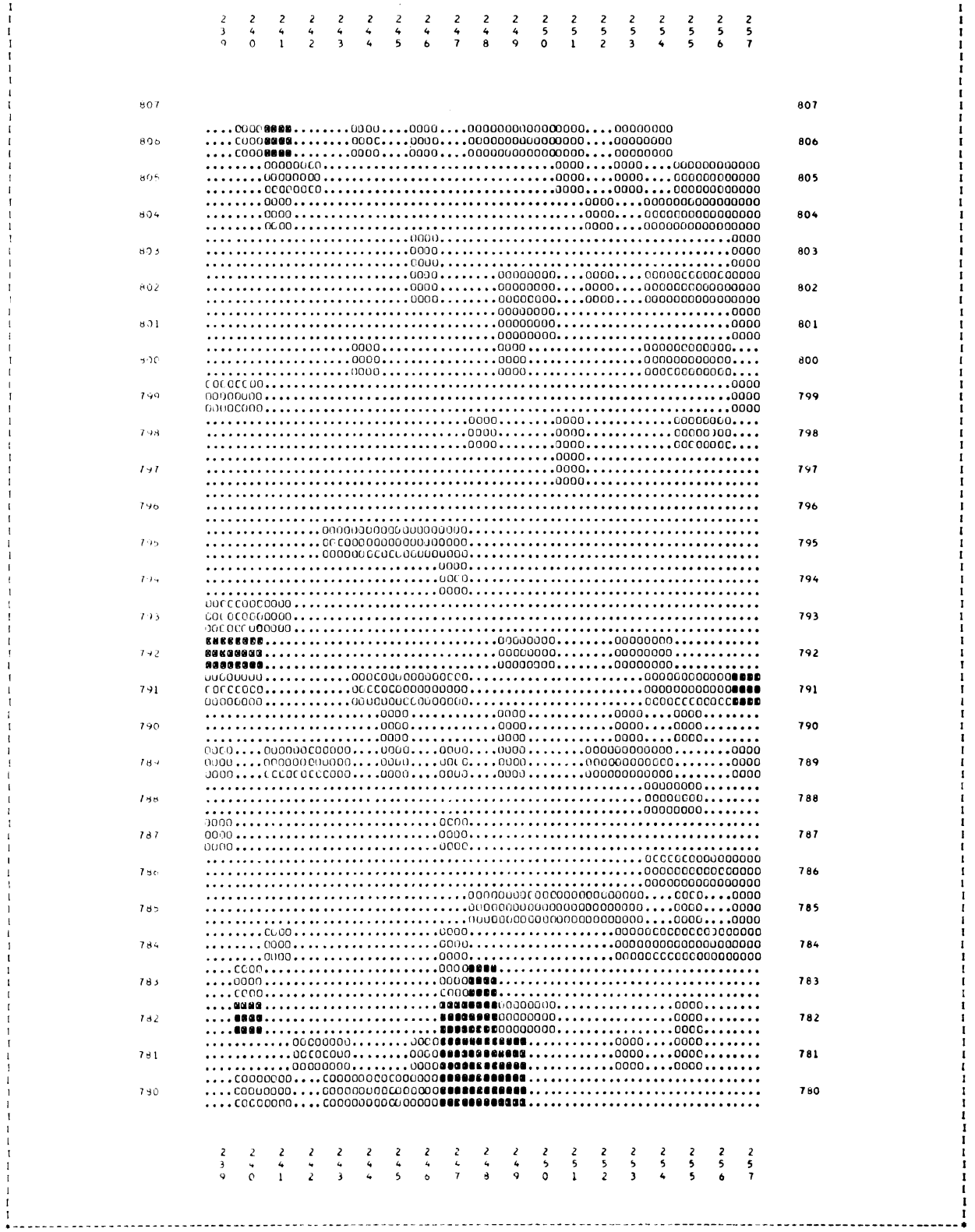
TOTAL COST - ORLEANS COUNTY NEW YORK

ELECTIVES USED FOR THIS MAP

2 THE FLEXIN LOCATOR = 6

Table 6 (cont'd.)

MAP 6,SHEET 2,DATA SET 1



TOTAL COST - ORLEANS COUNTY NEW YORK

Table 6 (cont'd.)

MAP 6,SHEET 1,DATA SET 1

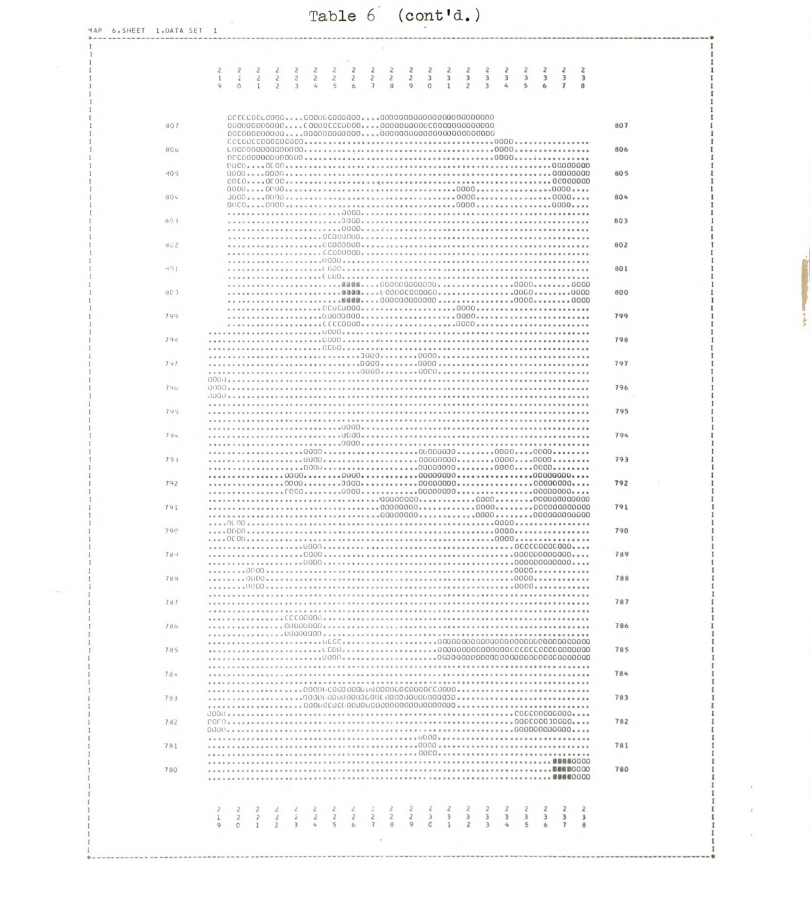


Table 6 (cont'd.)

PREPARED FOR FRANCIS M. DUMOY

BY THE GENESEE/FINGER LAKES REGIONAL PLANNING BOARD
REGIONAL INFORMATION SYSTEM
47 FITZHUGH ST. SOUTH
ROCHESTER, N.Y.

DATA MAPPED IN 3 LEVELS BETWEEN EXTREME VALUES OF 0.0 AND 409868.25 MEAN = 115230.06 ST. DEV. = 171311.88

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

MINIMUM	0.0	136622.75	273245.50
MAXIMUM	136622.75	273245.50	409868.25

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

	33.33	33.33	33.33

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

LEVELS	0	1	2
SYMBOLS	 000000000	 111111111	 222222222
	 000000000	 111111111	 222222222
	.... 000 0 000	.... 111 1 111	.... 222 2 222
	 000000000	 111111111	 222222222
	 000000000	 111111111	 222222222
FREQUENCY	824	216	16

Table 7 : Aesthetic Index - Orleans County, N.Y.

MAP TITLE

AESTHETIC INDEX - ORLEANS CO. NEW YORK

ELECTIVES USED FOR THIS MAP

2 THE FLEXIN LOCATOR = 7

4 THE MINIMUM VALUE IS SPECIFIED AS 0.0

5 THE MAXIMUM VALUE IS SPECIFIED AS 71.70

11 THE LEVELS MAPPED ARE STORED ON CARDS
- - IS AN INVALID INPUT CONTROL WORD

Table 7 (cont'd.)

MAP 7,SHEET 2,DATA SET 1

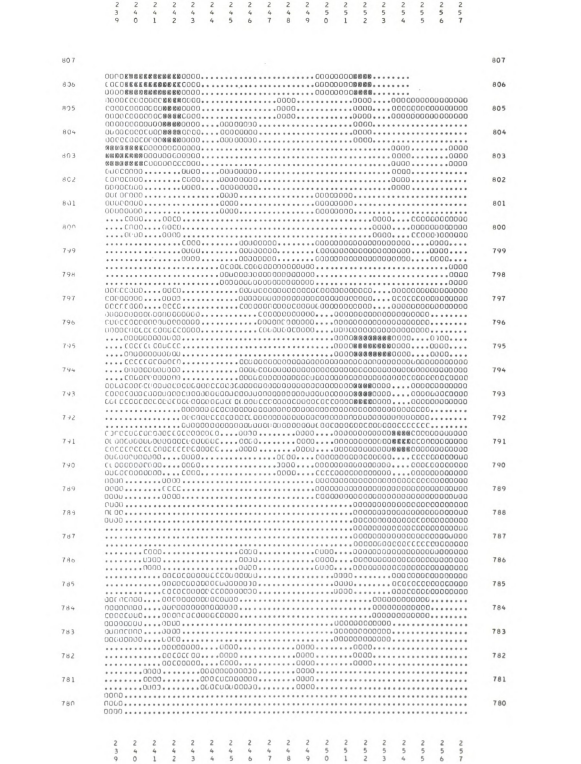


Table 7 (cont'd.)

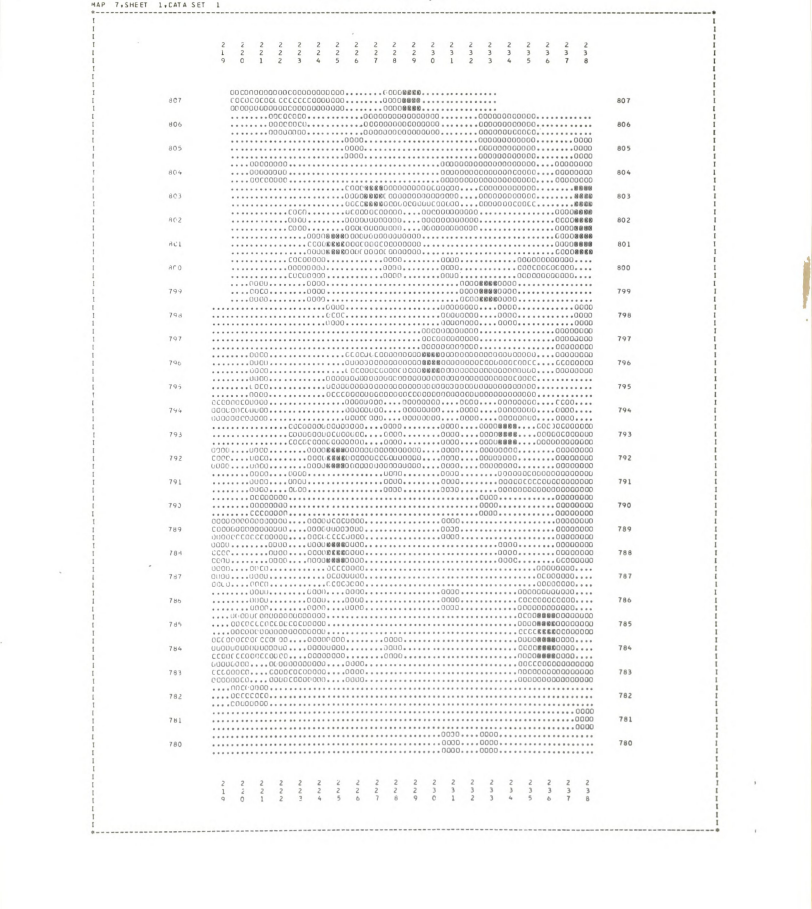


Table 7 (cont'd.)

[illegible]

[illegible] REGIONAL PLANNING BOARD
REGIONAL INFORMATION SYSTEM
[illegible]
[illegible]

DATA MAPPED IN [illegible] LEVELS BETWEEN EXTREME VALUES [illegible] AND 71.70 MEAN = 20.81 ST. DEV. = 31.97

ABSOLUTE VALUE RANGE APPLIED TO EACH LEVEL
[illegible]

AREA WEIGHTED MEAN VALUE ASSIGNED TO EACH LEVEL
[illegible]

FREQUENCY DISTRIBUTION OF DATA POINT VALUES BY [illegible] LEVEL
[illegible]

Table 8 : Low Property Tax Revenue Loss, Low Development Cost, and Low Aesthetic Index

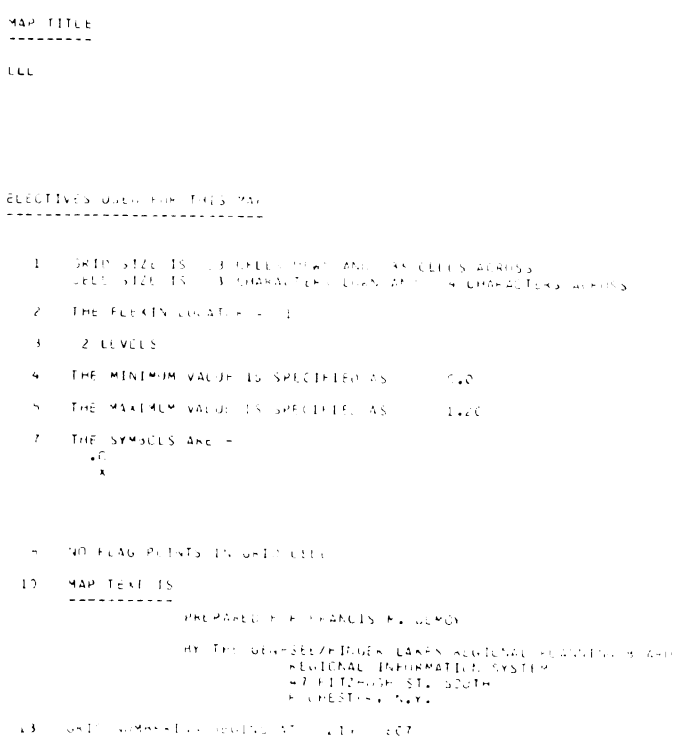


Table 8 (cont'd.)

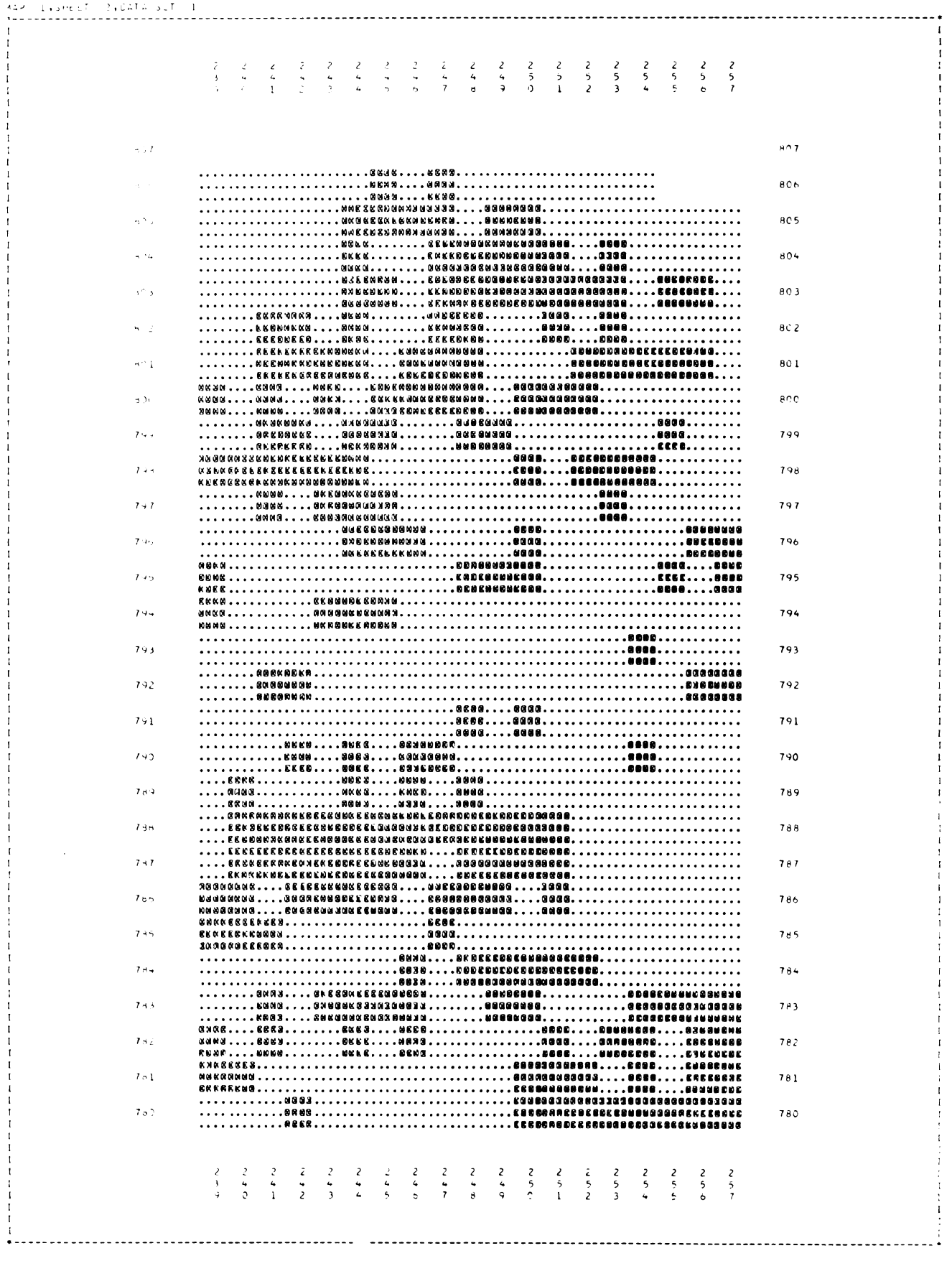


Table 8 (cont'd.)

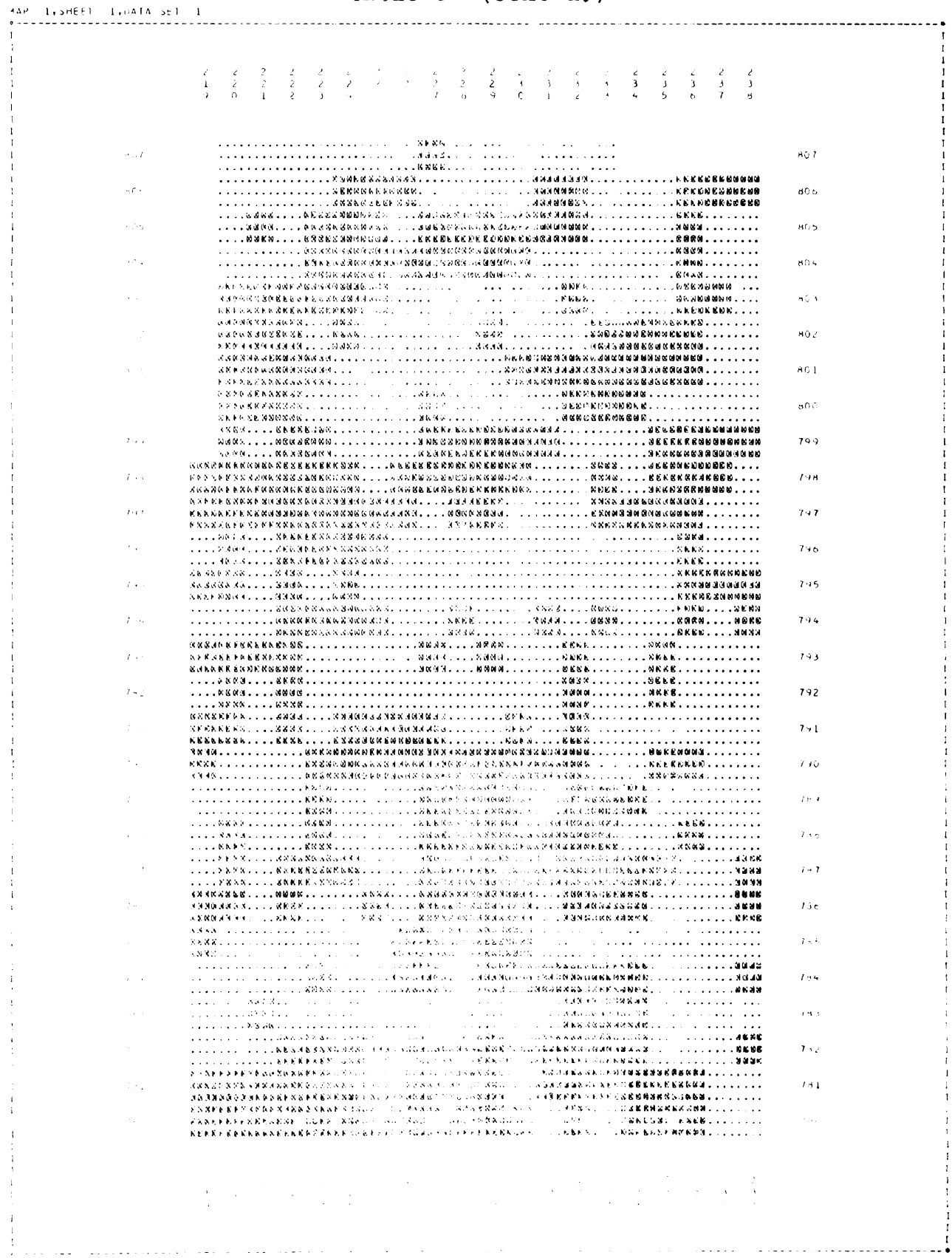


Table 8 (cont'd.)

PREPARED FOR FRANCIS X. DOMEY

BY THE [illegible] REGIONAL PLANNING BOARD
REGIONAL INFORMATION SYSTEM
[illegible]
[illegible], N.Y.

DATA MAPPED IN 2 LEVELS BETWEEN EXTREME VALUES OF [illegible] AND 1.20 MEAN = 0.44 ST. DEV. = 0.77

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

	LOW	HIGH
MINIMUM	[illegible]	0.60
MAXIMUM	0.60	1.20

PERCENTAGE OF TOTAL # VALID VALUE RANGE APPLYING TO EACH LEVEL

LOW	HIGH
50.00	50.00

FREQUENCY DISTRIBUTION OF DATA TOTAL VALUES IN EACH LEVEL

LEVELS	LOW VALUES 0	1	2	HIGH VALUES 3
SYMBOLS		.....	00000.2@@	
		.....	@@%@@@@@@	
		....	@%@@ @@@@	
		.....	@%@@@@@@@	
		.....	@%@@@@@@@	
FREQUENCY	0	594	462	0

Table 9 : Low Property Tax Revenue Loss, Low Development Cost, and Medium Aesthetic Index

MAP TITLE

LLM

OBJECTIVES USED FOR THIS MAP
---

2 THE FLEXIN LOCATION = 2

Table 9 (cont'd.)

MAP 2,SHEET 2,DATA SET 1

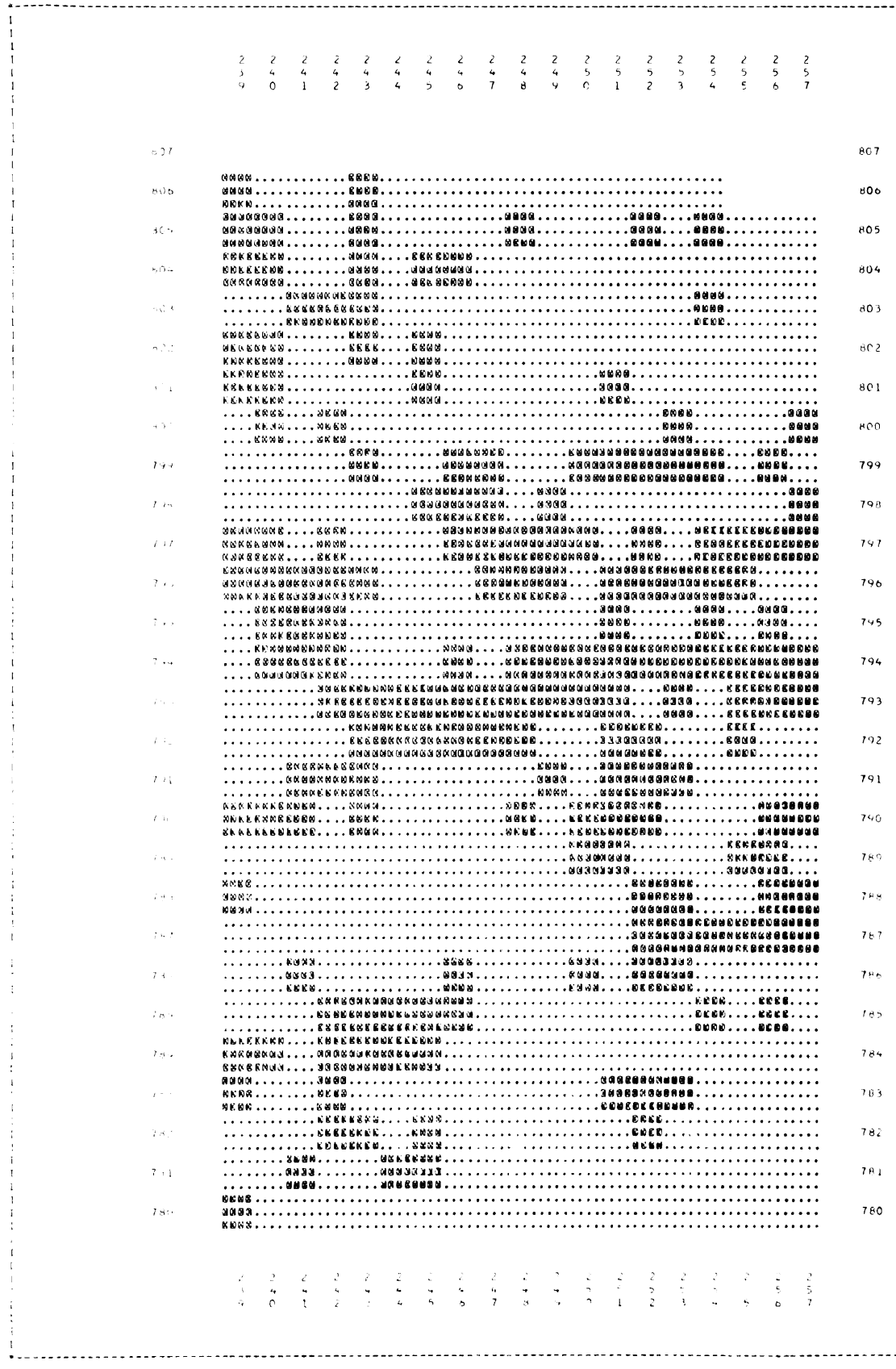


Table 9 (cont'd.)

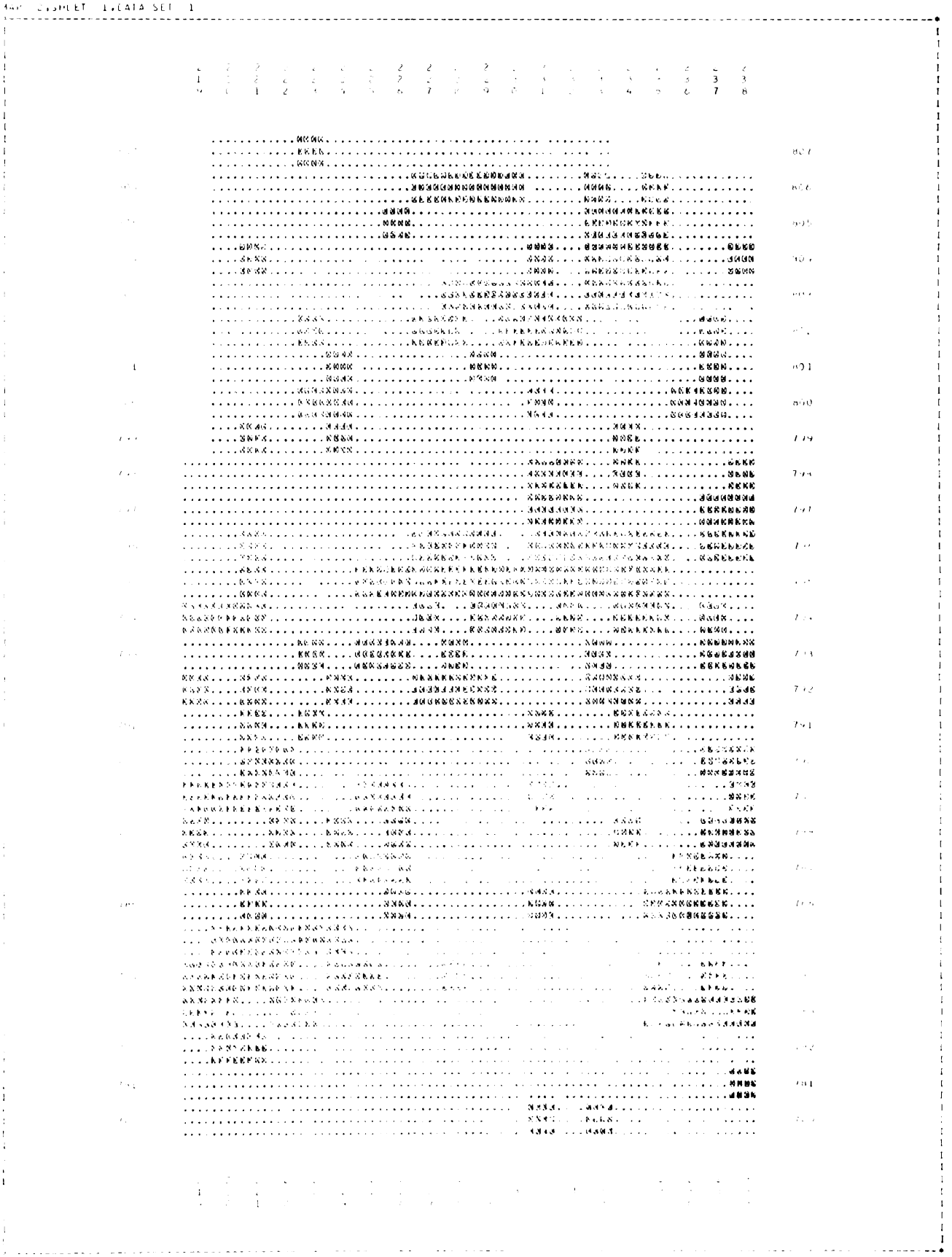


Table 9 (cont'd.)

PREPARED FOR FRANCIS M. DUNDY

BY THE GENESEE/FINGER LAKES REGIONAL PLANNING BOARD
REGIONAL INFORMATION SYSTEM
W/ [illegible] St. Scale
ROCHESTER, N.Y.

DATA MAPPED IN 2 LEVELS BETWEEN EXTREME VALUES OF 0.0 AND 1.2% MEAN = 0.22 ST. DEV. = 0.65

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

	LEVEL 0	LEVEL 1
MINIMUM	0.0	0.6%
MAXIMUM	0.6	1.2%

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

LEVEL 0	LEVEL 1
50.0	50.0

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

	LOW VALUES		HIGH VALUES	
LEVELS	0	1	2	3
SYMBOLS	.	*		
FREQUENCY	0	71A	33H	0

Table 10: Low Property Tax Revenue Loss, Low Development Cost, and High Aesthetic Index

MAP TITLE

LOW

OBJECTIVES USED IN THIS MAP

2 THE PERMIT LOCATION

Table 10 (cont'd.)

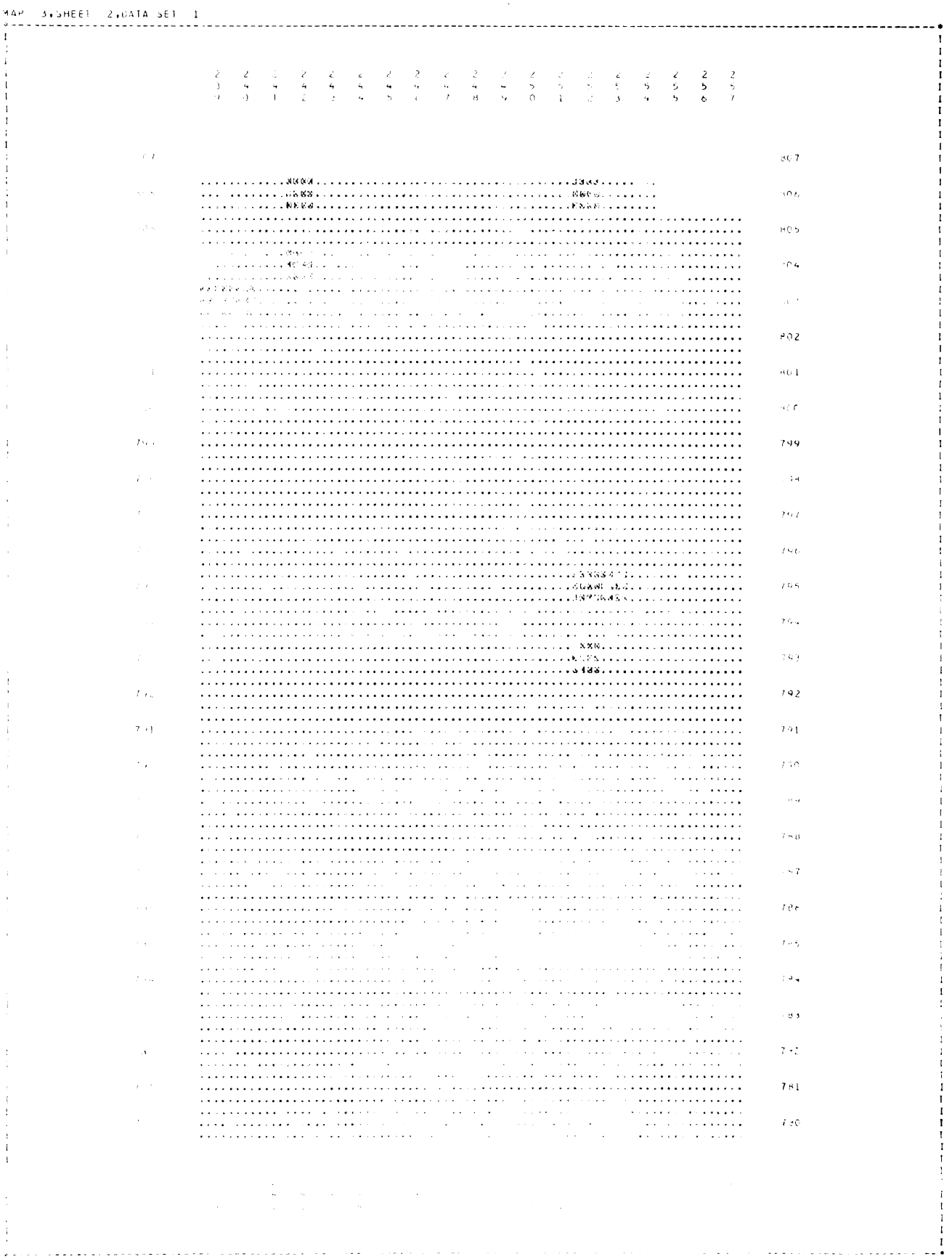


Table 10 (cont'd.)

MAP 3,SHEET 1,DATA SET 1

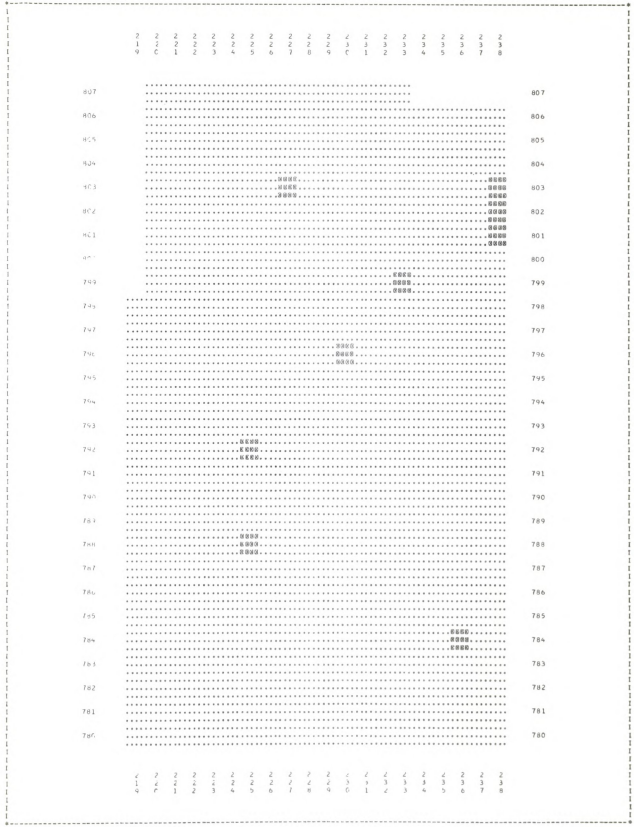


Table 10 (cont'd.)

PREPARED FOR FRANCIS P. DUMOY

BY THE GENESEE/FINGER LAKES REGIONAL PLANNING BOARD
REGIONAL INFORMATION SYSTEM
47 FITZHUGH ST. SOUTH
ROCHESTER, N.Y.

DATA MAPPED TO 4 LEVELS BETWEEN EXTREME VALUES OF 0.0 AND 1.20 MEAN = 0.42 ST. DEV. = 0.13

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

	LOW	HIGH
MINIMUM	0.0	0.03
MAXIMUM	1.05	1.20

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

LOW	HIGH
50.00	50.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES BY EACH LEVEL

LEVELS	LOW VALUES 0	1	2	HIGH VALUES 3
SYMBOLS		.....	.....	**********
		.....	.....	**********
		.....	.....	**********
		.....	.....	**********
		.....	.....	**********
FREQUENCY	0	1739	17	0

Table 11: Low Property Tax Revenue Loss, Medium Development Cost, and Low Aesthetic Index

MAP TITLE

LML

OBJECTIVES USED FOR THIS MAP

2 THE FLEXIN LOCATION = 4

Table 11 (cont'd.)

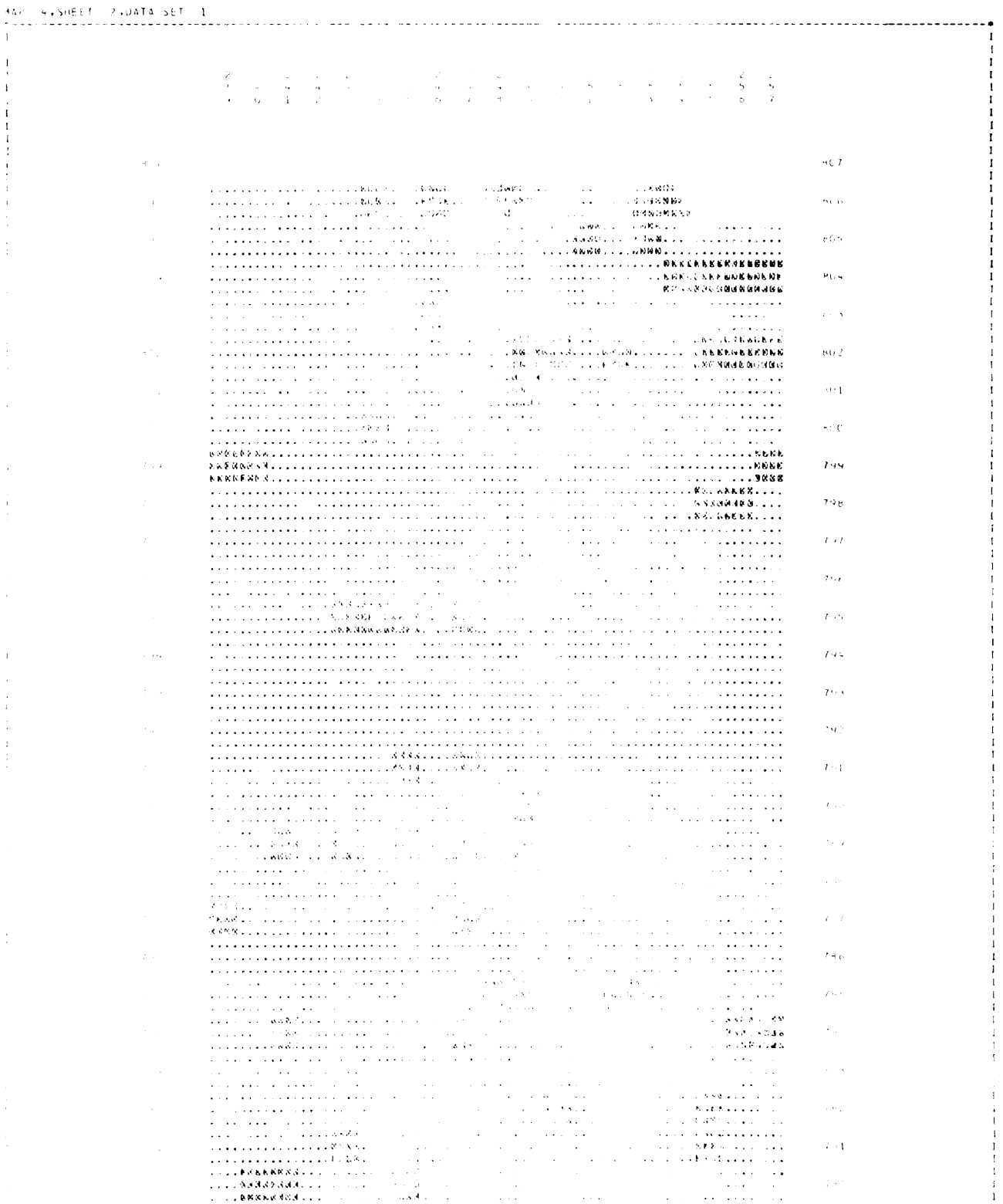


Table 11 (cont'd.)

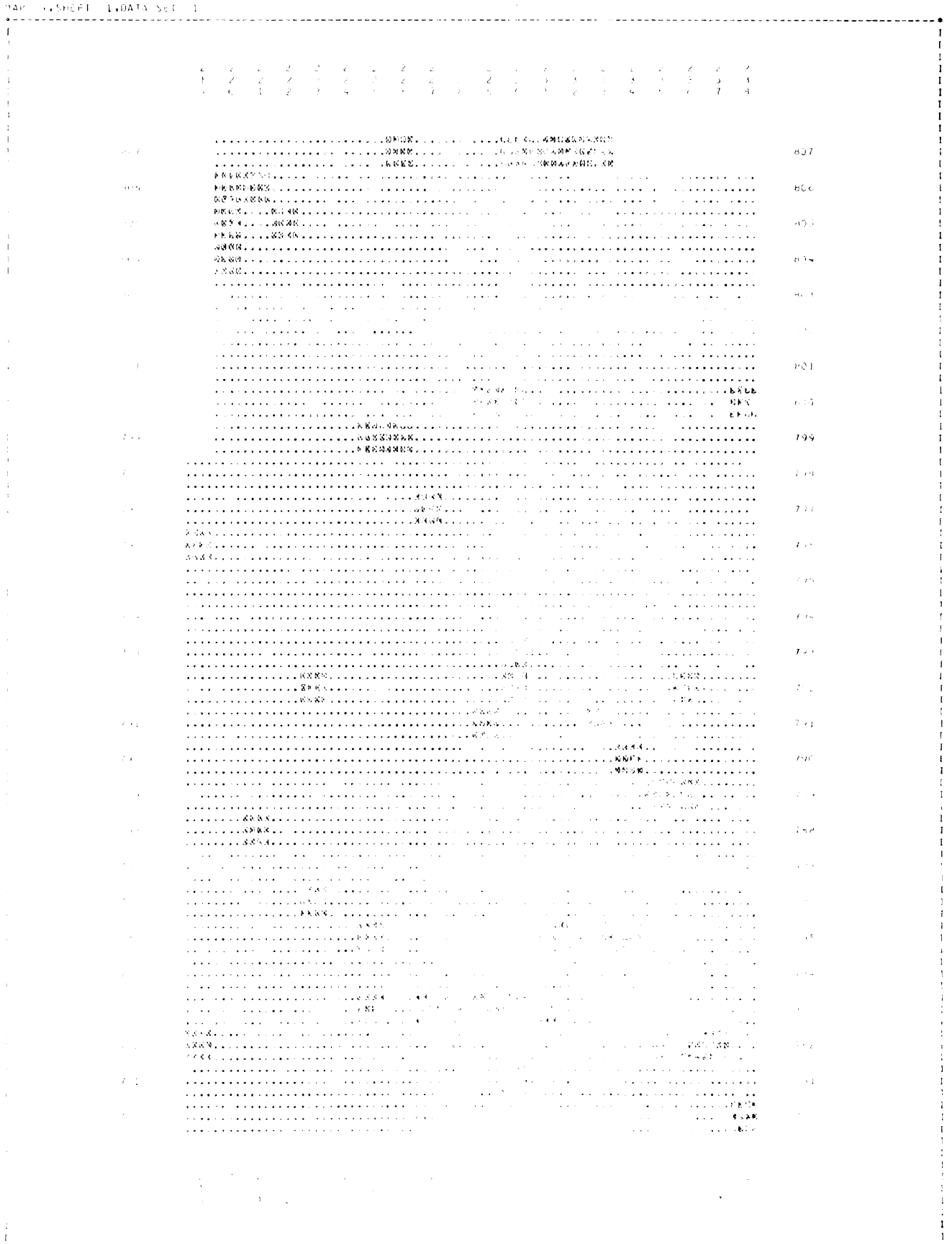


Table 11 (cont'd.)

[illegible] FOR PLANNING PURPOSES ONLY

AS THE GENESEE/FINGER LAKES REGIONAL PLANNING BOARD
REGIONAL INFORMATION SYSTEM
[illegible] ST. SOUTH
[illegible], N.Y.

DATA MAPPED IN [illegible] LEVELS BETWEEN EXTREME VALUES OF [illegible] AND [illegible] MEAN = 0.10 ST. DEV. = 0.32

ABSOLUTE VALUE RANGE APPLIED TO EACH LEVEL
MINIMUM [illegible]
MAXIMUM [illegible]

PERCENTAGE OF TOTAL AREA [illegible] FALLS WITHIN EACH APPLIED RANGE LEVEL
[illegible]

PERCENTAGE DISTRIBUTION OF [illegible] WITHIN EACH LEVEL
LOG VALUES
LEVELS [illegible]
[illegible]
SYMBOLS
[illegible]

Table 12: Low Property Tax Revenue Loss, Medium Development Cost, and Medium Aesthetic Index

MAP TITLE

LMM

SELECTIVES USED FOR THIS MAP
---

2 THE FLEXIN LOCATION

Table 12 (cont'd.)

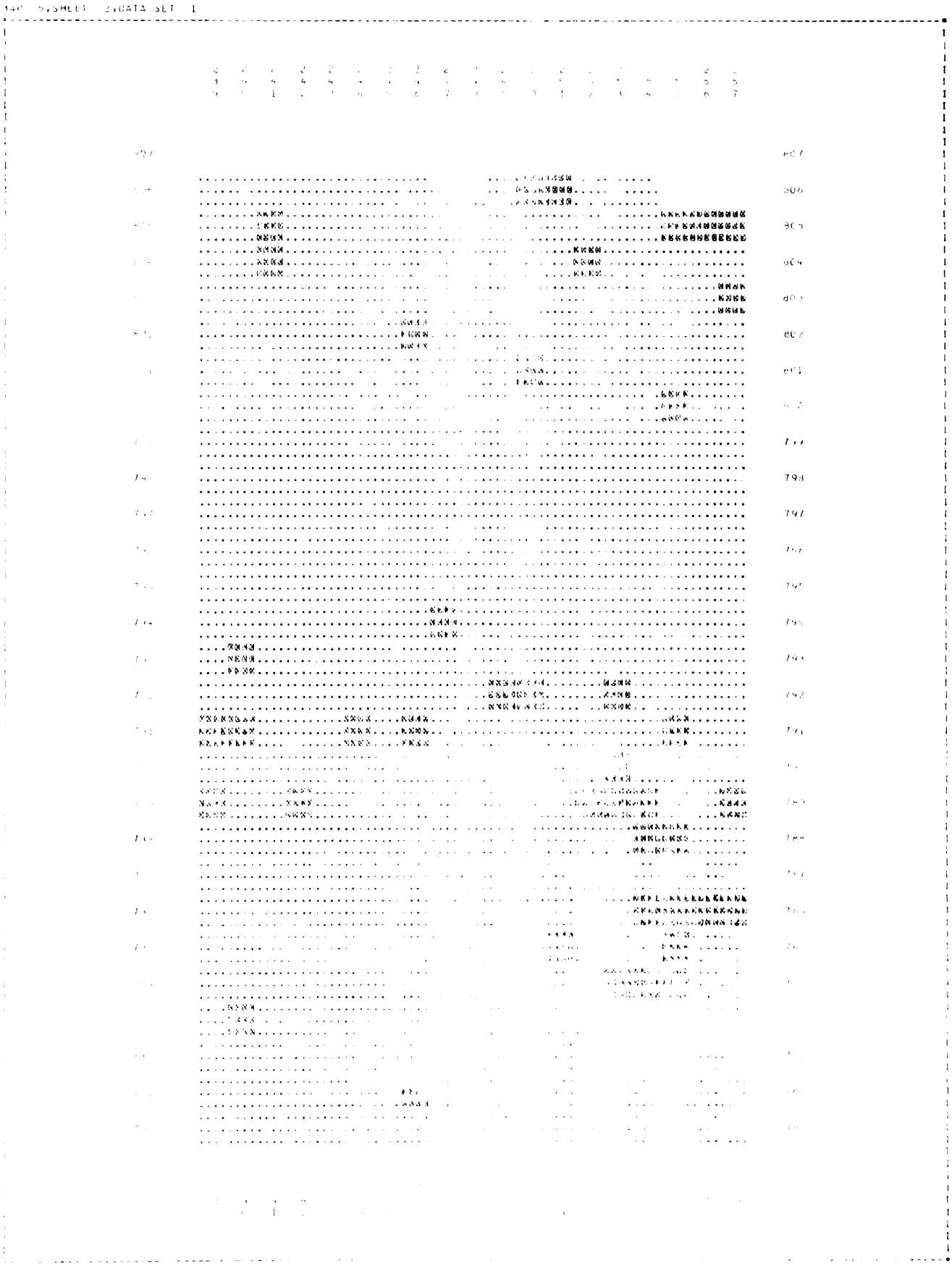


Table 12 (cont'd.)

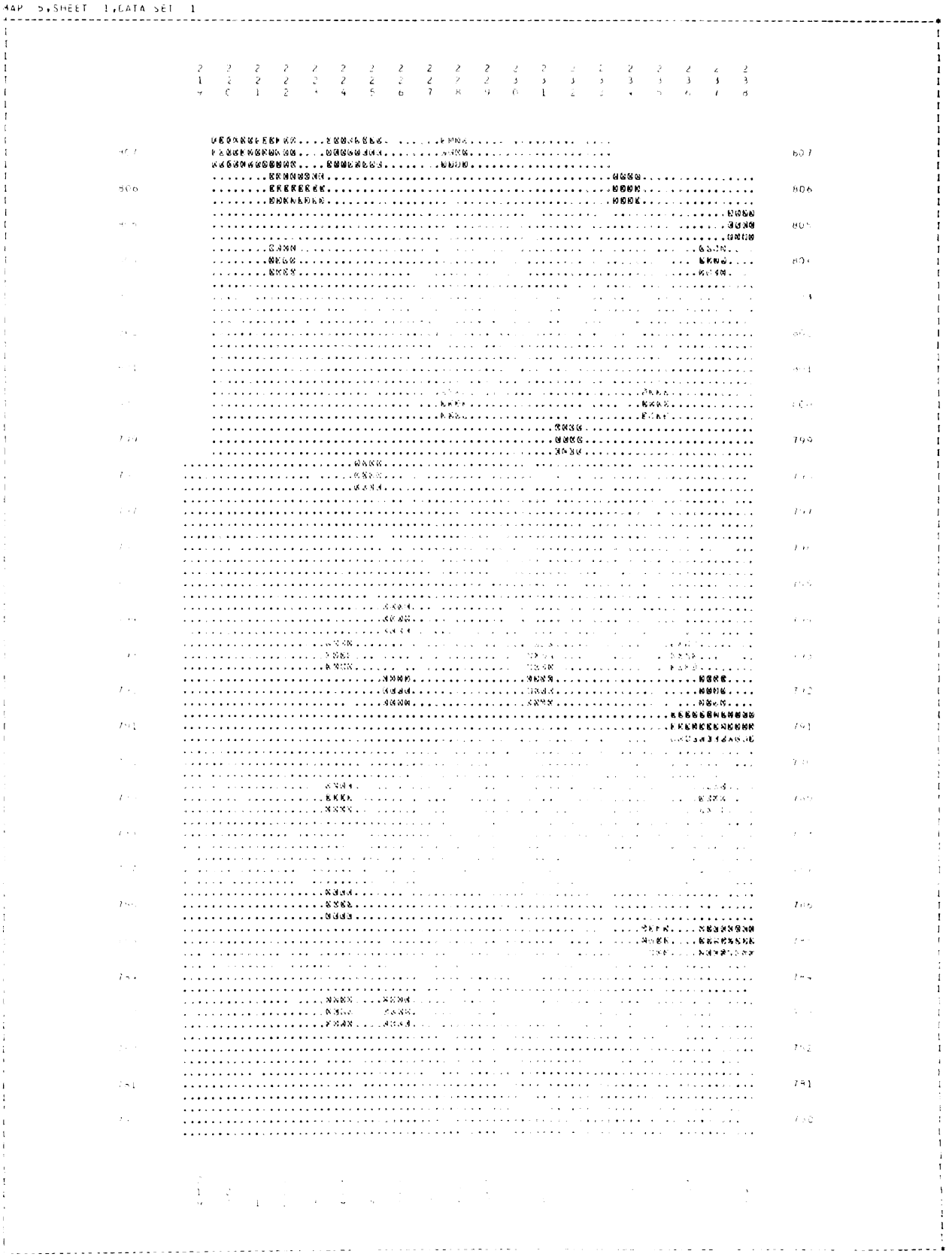


Table 12 (cont'd.)

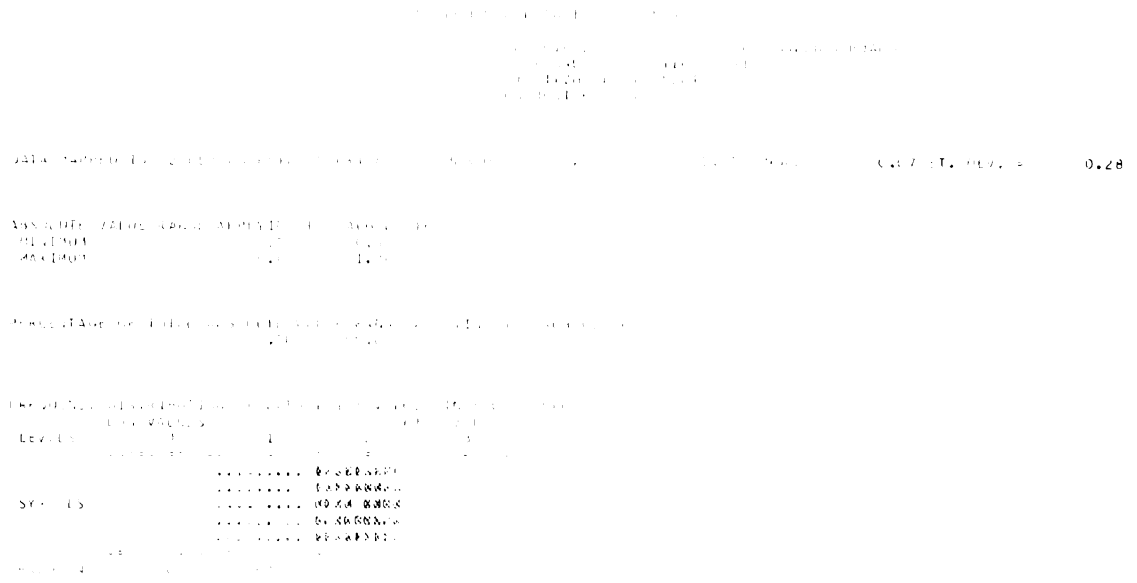


Table 13: Low Property Tax Revenue Loss, Medium Development Cost, and High Aesthetic Index

MAP TITLE

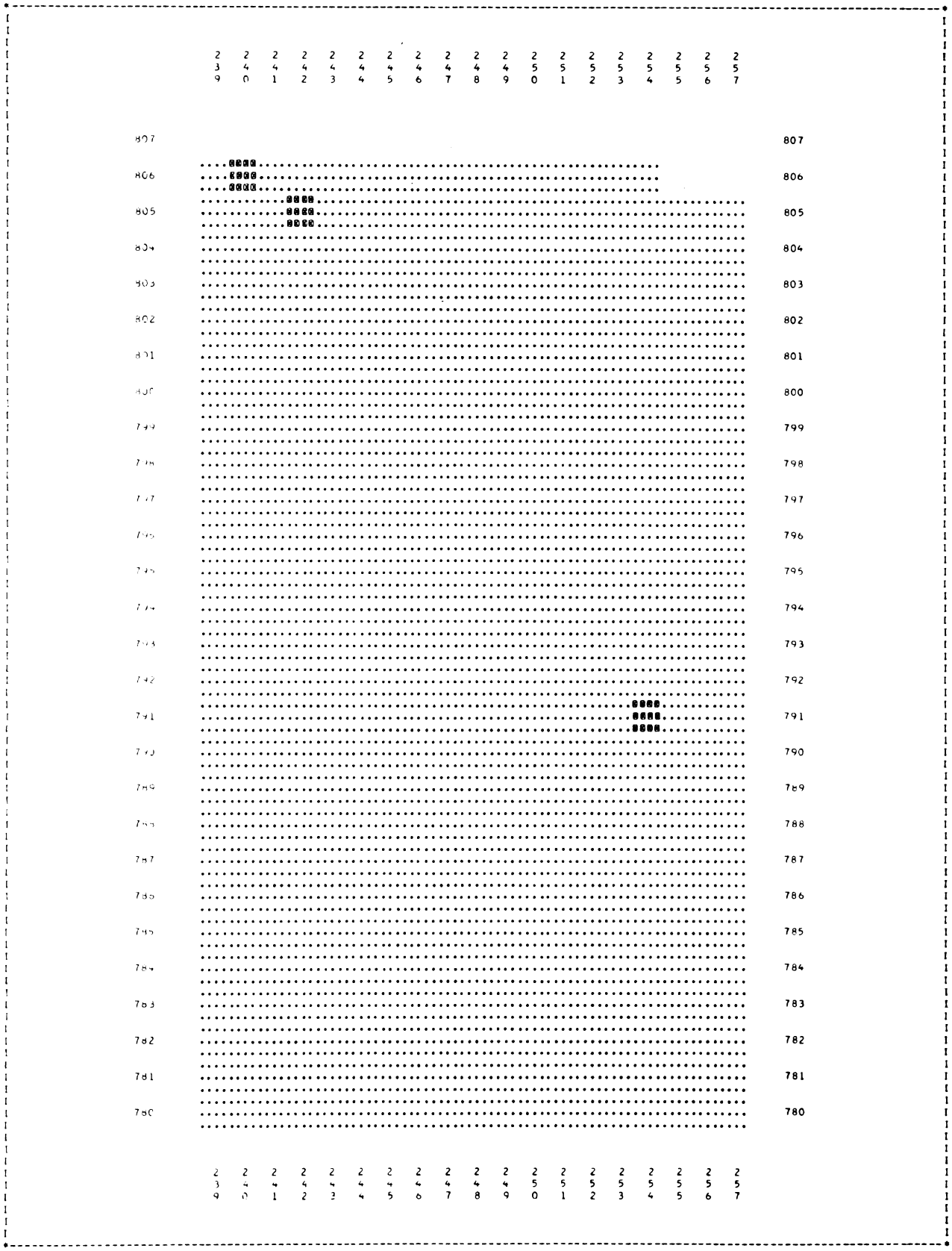
LMH

ELECTIVES USED FOR THIS MAP

Z THE FLEXIN LOCATOR = 6

Table 13 (cont'd.)

MAP 6,SHEET 2,DATA SET 1



LMH

Table 13 (cont'd.)

MAP 6,SHEET 1,DATA SET 1

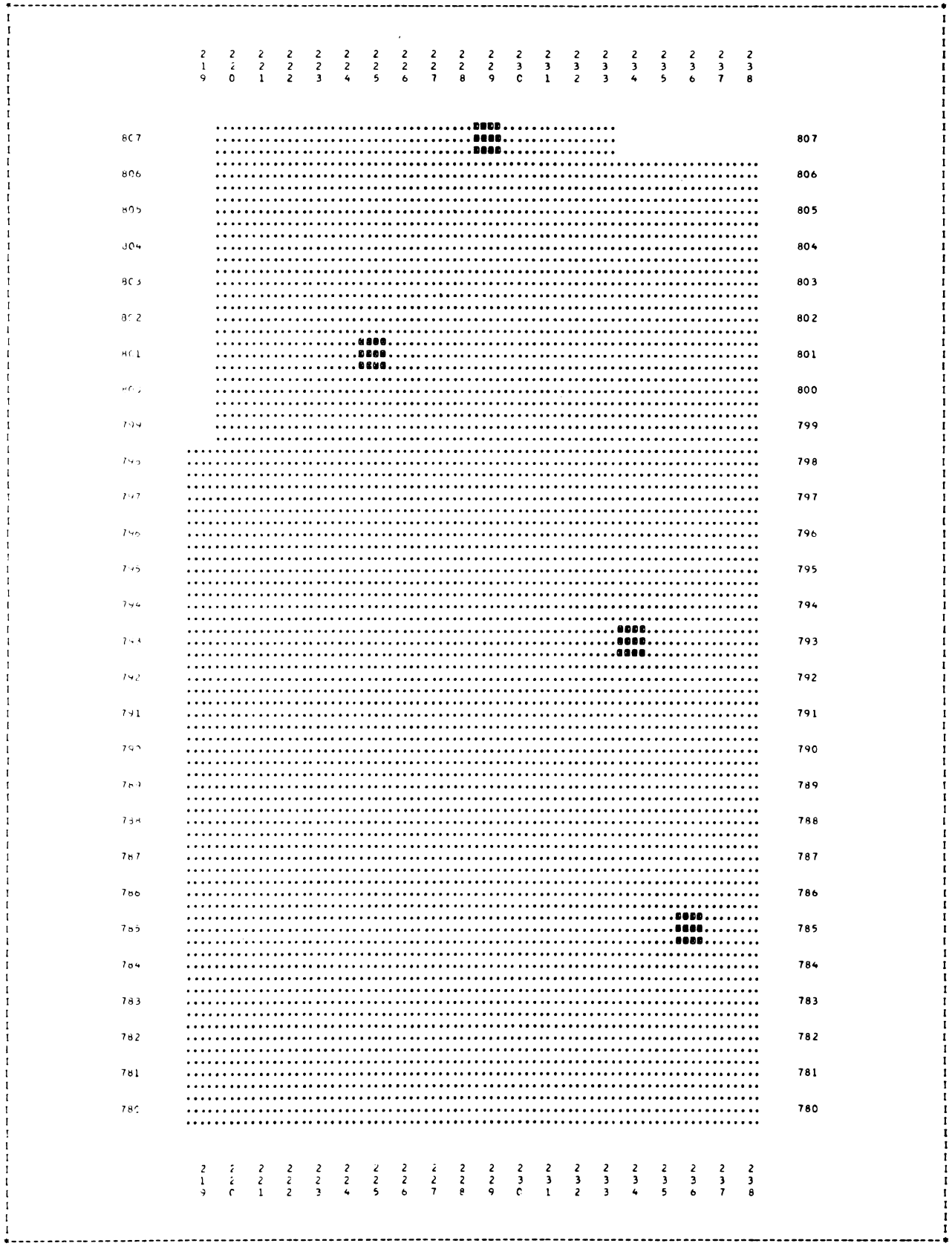


Table 13 (cont'd.)

PREPARED FOR FRANCIS M. DOMOY

BY THE GENESEE/FINGER LAKES REGIONAL PLANNING BOARD
REGIONAL INFORMATION SYSTEM
47 FITZHUGH ST. SOUTH
ROCHESTER, N.Y.

DATA MAPPED IN 2 LEVELS BETWEEN EXTREME VALUES OF 0.0 AND 1.20 MEAN = 0.01 ST. DEV. = 0.08

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

MINIMUM	0.0	0.60
MAXIMUM	0.60	1.20

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

	50.00	50.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

	LOW VALUES			HIGH VALUES
LEVELS	0	1	2	3
SYMBOLS		..... [illegible]		
		..... [illegible]		
		.... [illegible]		
		..... [illegible]		
		..... [illegible]		
FREQUENCY	0	1049	7	0

Table 14: Low Property Tax Revenue Loss, High Development Cost, and Low Aesthetic Index

Table 14 (cont'd.)

MAP 7,SHEET 2,DATA SET 1

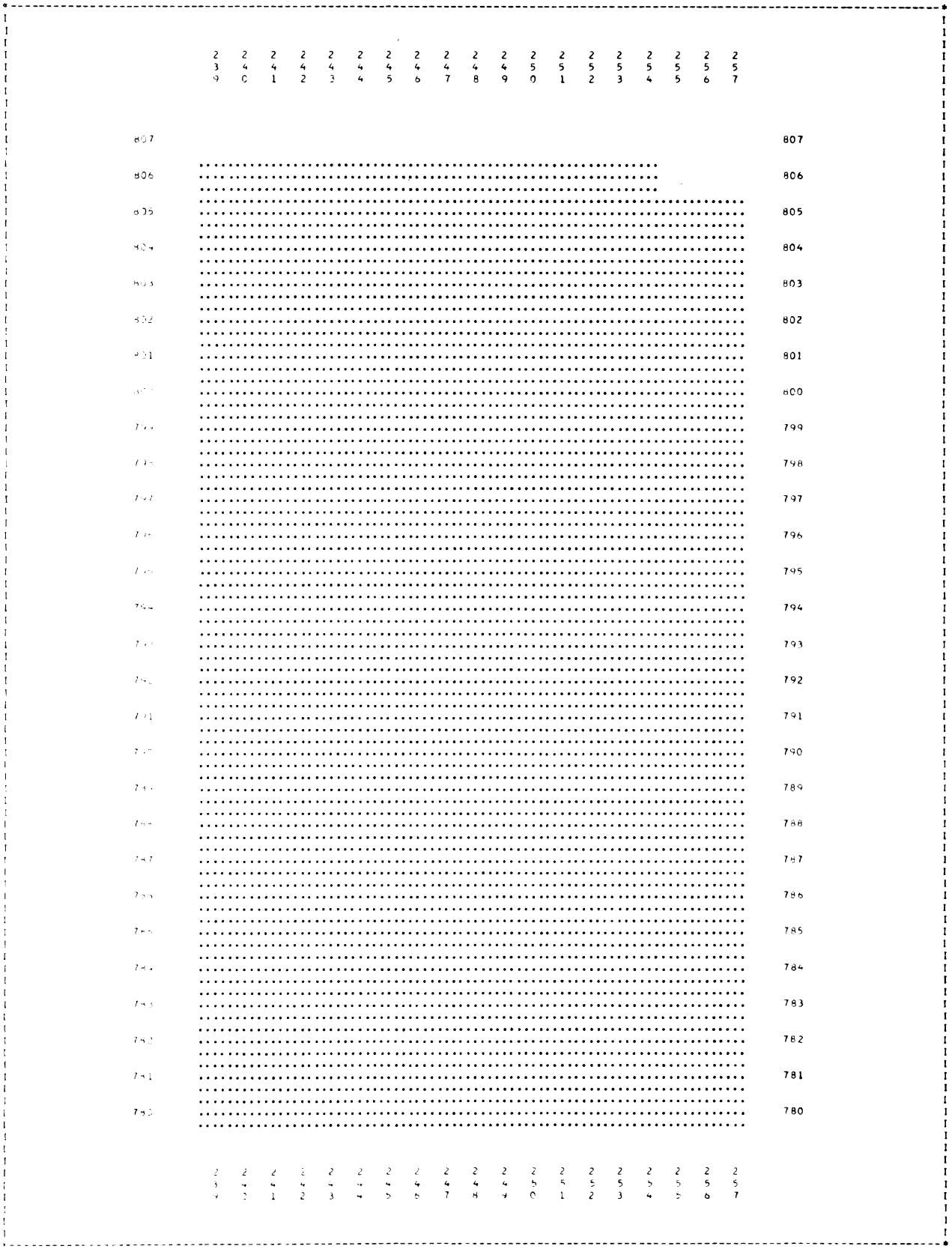


Table 14 (cont'd.)

MAP 7,SHEET 1,DATA SET 1

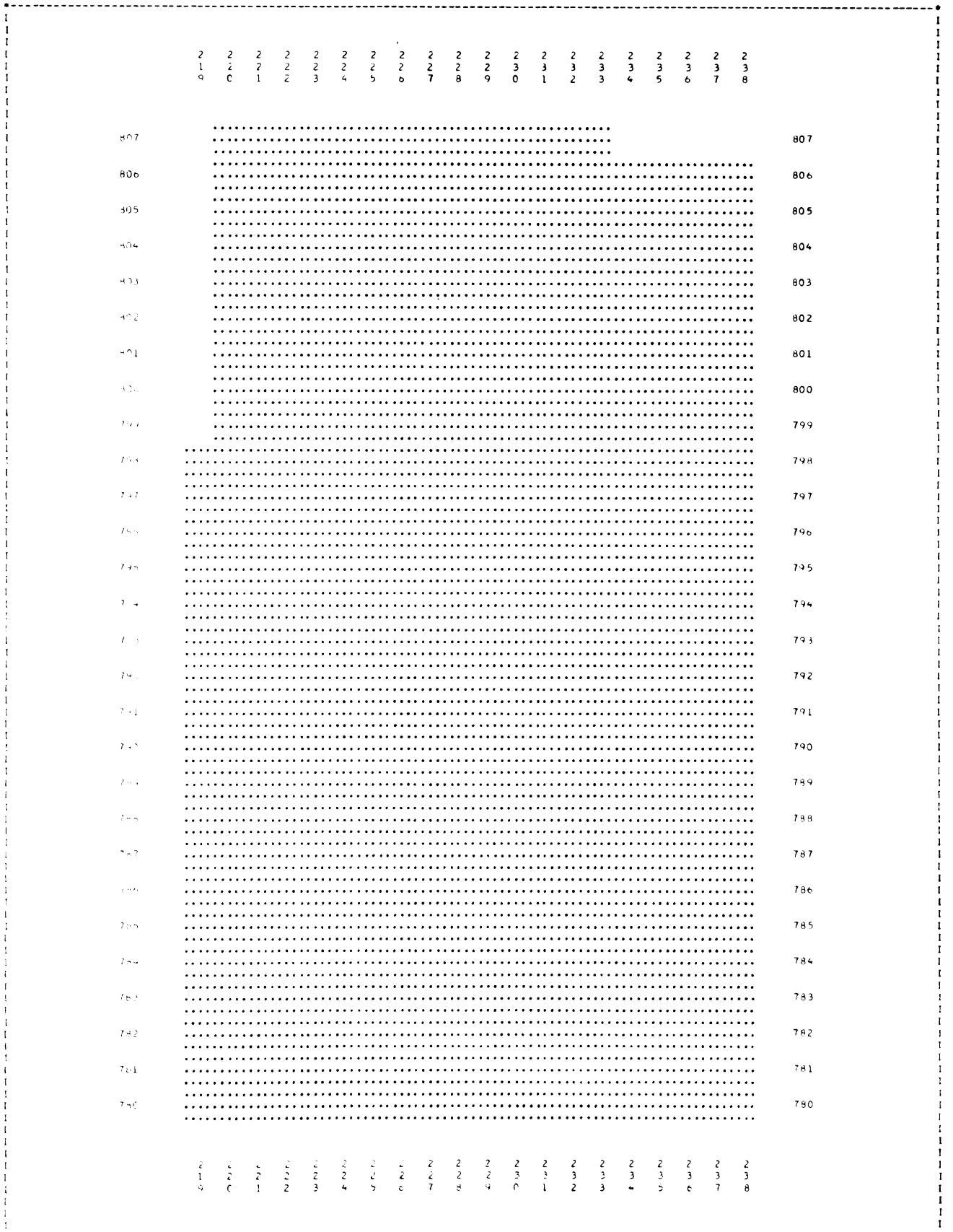


Table 14 (cont'd.)

PREPARED FOR FRANCIS M. DOMOY

BY THE GENESEE/FINGER LAKES REGIONAL PLANNING BOARD
REGIONAL INFORMATION SYSTEM
47 FITZHUGH ST. SOUTH
ROCHESTER, N.Y.

DATA MAPPED IN 2 LEVELS BETWEEN EXTREME VALUES OF 0.0 AND 1.20 MEAN = 0.0 ST. DEV. = 0.0

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

MINIMUM	0.0	0.60
MAXIMUM	0.60	1.20

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

	50.00	50.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

	LOW VALUES		HIGH VALUES	
LEVELS	0	1	2	3
SYMBOLS		.....		
FREQUENCY	0	1056	0	0

Table 15: Low Property Tax Revenue Loss, High Development Cost, and Medium Aesthetic Index

MAP TITLE

LMA

OBJECTIVES USED FOR THIS MAP

2 THE FLEXIBILITY

Table 15 (cont'd.)

MAP 8,SHEET 2,DATA SET 1

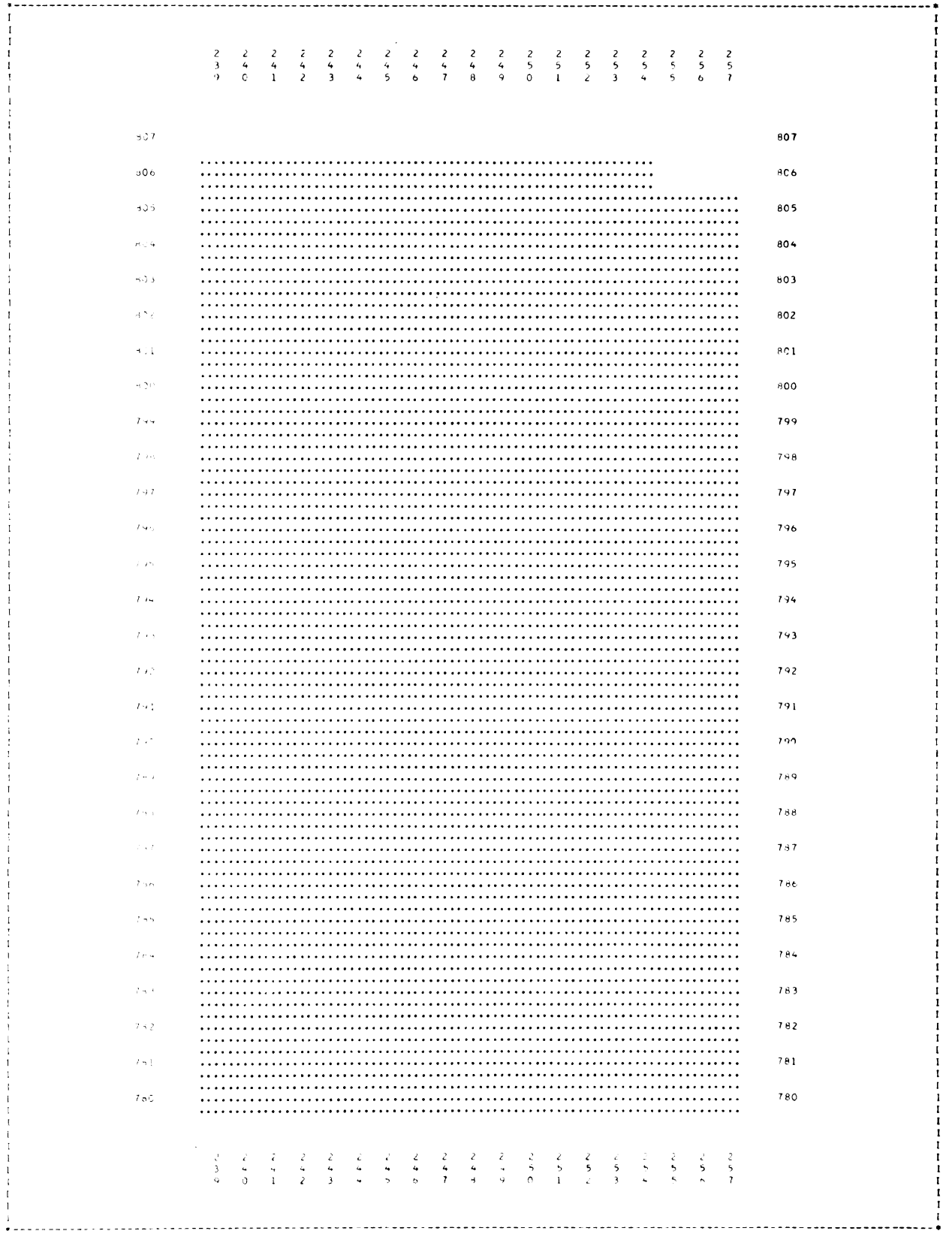


Table 15 (cont'd.)

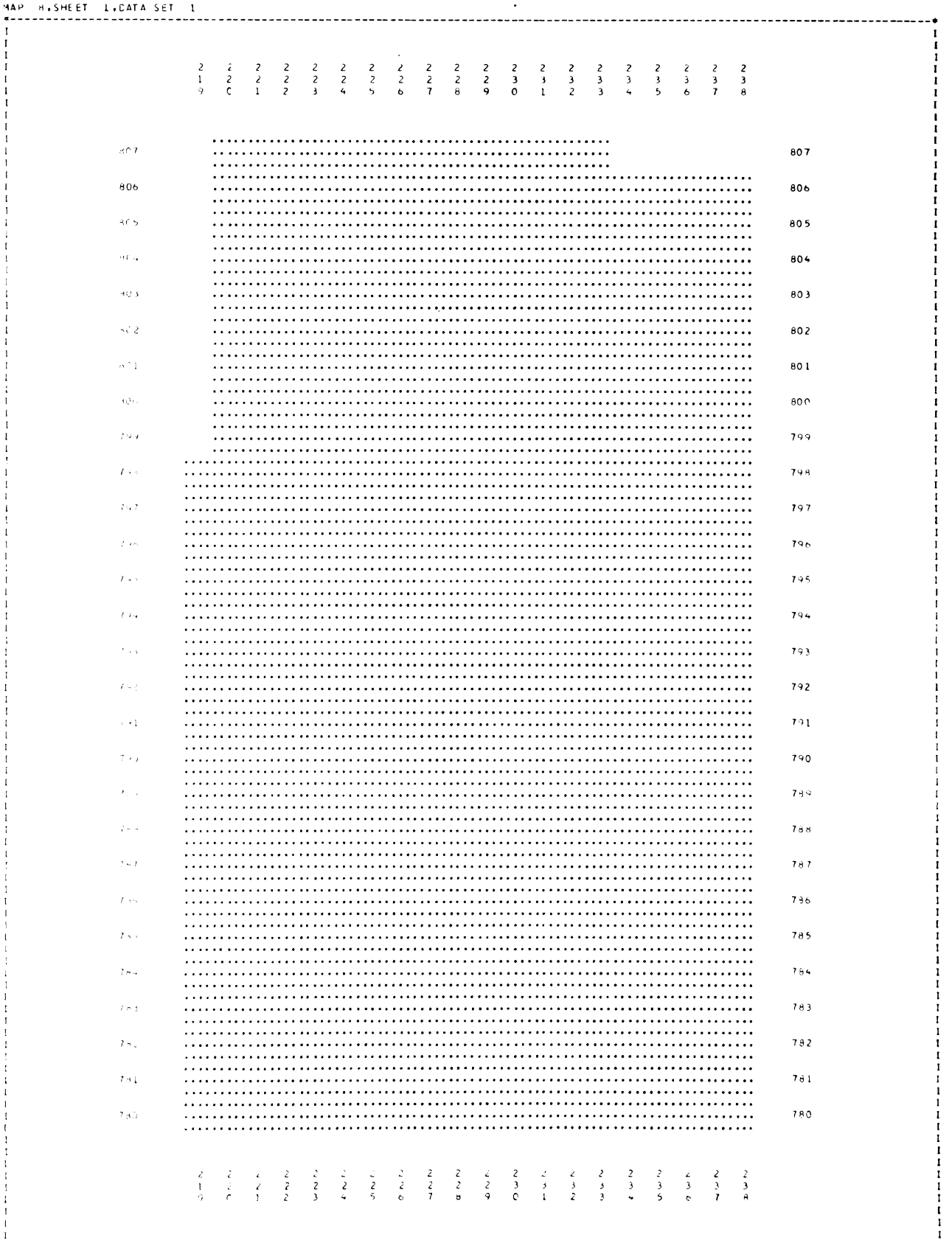


Table 15 (cont'd.)

PREPARED FOR FRANCIS M. DOMOY

BY THE GENESEE/FINGER LAKES REGIONAL PLANNING BOARD
REGIONAL INFORMATION SYSTEM
47 FITZHUGH ST. SOUTH
ROCHESTER, N.Y.

DATA MAPPED IN 2 LEVELS BETWEEN EXTREME VALUES OF 0.0 AND 1.20 MEAN = 0.0 ST. DEV. = 0.0

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

MINIMUM	0.0	0.60
MAXIMUM	0.60	1.20

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

50.00 50.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

LEVELS	LOW VALUES 0	1	2	HIGH VALUES 3
SYMBOLS		.....		
		.....		
		....		
		.....		
		.....		
FREQUENCY	0	1000	0	0

Table 16: Low Property Tax Revenue Loss, High Development Cost, and High Aesthetic Index

MAP TITLE

CMA

OBJECTIVES USED FOR THIS MAP
---

2 THE FLEXIS LOCATOR =

Table 16 (cont'd.)

MAP 9, SHEET 2, DATA SET 1

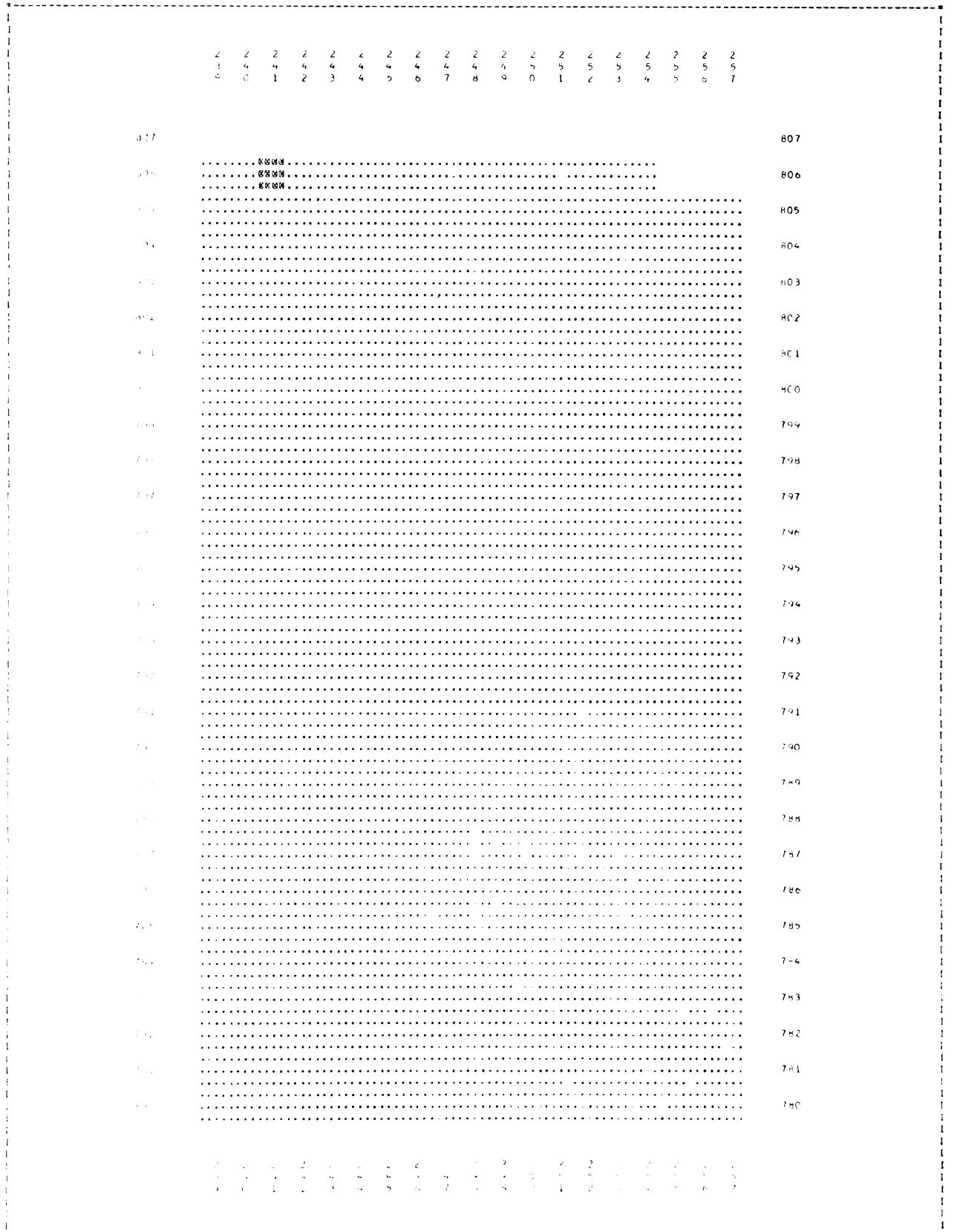


Table 16 (cont'd.)

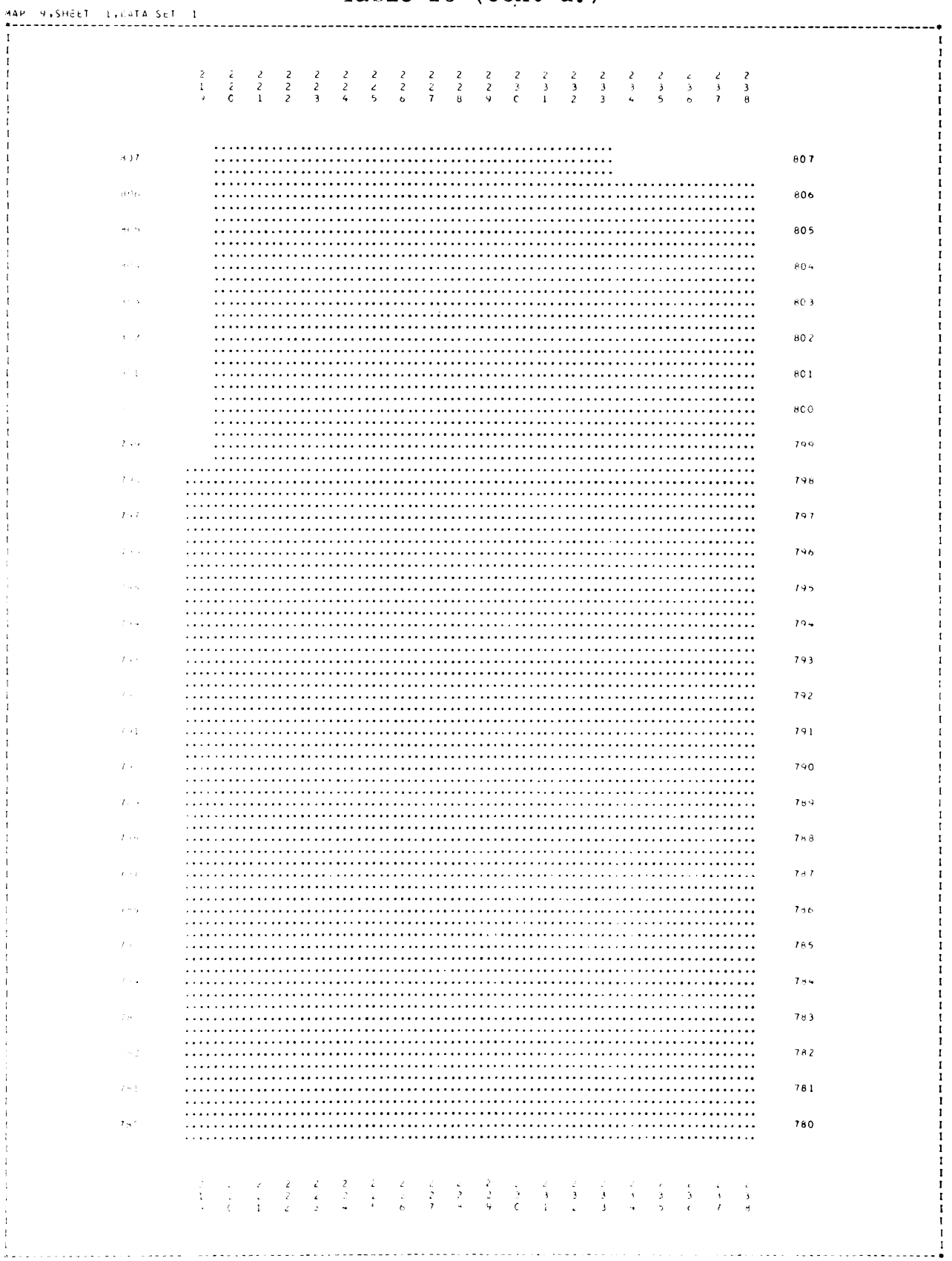


Table 16 (cont'd.)

PREPARED FOR FRANCIS M. DUGGY

BY THE GENESEE/FINGER LAKES REGIONAL PLANNING BOARD
REGIONAL INFORMATION SYSTEM
47 FITZHUGH ST. SOUTH
ROCHESTER, N.Y.

DATA MAPPED IN 2 LEVELS BETWEEN EXTREME VALUES OF 0.0 AND 1.20 MEAN = 0.00 ST. DEV. = 0.03

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

	LOW	HIGH
MINIMUM	0.0	0.03
MAXIMUM	0.03	1.20

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

	LOW	HIGH
	97.5%	93.0%

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

	LOW VALUES		HIGH VALUES	
LEVELS	-2	-1	2	3
SYMBOLS		.....	#####	
		.....	#####	
		....	#### ####	
		.....	#####	
		.....	#####	
FREQUENCY	0	1285	1	0

Table 17: Medium Property Tax Revenue Loss, Low Development Cost, and Low Aesthetic Index

MAP TITLE

ALL

OBJECTIVES USED FOR THIS MAP
---

2 THE FLEAIN LOCATOR = 10

Table 17 (cont'd.)

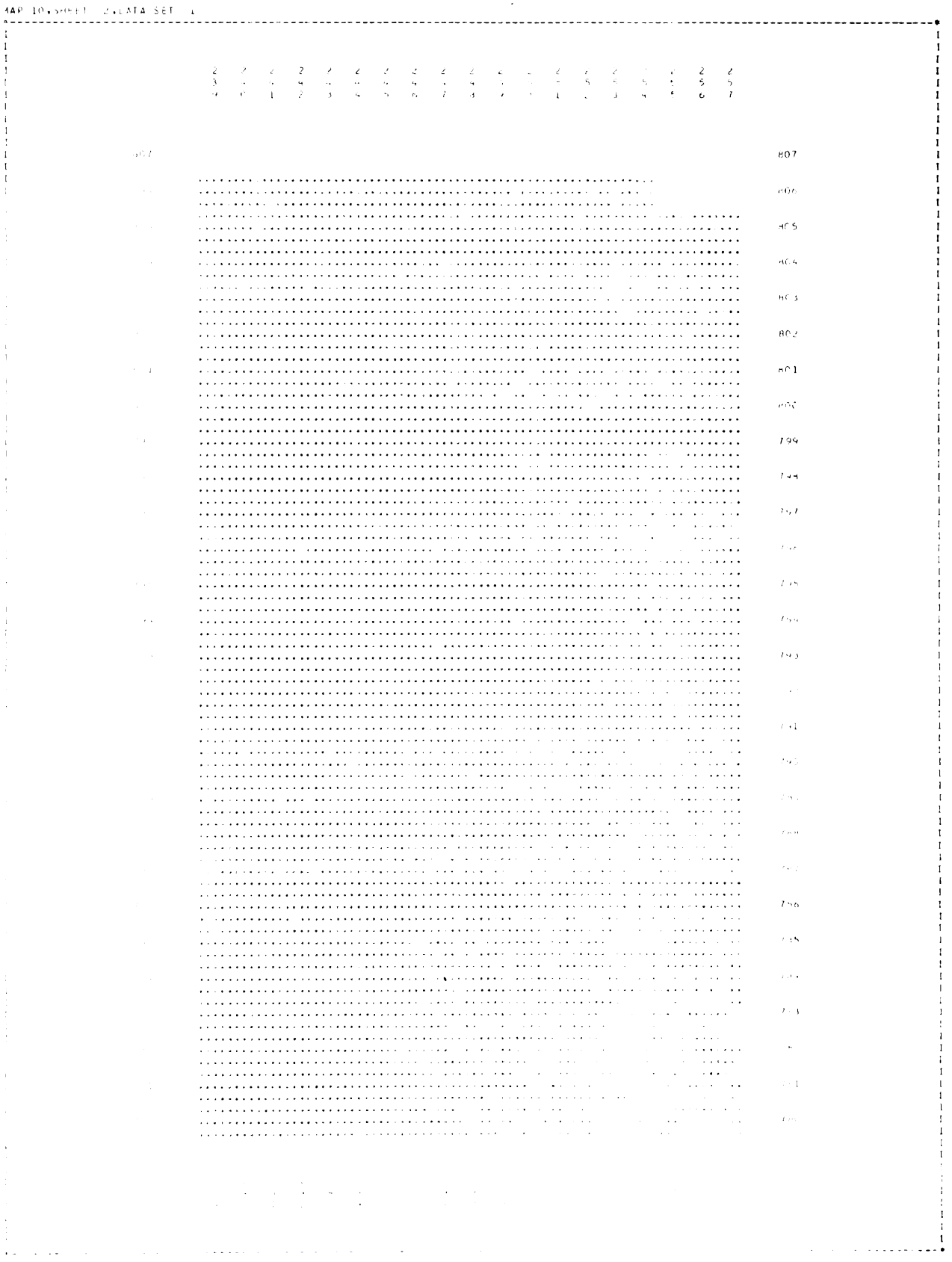


Table 17 (cont'd.)

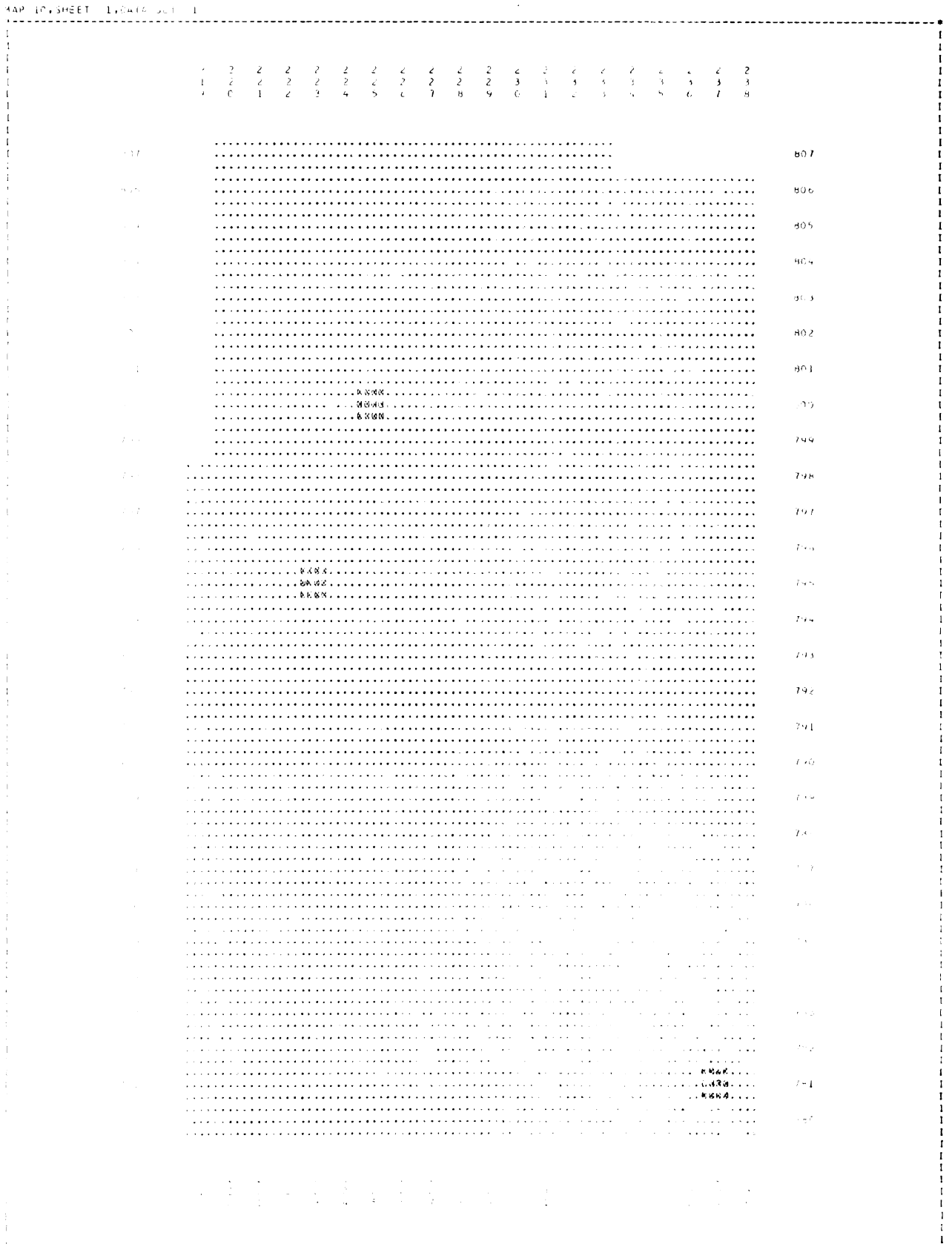


Table 17 (cont'd.)

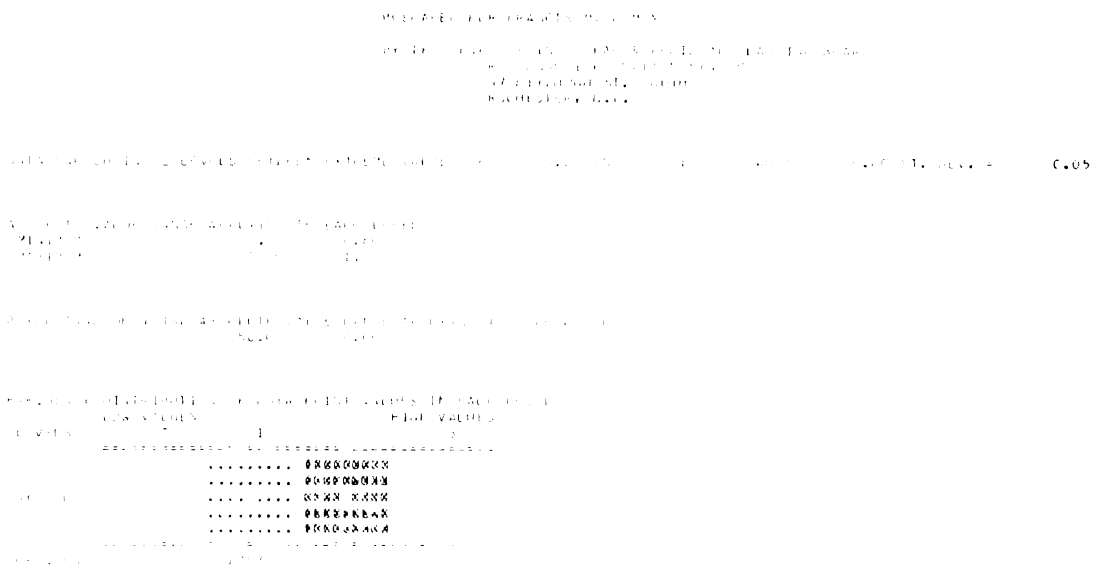


Table 18: Medium Property Tax Revenue Loss, Low Development Cost, and Medium Aesthetic Index

MAP TITLE

ALT

OBJECTIVES USED FOR THIS MAP

2 THE VERTEX LOCATOR = 11

Table 18 (cont'd.)

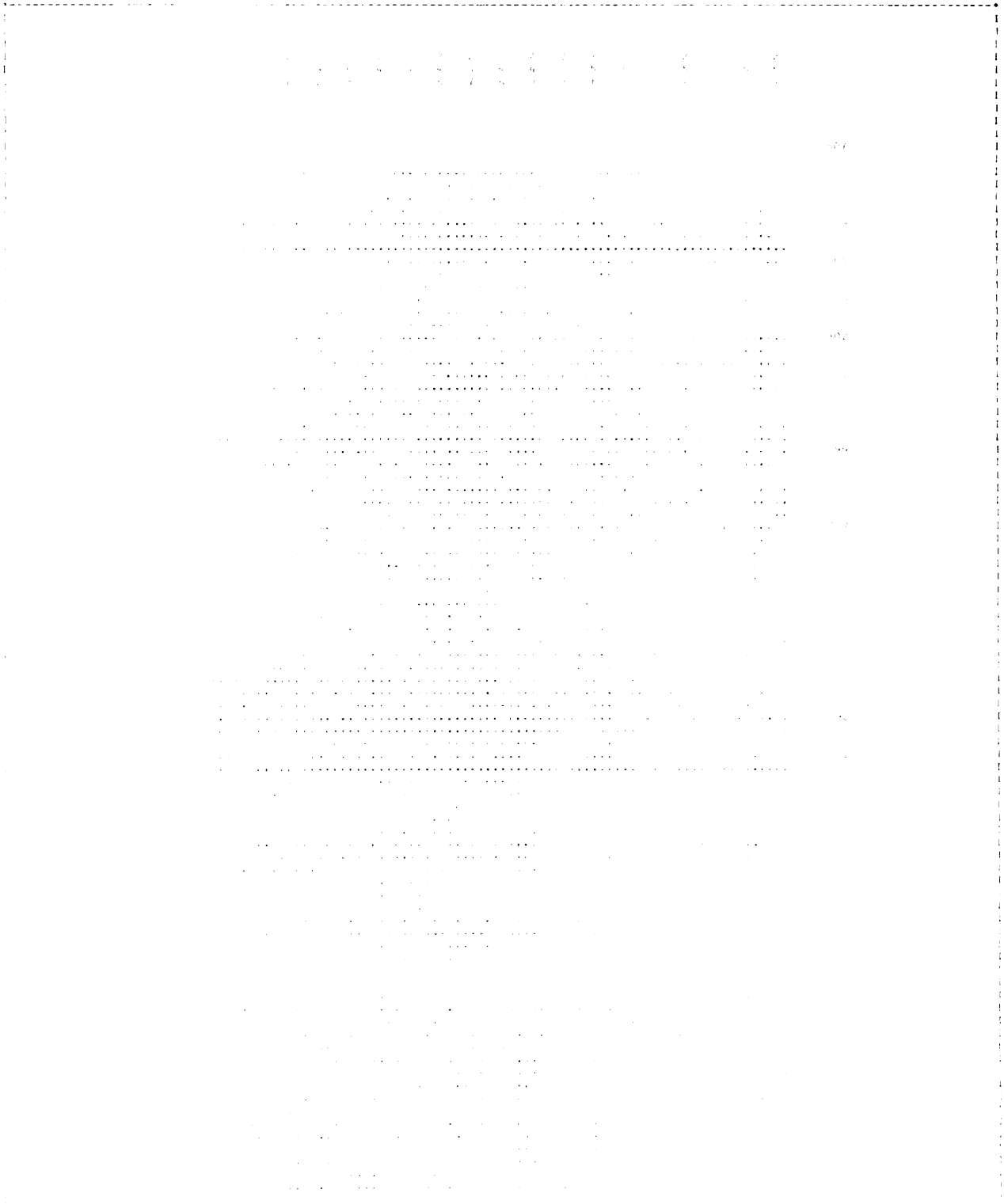


Table 18 (cont'd.)

Table 18 (cont'd.)

Table 19: Medium Property Tax Revenue Loss, Low Development Cost, and High Aesthetic Index

Table 19 (cont'd.)



Table 19 (cont'd.)

MAP 12,SHEET 1,DATA SET 1

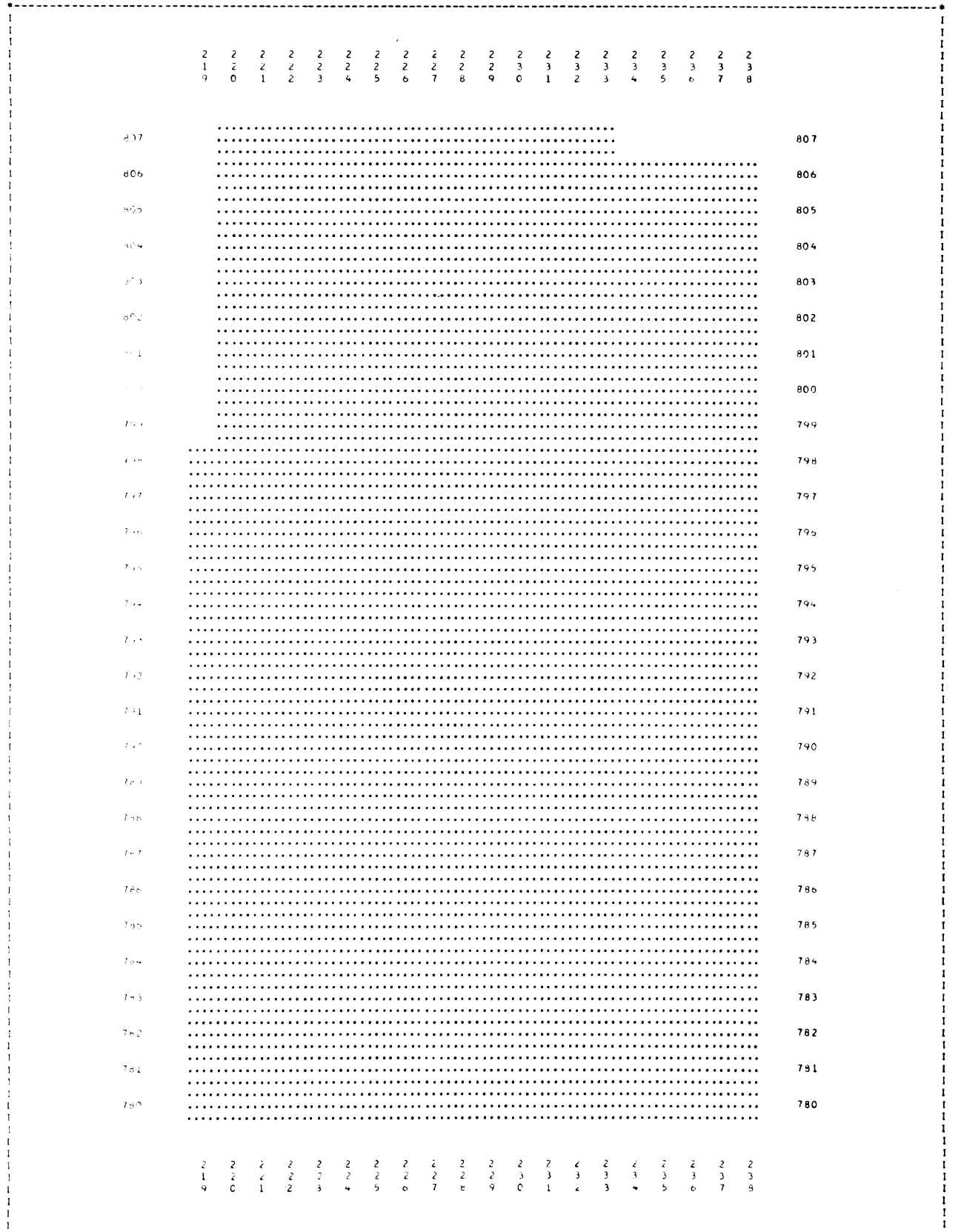


Table 19 (cont'd.)

Table 20: Medium Property Tax Revenue Loss, Medium Development Cost, and Low Aesthetic Index

Table 20 (cont'd.)

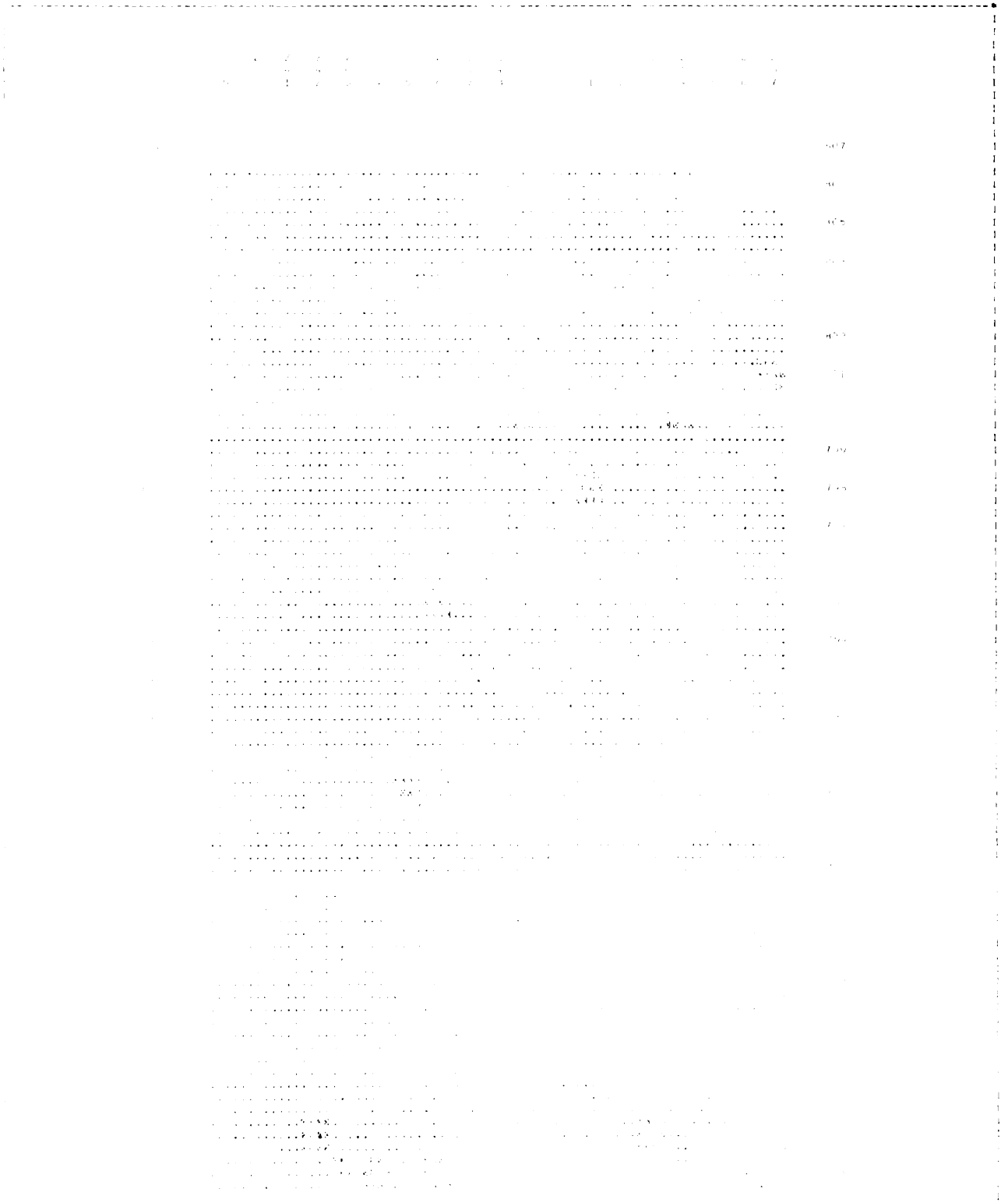


Table 20 (cont'd.)

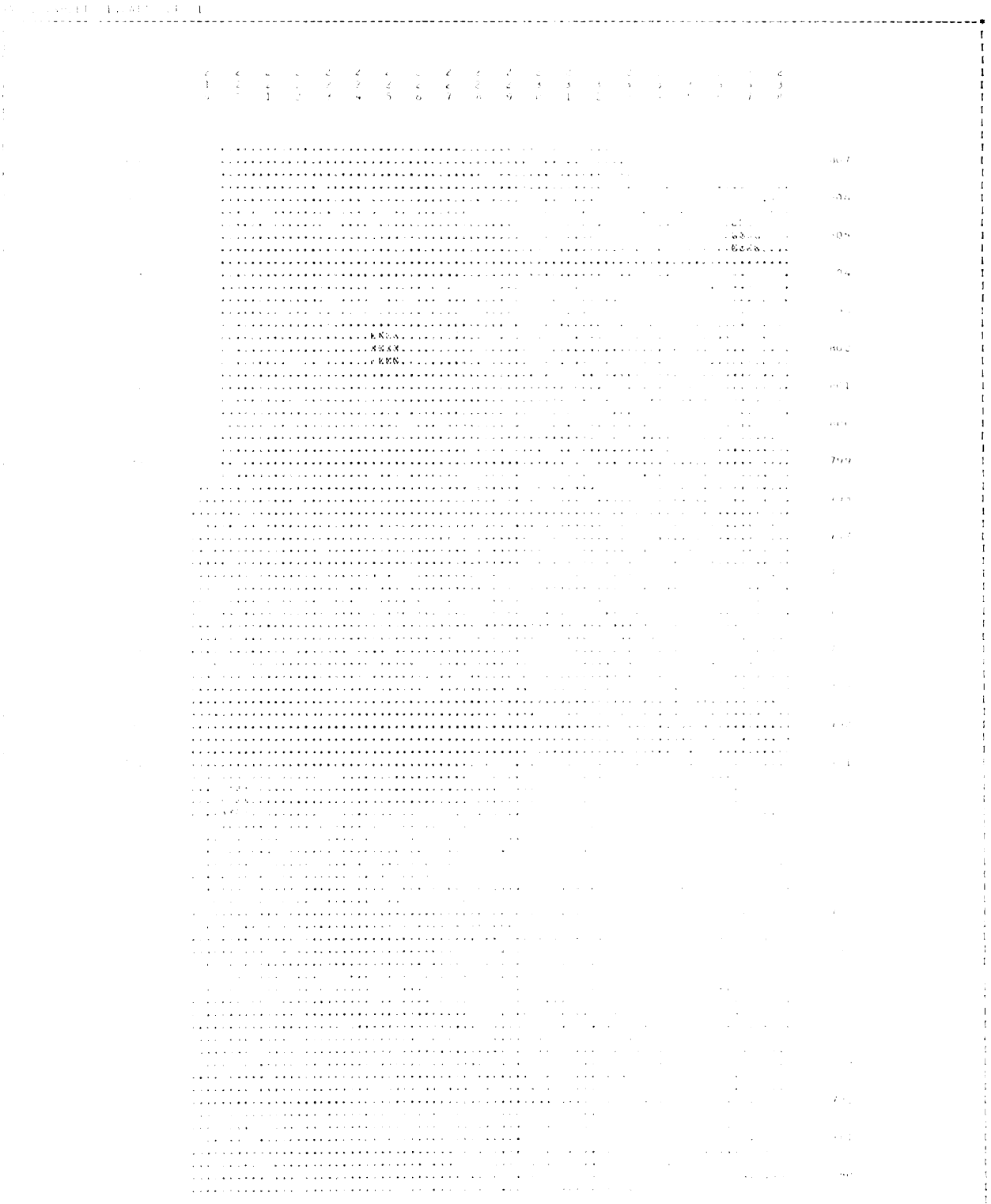


Table 20 (cont'd.)

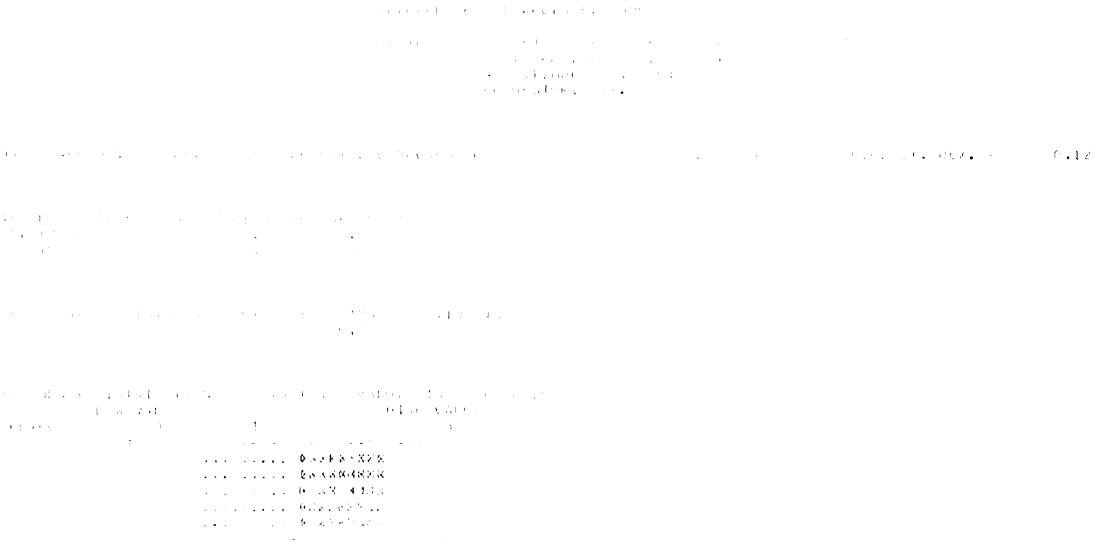


Table 21: Medium Property Tax Revenue Loss, Medium Development Cost, and Medium Aesthetic Index

MAP TITLE

MMM

OBJECTIVES USED FOR THIS MAP

2 THE FLEXIN LOCATION = 14

Table 21 (cont'd.)

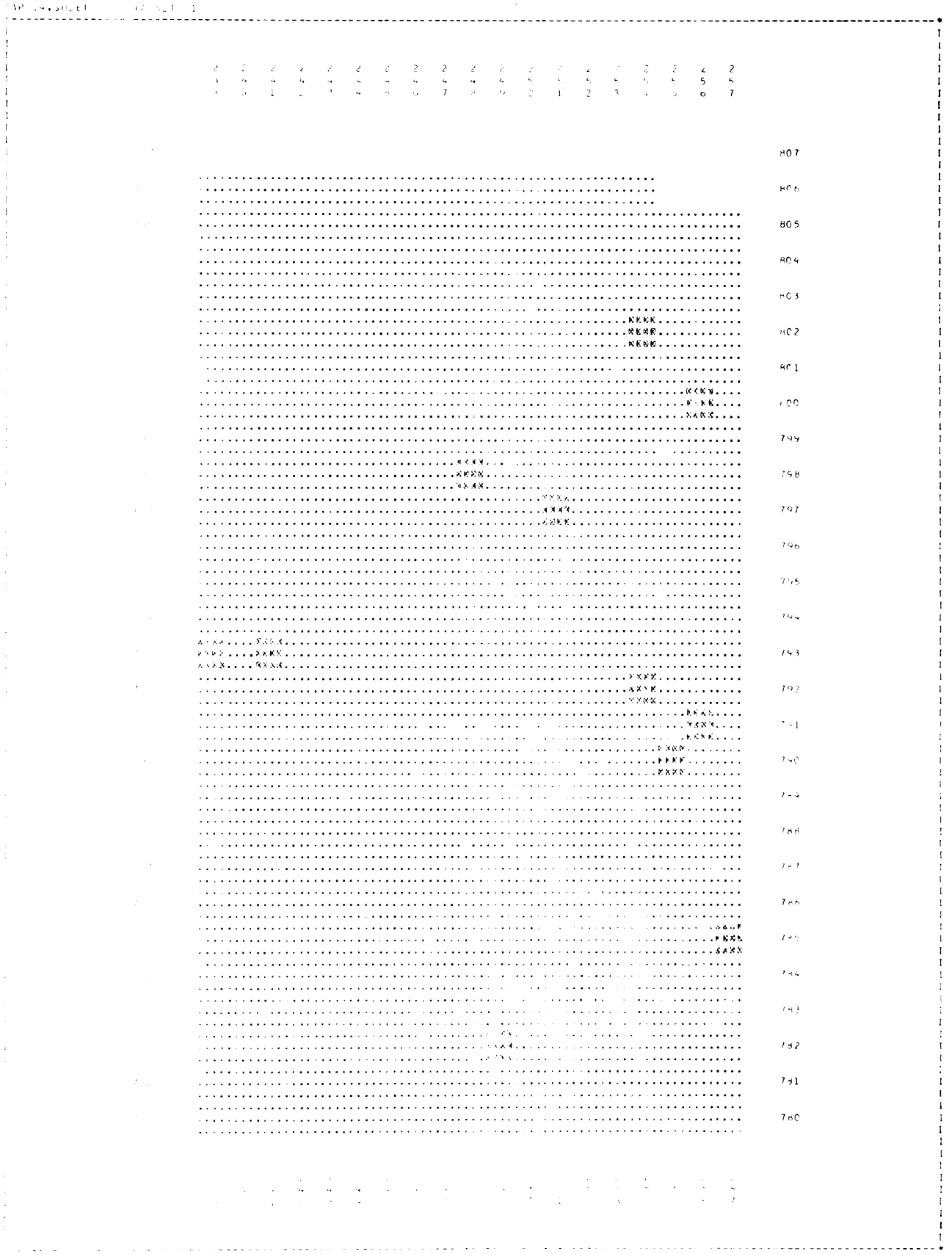


Table 21 (cont'd.)

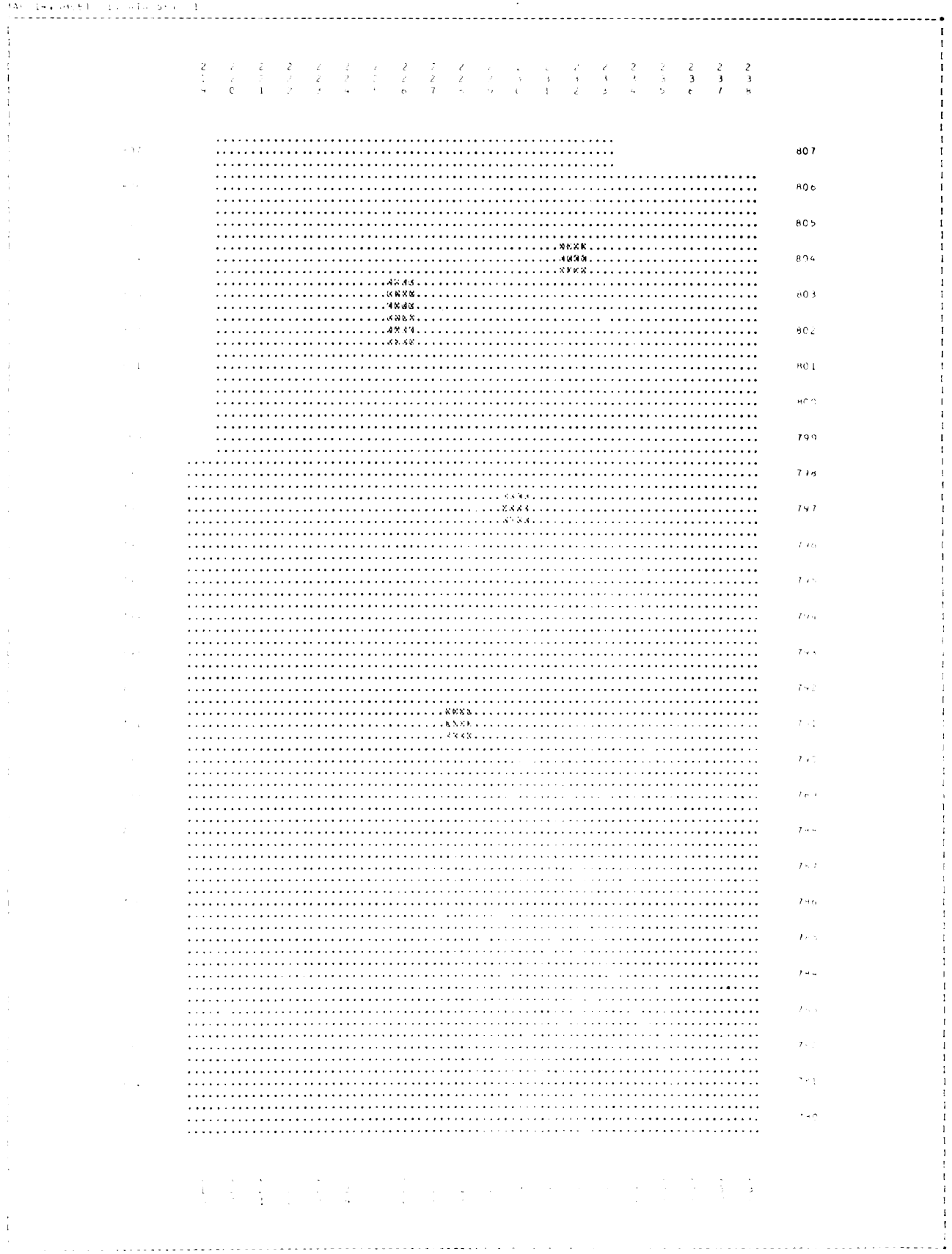


Table 21 (cont'd.)

PREPARED FOR FRANCIS V. DEMUY

BY THE GENESEE/FINGER LAKES REGIONAL PLANNING BOARD
REGIONAL INFORMATION SYSTEM
47 FITZHUGH ST. SOUTH
ROCHESTER, N.Y.

DATA MAPPED IN 2 LEVELS BETWEEN EXTREME VALUES OF 0.0 AND 1.20 MEAN = 0.02 ST. DEV. = 0.12

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

MINIMUM	0.0	0.66
MAXIMUM	0.66	1.20

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

50.00 50.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

	LOW VALUES		HIGH VALUES	
LEVELS	0	1	2	3
SYMBOLS	.....	.....	#####	#####
	.....	.....	#####	#####
	....	....	####	####
	.....	.....	#####	#####
	.....	.....	#####	#####
FREQUENCY	0	1040	16	0

Table 22: Medium Property Tax Revenue Loss, Medium Development Cost, and High Aesthetic Index

Table 22 (cont'd.)

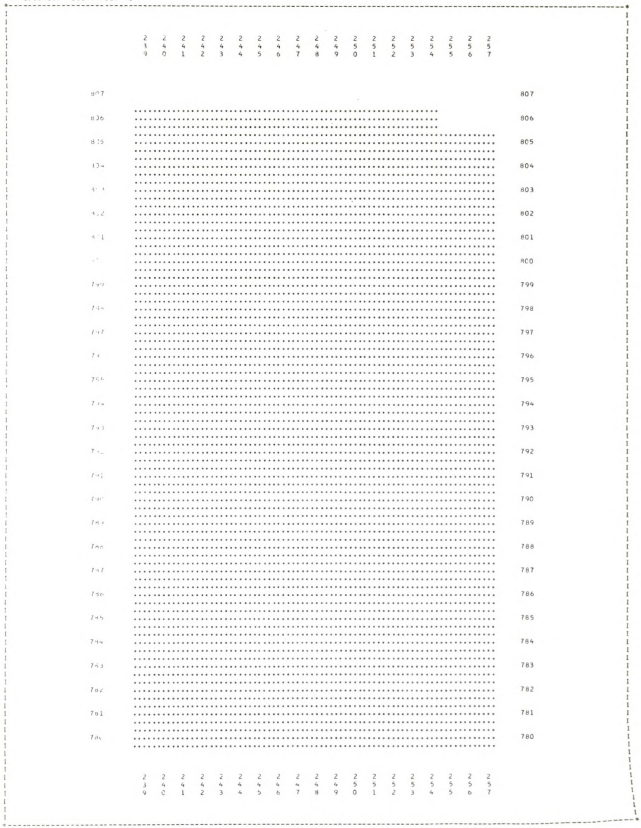


Table 22 (cont'd.)

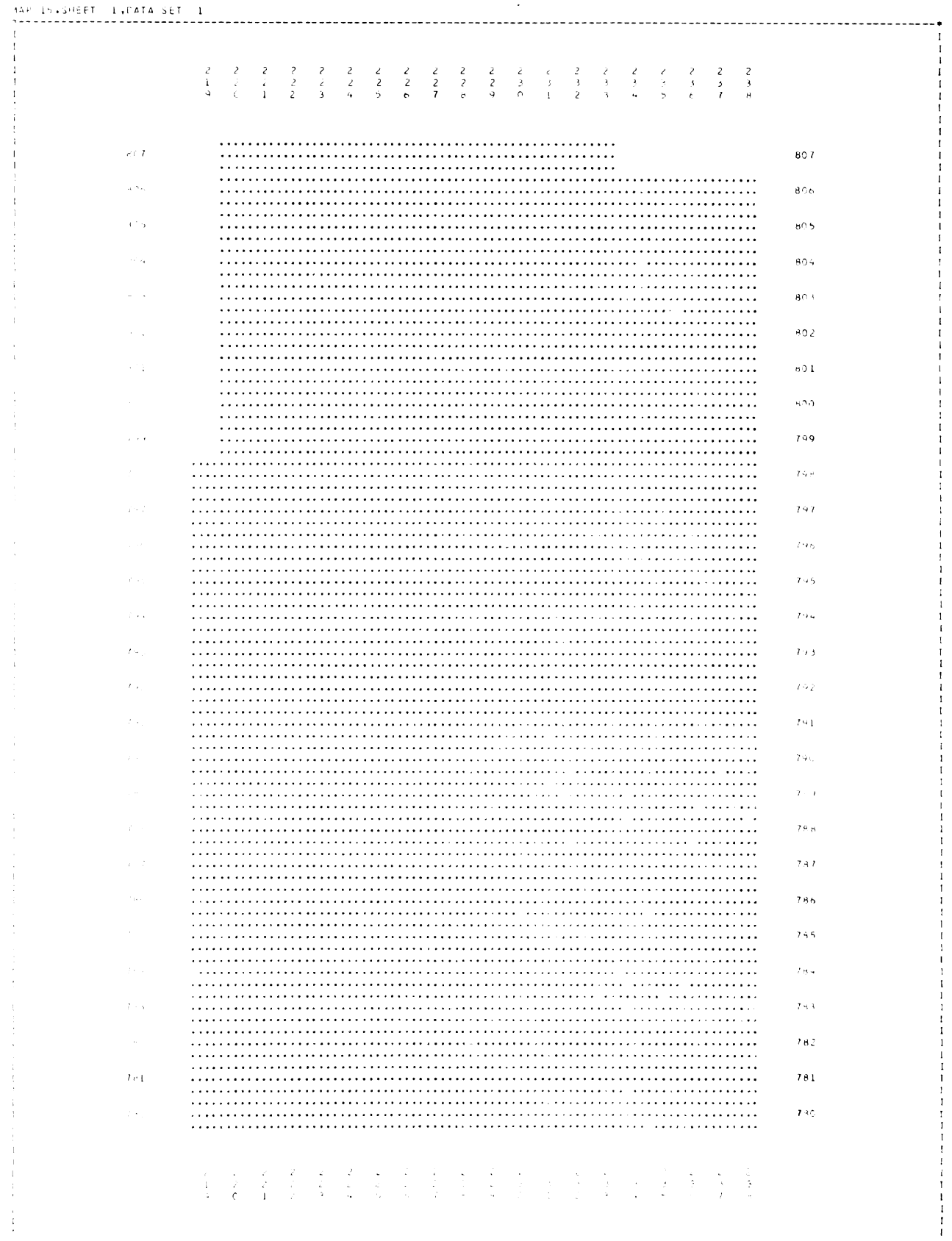


Table 22 (cont'd.)

Table 23: Medium Property Tax Revenue Loss, High Development Cost, and Low Aesthetic Index

Table 23 (cont'd.)

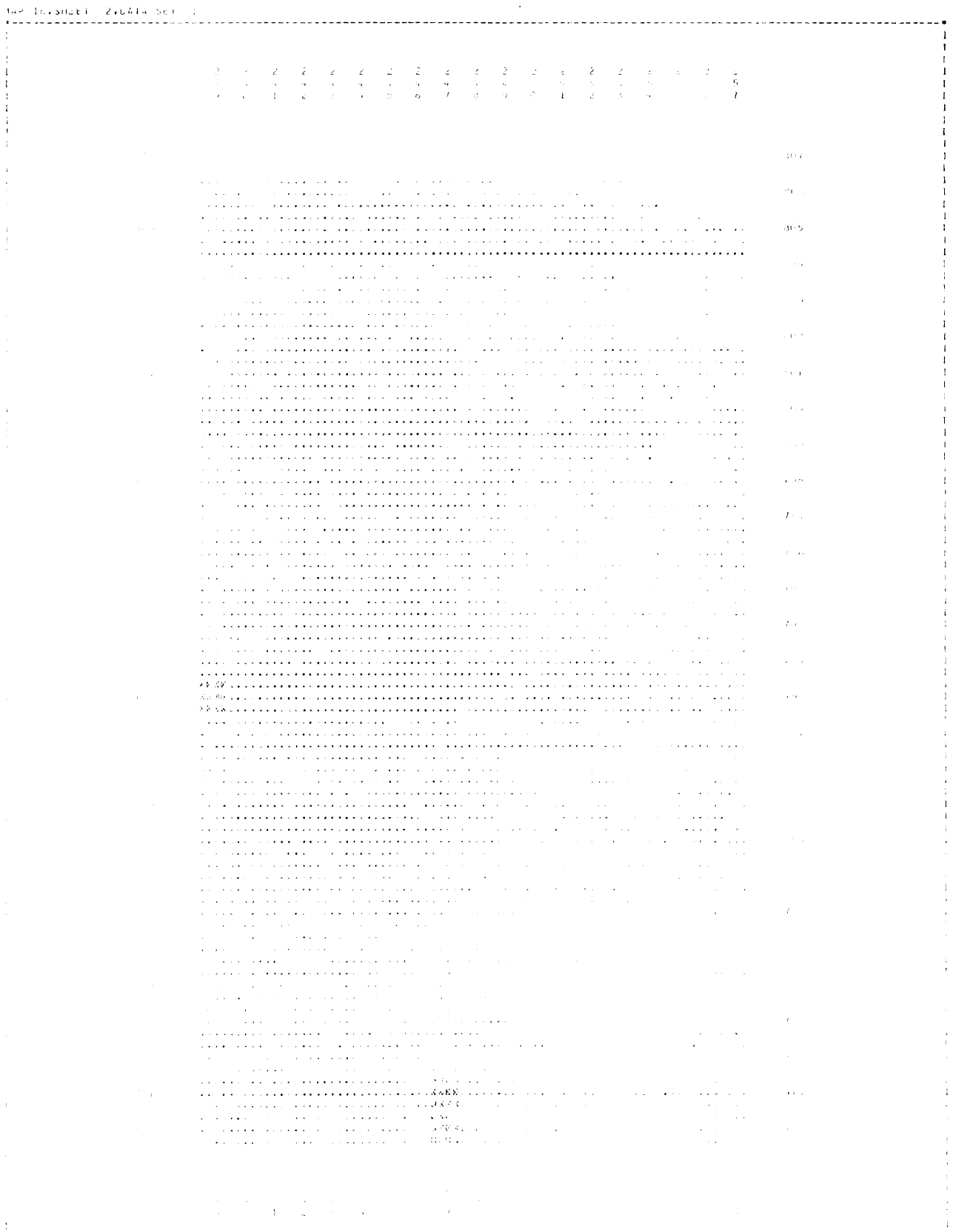


Table 23 (cont'd.)

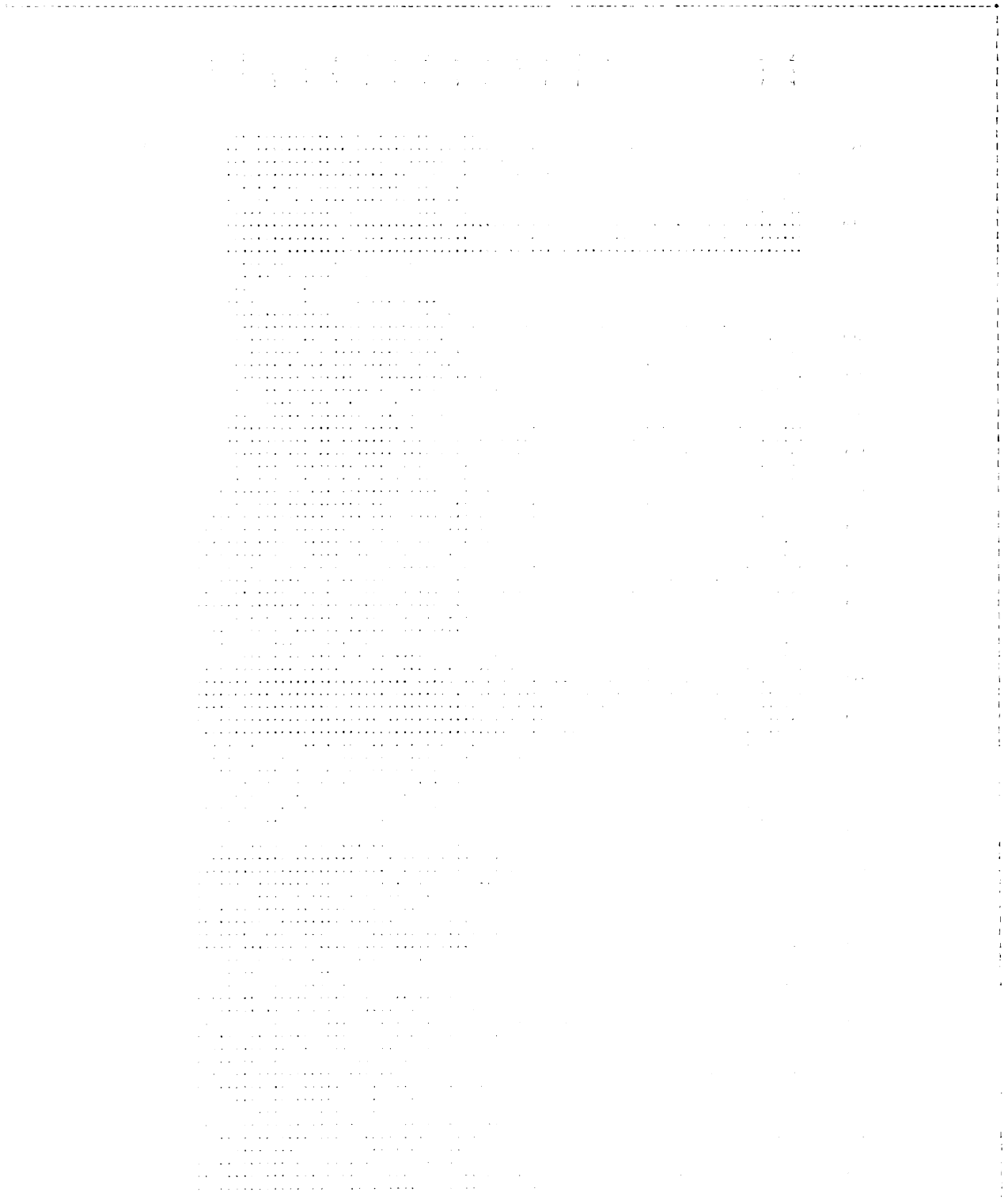


Table 23 (cont'd.)

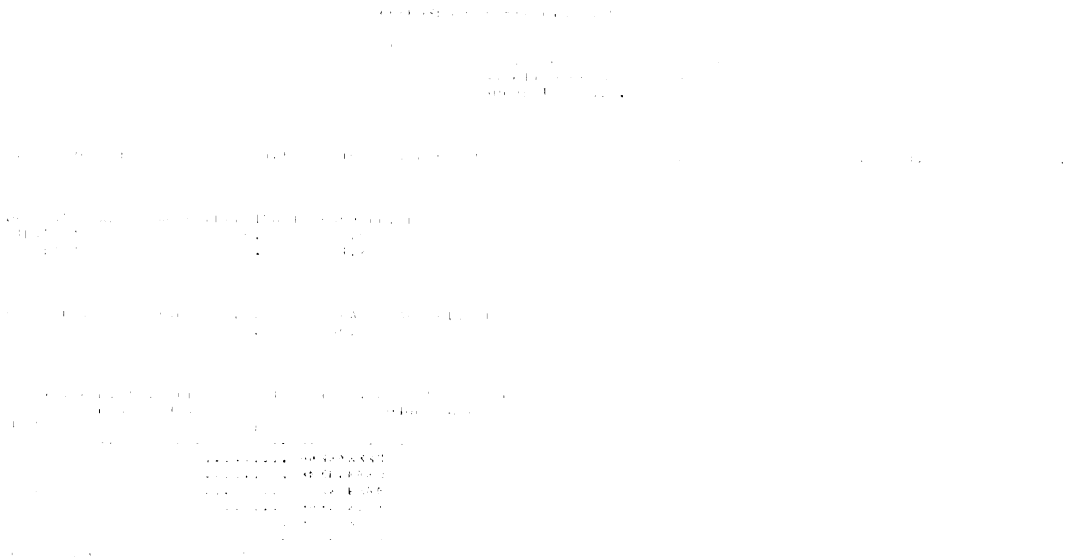


Table 24: Medium Property Tax Revenue Loss, High Development Cost, and Medium Aesthetic Index

MAP TITLE

AHM

OBJECTIVES USED FOR THIS MAP

2 THE ELEVATION LOCATION = 17

Table 24 (cont'd.)

MAP 17.SHEET 2.DATA SET 1

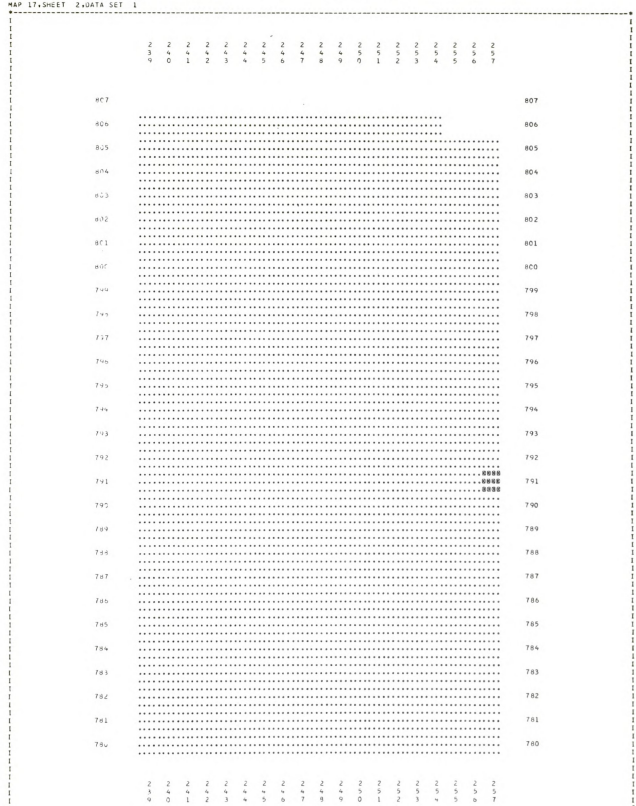


Table 24 (cont'd.)

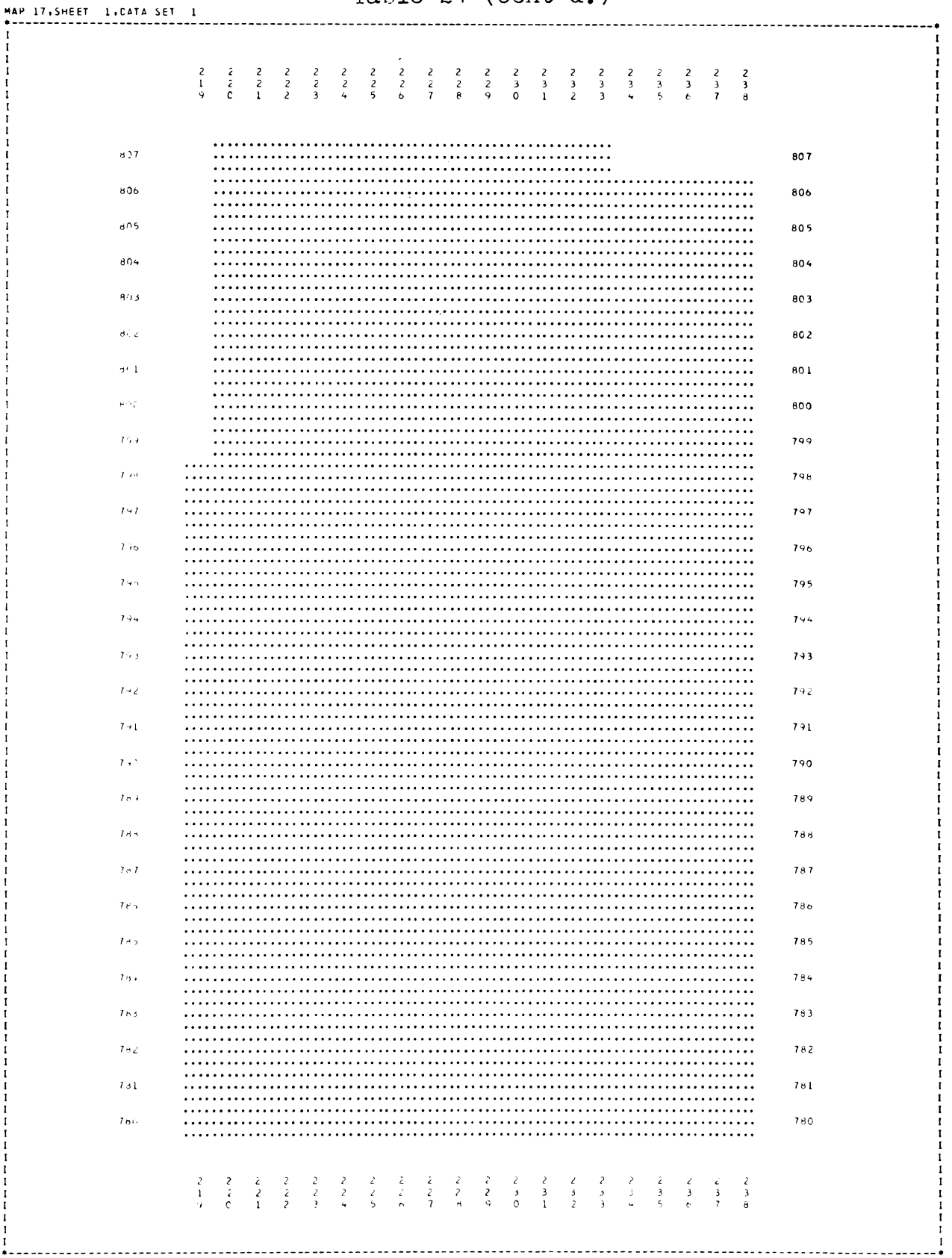


Table 24 (cont'd.)

PREPARED FOR FRANCIS M. DUMOY

BY THE GENESEE/FINGER LAKES REGIONAL PLANNING BOARD
REGIONAL INFORMATION SYSTEM
47 FITZHUGH ST. SOUTH
ROCHESTER, N.Y.

DATA MAPPED IN 2 LEVELS BETWEEN EXTREME VALUES OF 0.0 AND 1.20 MEAN = 0.00 ST. DEV. = 0.03

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

MINIMUM	0.0	0.60
MAXIMUM	0.60	1.20

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

50.00 50.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

	LOW VALUES		HIGH VALUES	
LEVELS	0	1	2	3
SYMBOLS		..... #####		
		..... #####		
		.... #### ####		
		..... #####		
		..... #####		
FREQUENCY	0	1055	1	0

Table 25: Medium Property Tax Revenue Loss, High Development Cost, and High Aesthetic Index

Table 25 (cont'd.)



Table 25 (cont'd.)



Table 25 (cont'd.)

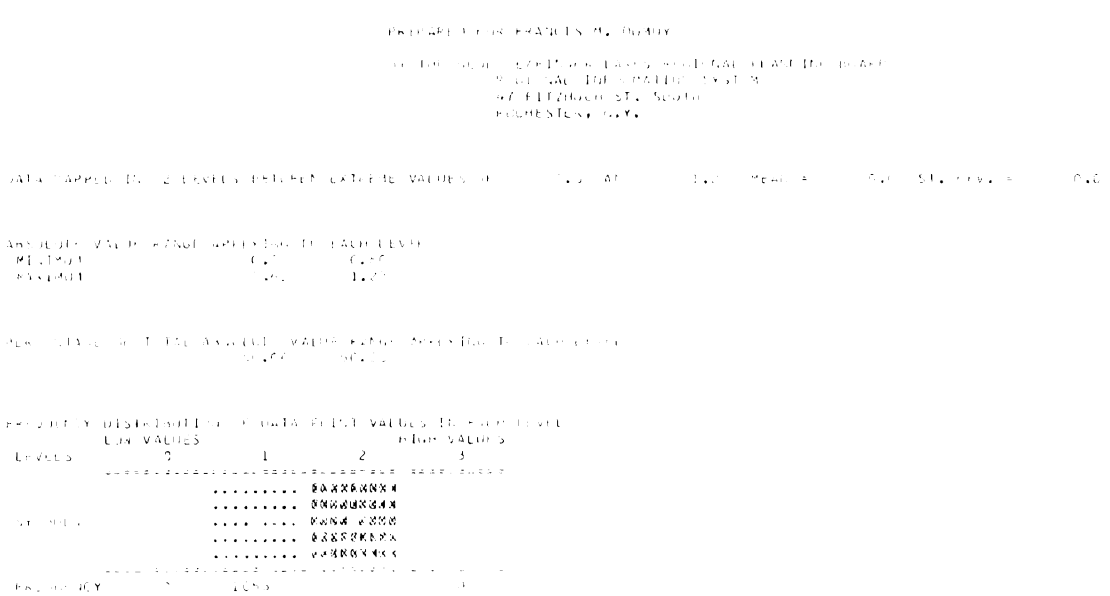


Table 26: High Property Tax Revenue Loss, Low Development Cost, and Low Aesthetic Index

Table 26 (cont'd.)



Table 26 (cont'd.)

MAP 19,SHEET 1,DATA SET 1

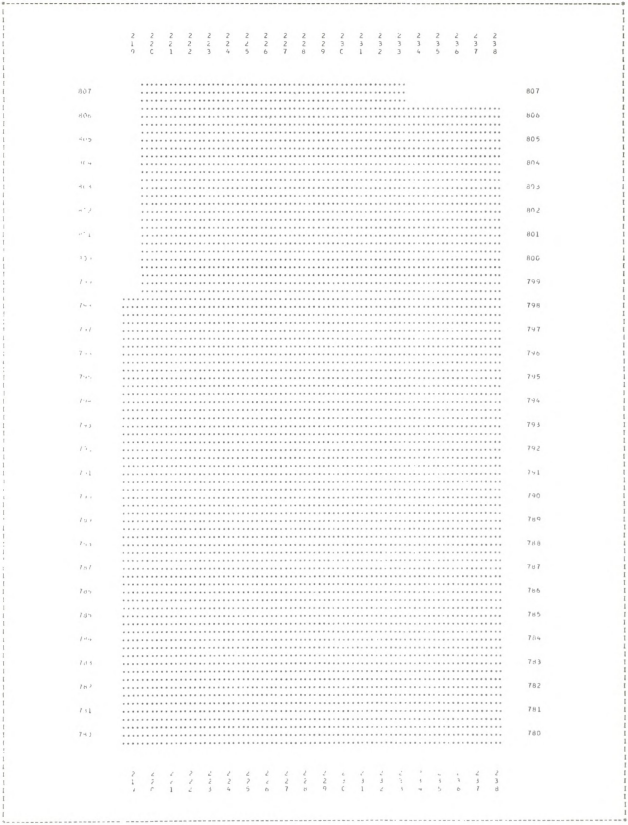


Table 26 (cont'd.)

Table 27: High Property Tax Revenue Loss, Low Development Cost, and Medium Aesthetic Index

Table 27 (cont'd.)

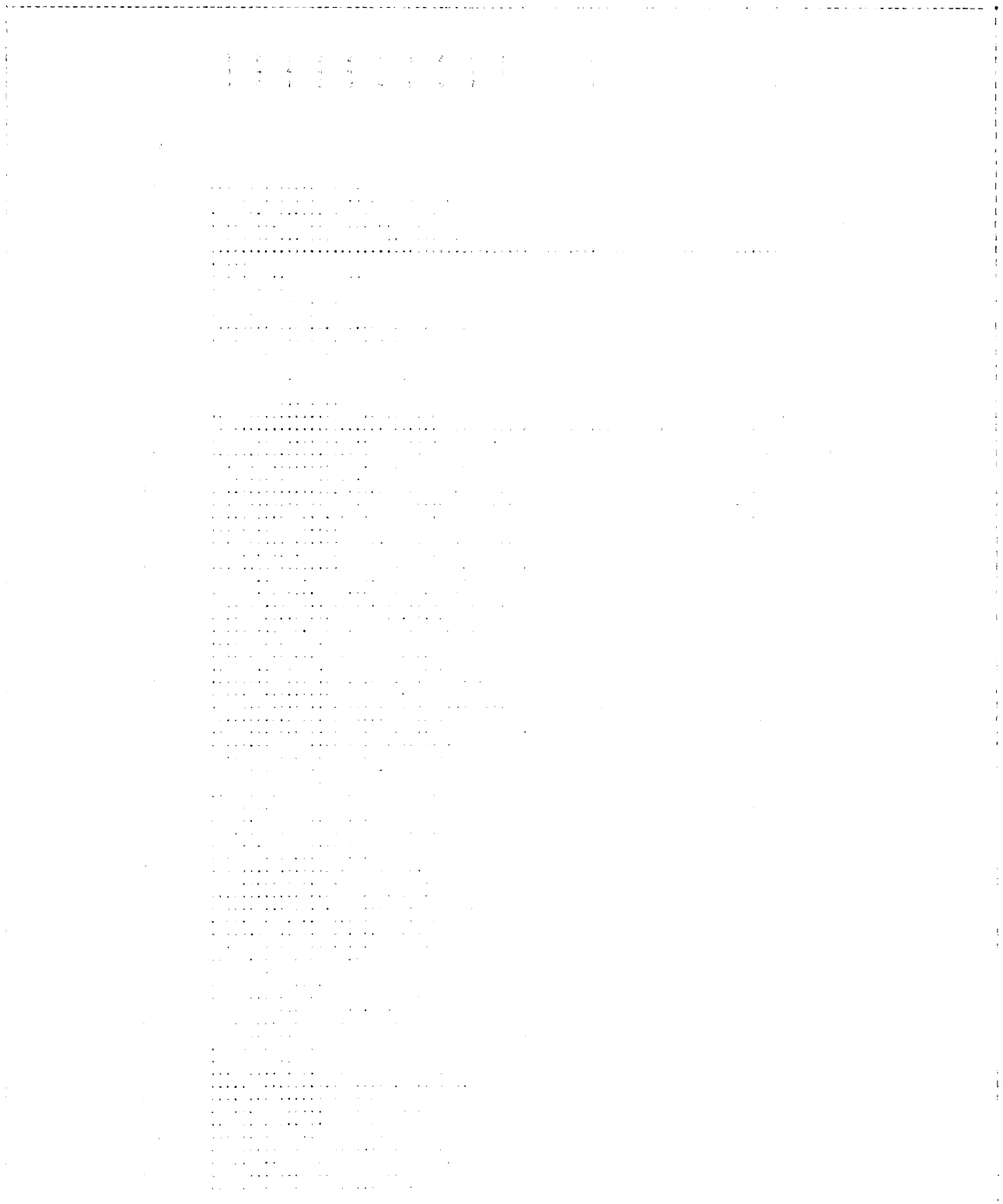


Table 27 (cont'd.)

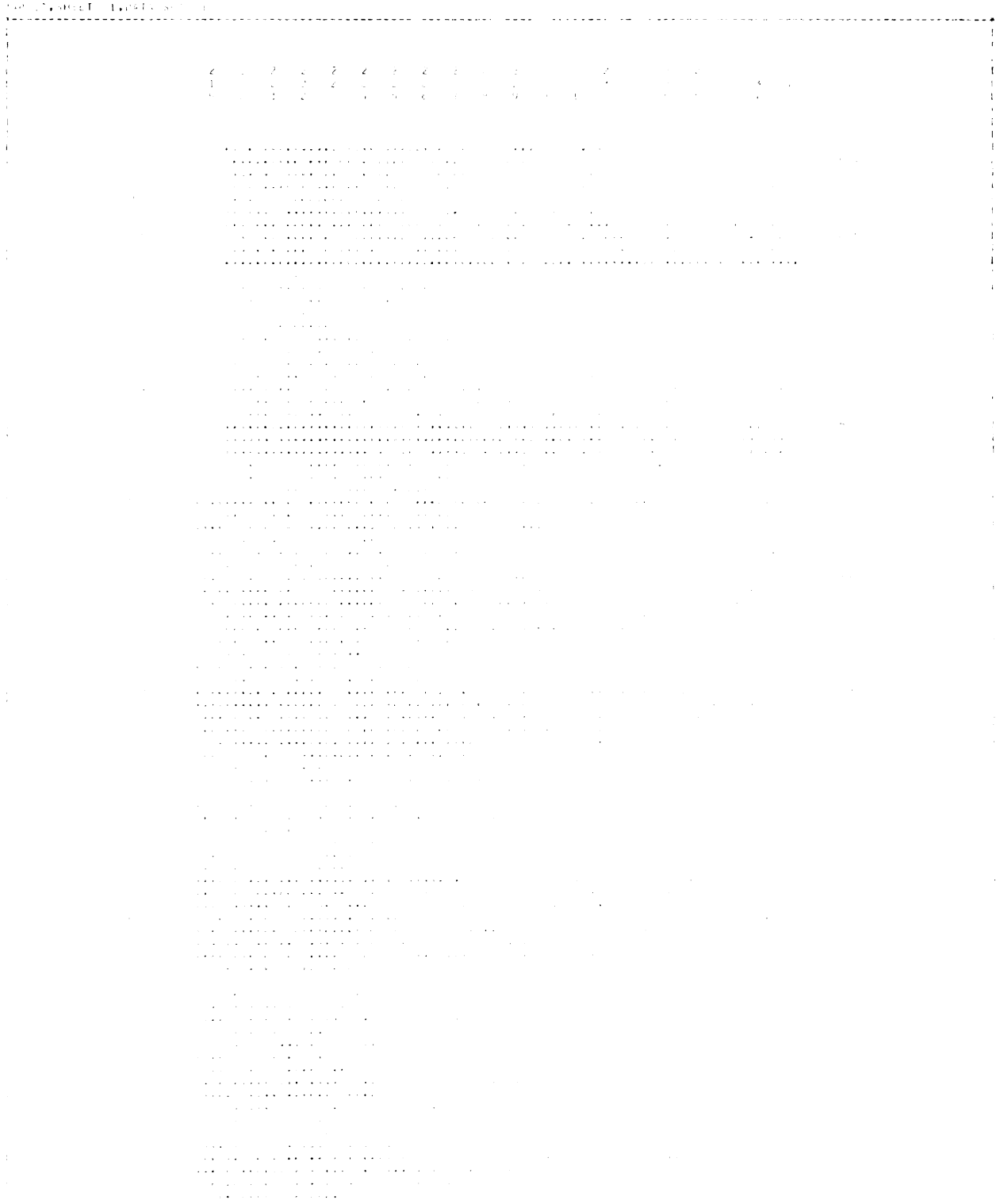


Table 27 (cont'd.)

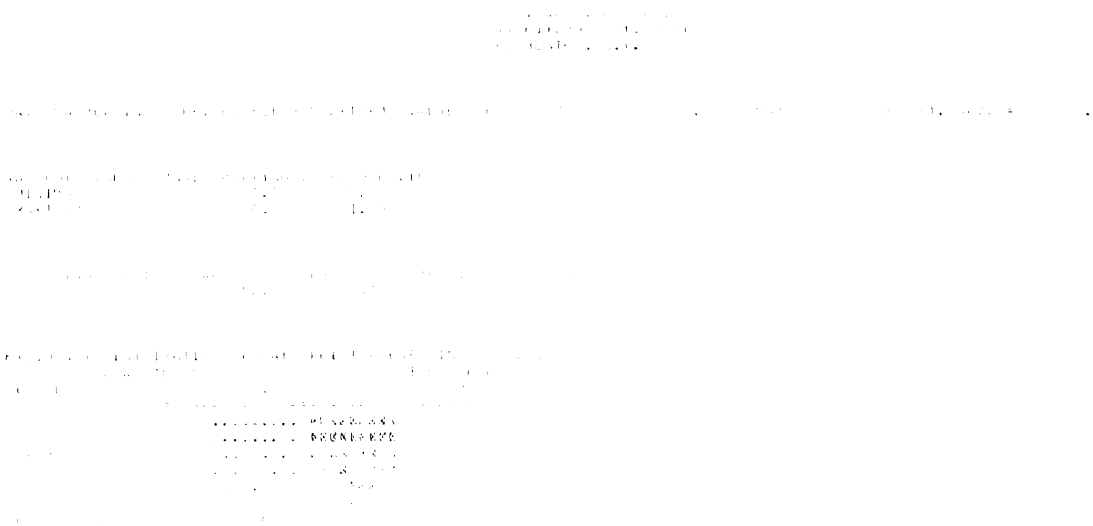


Table 28: High Property Tax Revenue Loss, Low Development Cost, and High Aesthetic Index

Table 28 (cont'd.)



Table 28 (cont'd.)



Table 28 (cont'd.)

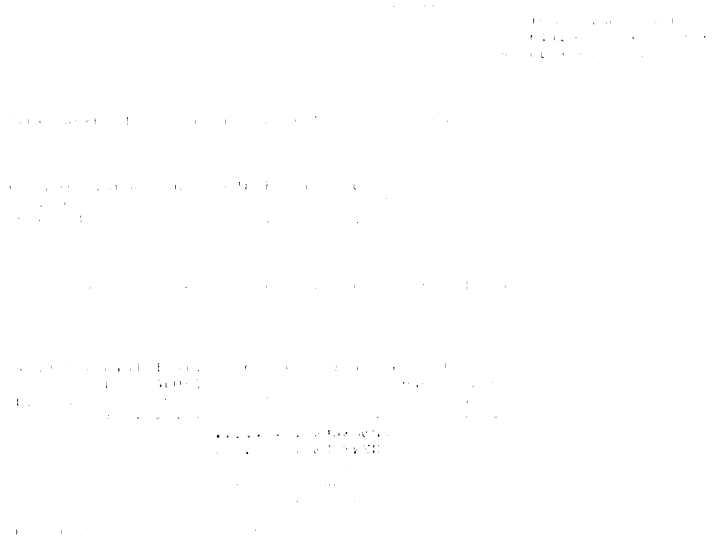


Table 29: High Property Tax Revenue Loss, Medium Development Cost, and Low Aesthetic Index

Table 29 (cont'd.)

MAP 22,SHEET 2,DATA SET 1

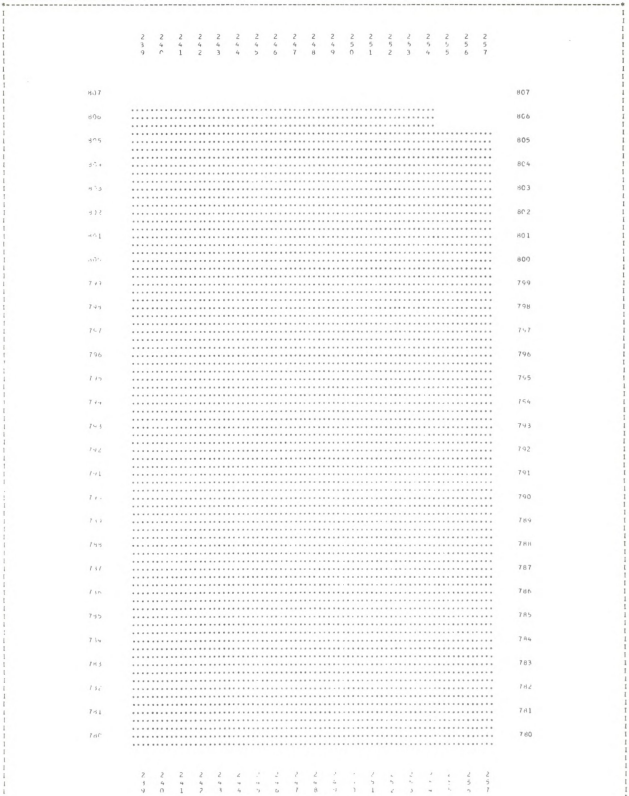


Table 29 (cont'd.)

MAP 22,SHEET 1,DATA SET 1

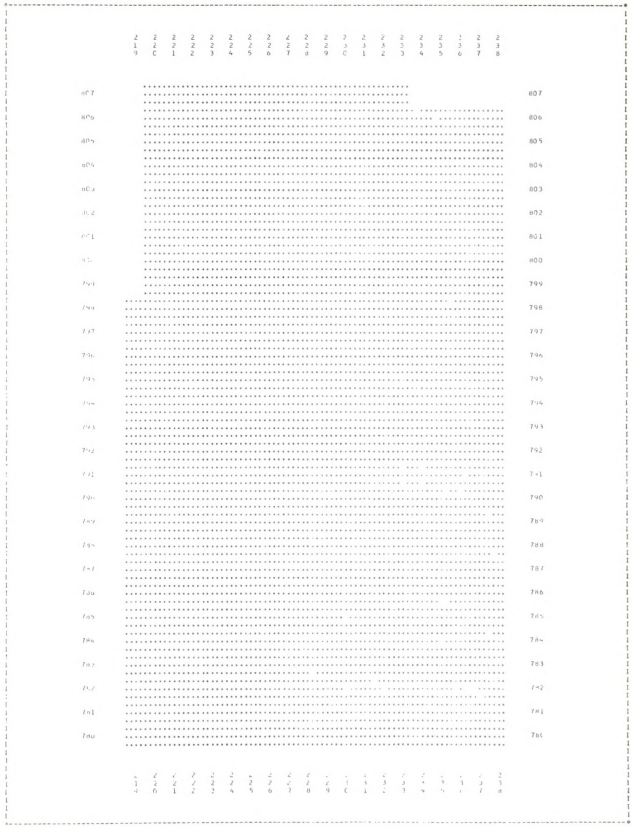


Table 29 (cont'd.)

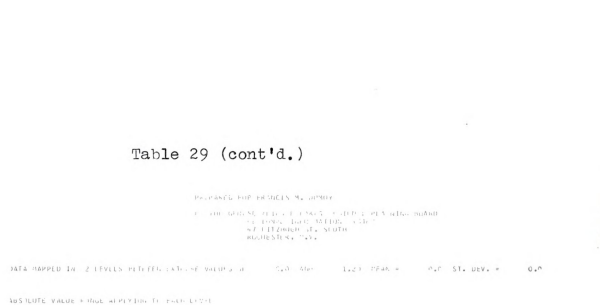


Table 30: High Property Tax Revenue Loss, Medium Development Cost, and Medium Aesthetic Index

Table 30 (cont'd.)

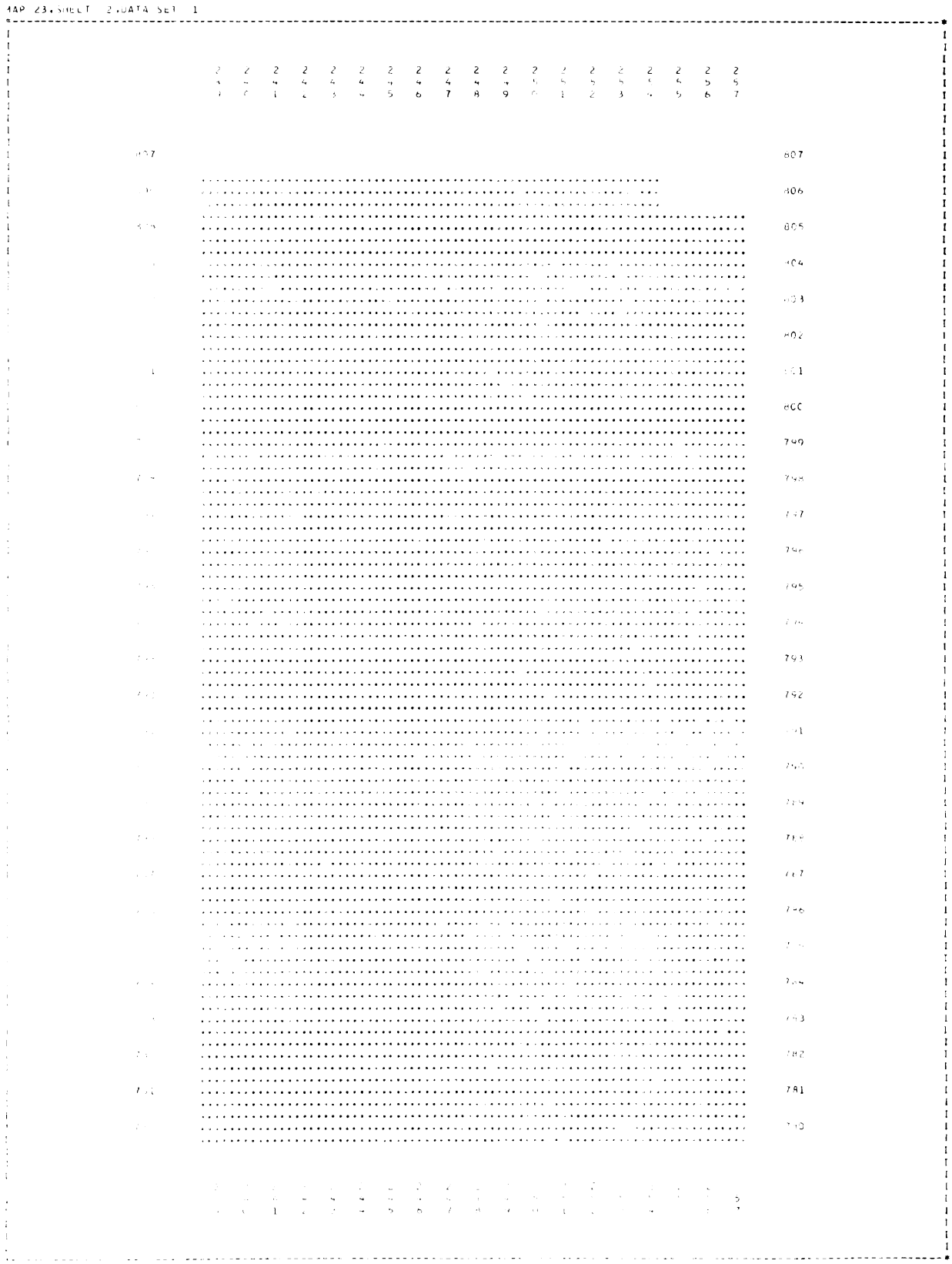


Table 30 (cont'd.)



Table 30 (cont'd.)

PREPARED FOR FRANCES M. DUMLY

BY THE GREATER FINGER LAKES REGIONAL PLANNING BOARD
REGIONAL INFORMATION SYSTEM
47 FITZHUGH ST. SOUTH
ROCHESTER, N.Y.

DATA MAPPED IN 2 LEVELS BETWEEN EXTREME VALUES OF .2 AND 1.2 MEAN = .6 ST. DEV. = .6

ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

MINIMUM	.2	.8
MAXIMUM	.8	1.2

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

	50.0 50.0

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

LEVELS	LOW VALUES	1	2	HIGH VALUES 3
SYMBOLS		.....	.....	#####
		.....	.....	#####
		....	.....	####
		.....	.....	#####
		.....	.....	#####
FREQUENCY	0	10%	0	0

Table 31: High Property Tax Revenue Loss, Medium Development Cost, and High Aesthetic Index

MAP TITLE

HMH

OBJECTIVES USED FOR THIS MAP

2 THE PEIKIN LOCATION = 24

Table 31 (cont'd.)

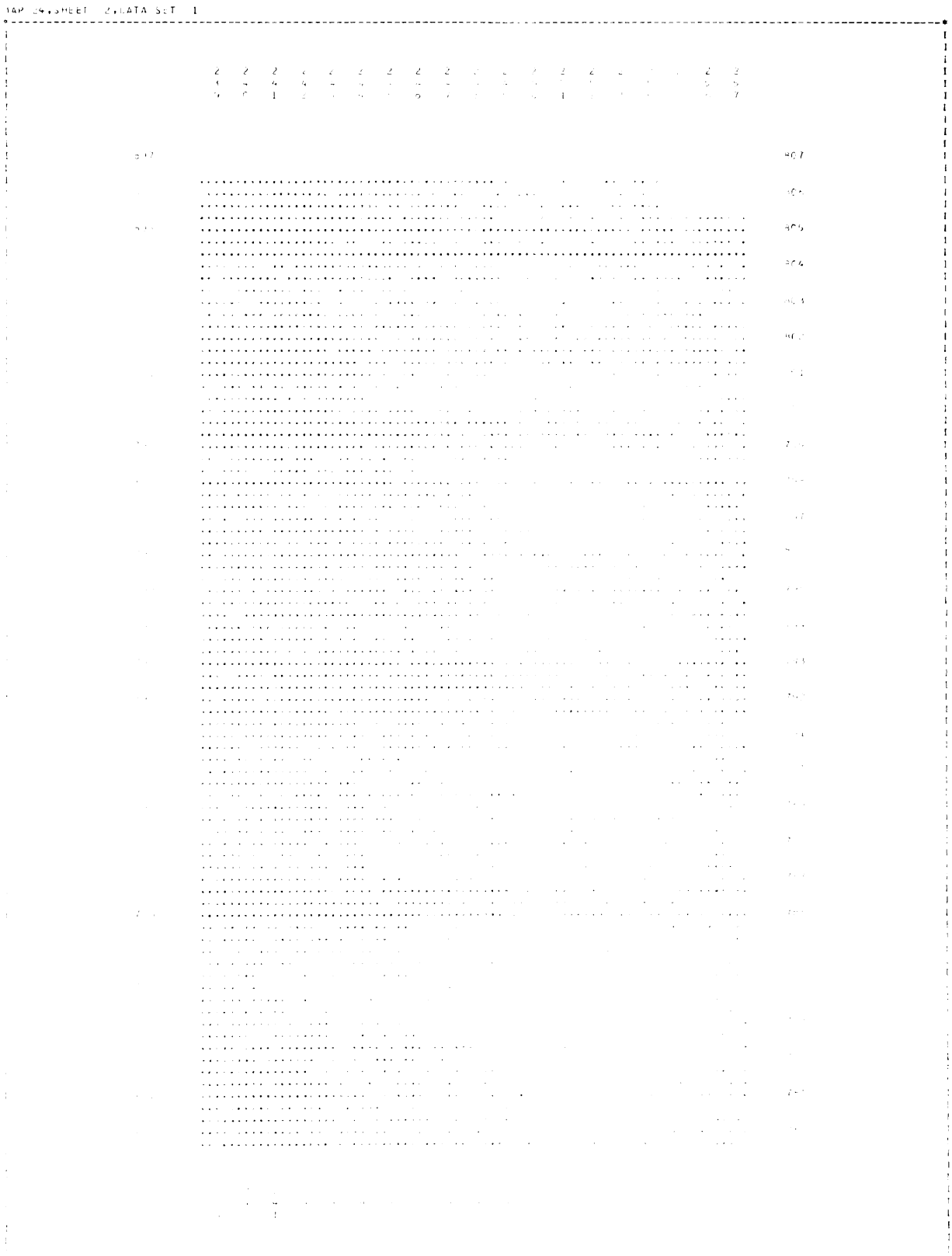


Table 31 (cont'd.)



Table 31 (cont'd.)

Table 32: High Property Tax Revenue Loss, High Development Cost, and Low Aesthetic Index

Table 32 (cont'd.)

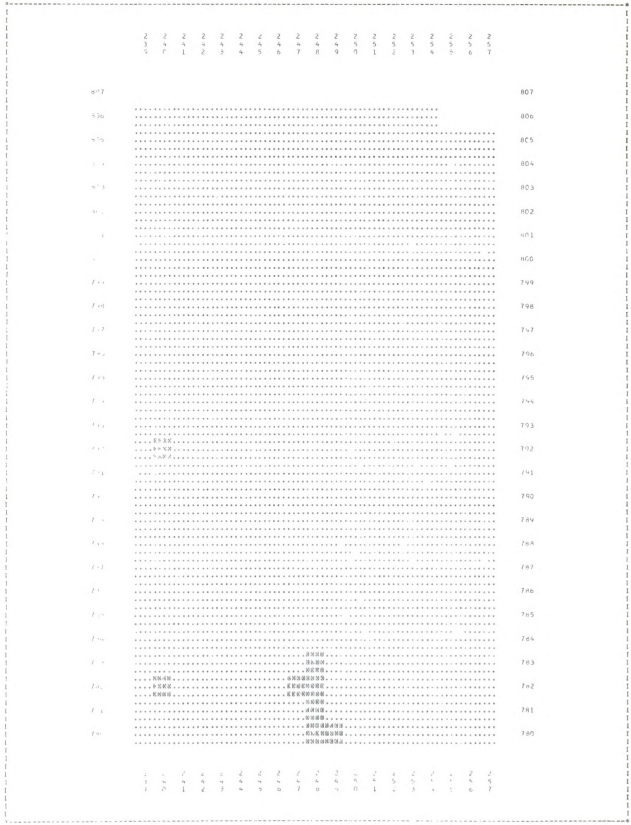


Table 32 (cont'd.)

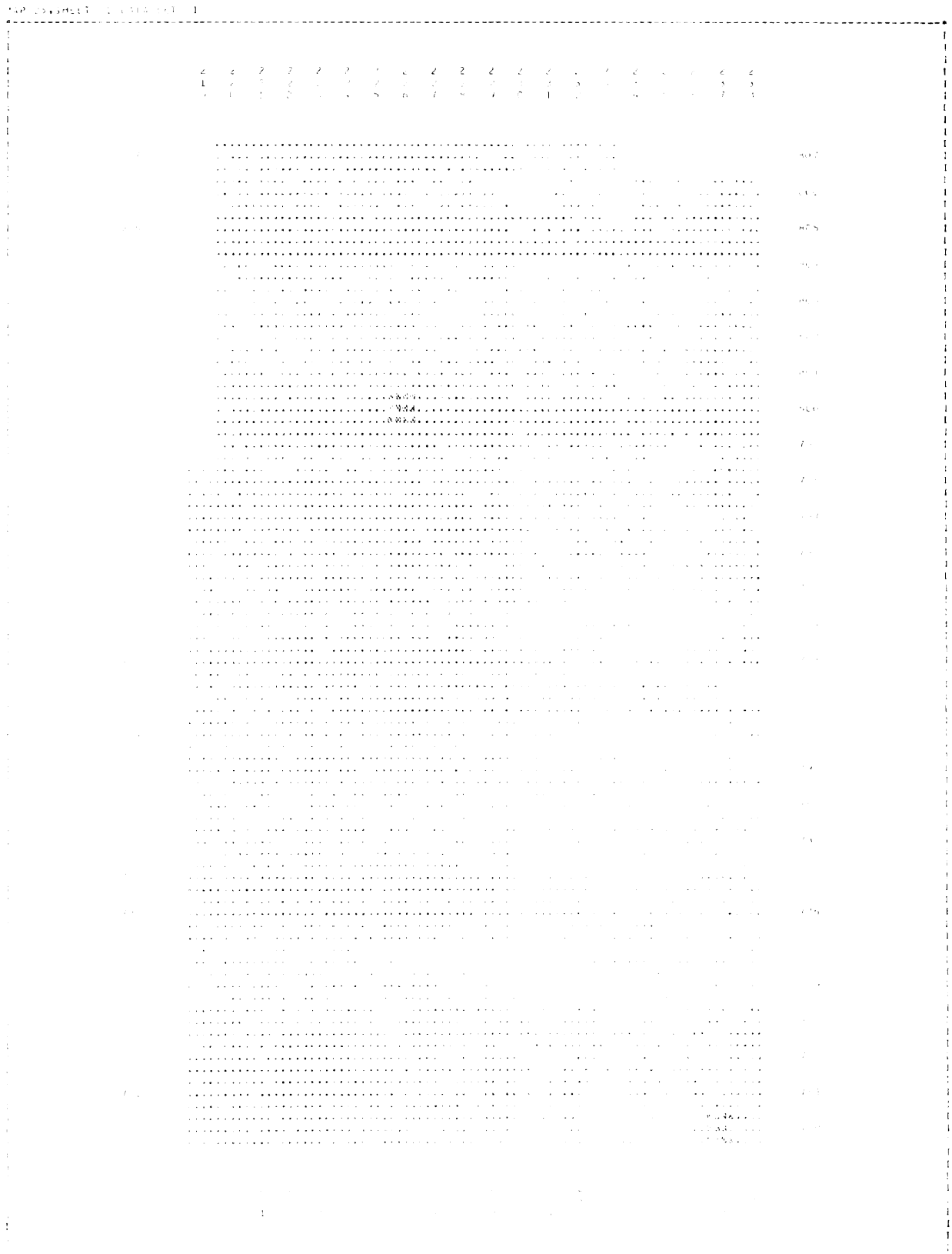


Table 32 (cont'd.)

Table 33: High Property Tax Revenue Loss, High Development Cost, and Medium Aesthetic Index

Table 33 (cont'd.)

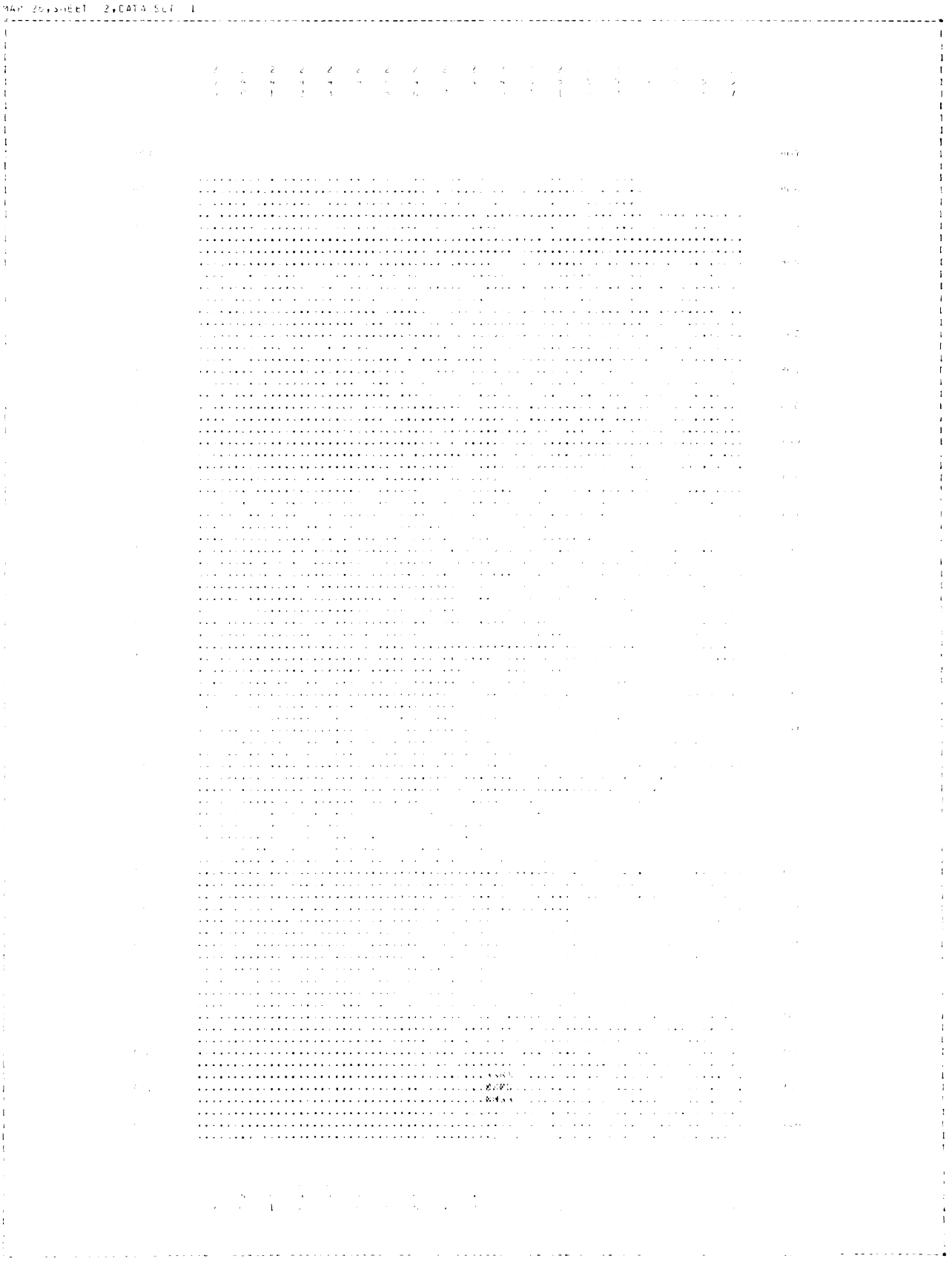


Table 33 (cont'd.)

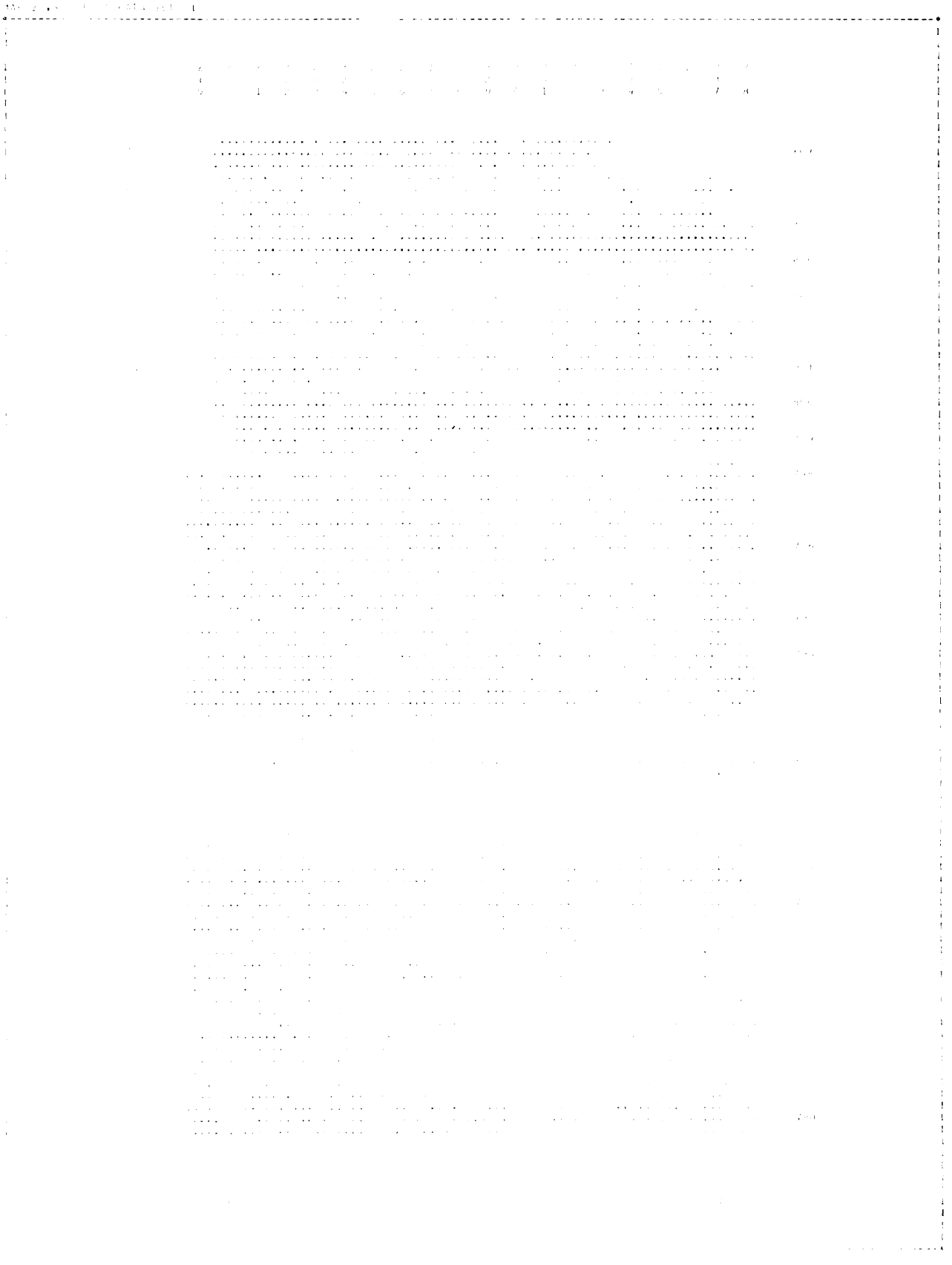


Table 33 (cont'd.)

Table 34: High Property Tax Revenue Loss, High Development Cost, and High Aesthetic Index

Table 34 (cont'd.)



Table 34 (cont'd.)

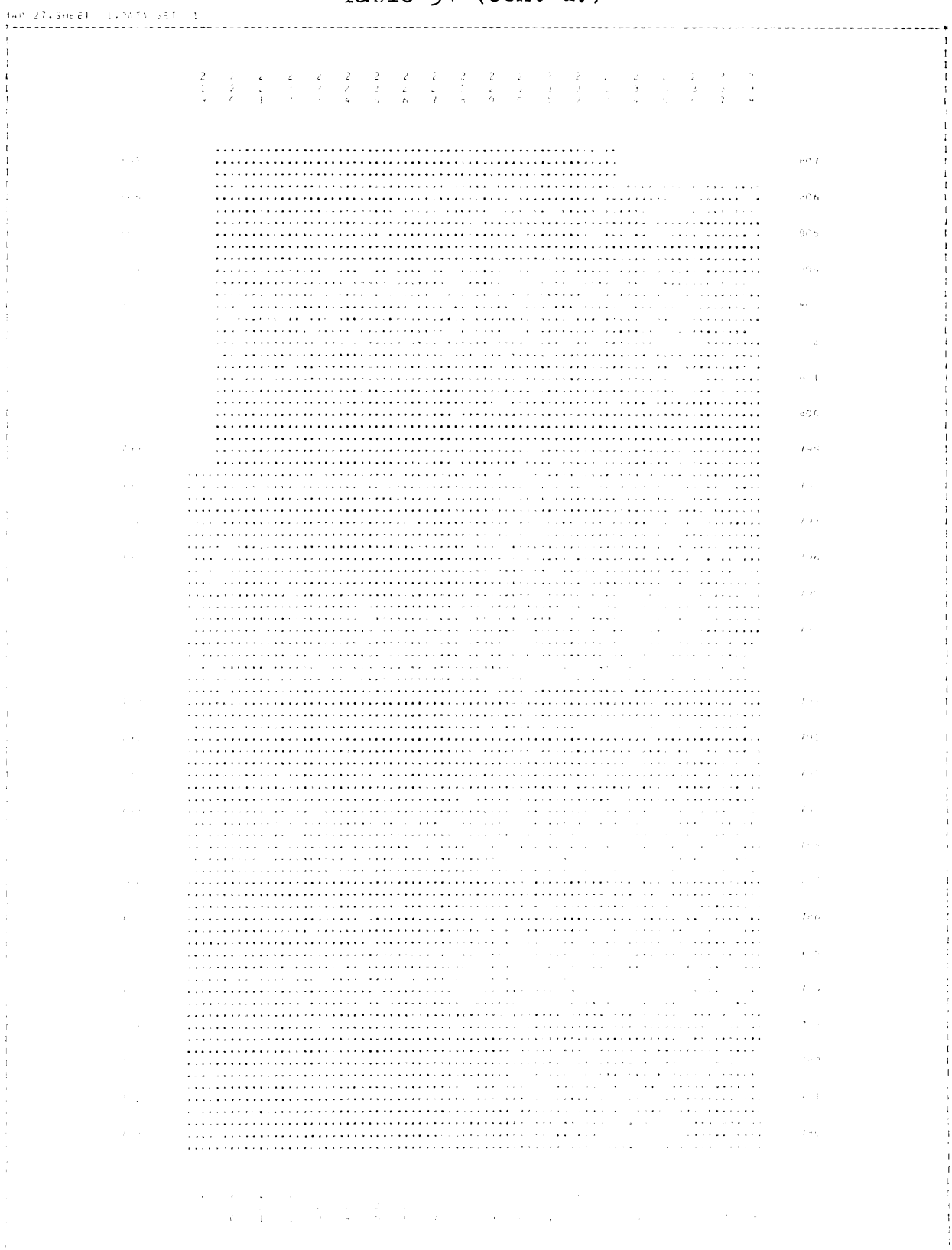


Table 34 (cont'd.)

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