THE IMPACT OF ELECTRIC TRANSMISSION LINES ON SUBURBAN AREAS: A CASE STUDY IN SURREY, BRITISH COLUMBIA

by

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ABSTRACT

The central problem which overhead electric transmission lines pose for suburban areas is that right of way location decisions made in earlier years have influenced, and sometimes determined, the present overall pattern of suburban development and especially its residential aspects. The study is therefore limited to considerations of the impact on residential areas. The result has been that past decisions made by one agency on the basis of technical determinants and economic criteria applicable to a utility project have often been responsible for the present form and pattern of urban areas.

Another problem is that in the suburban areas near those lines which have ugly structures and unmaintained rights of way, there is an adverse effect upon the quality of adjacent residential development. This effect is most marked in those areas which are striving for urban standards of residential density and neighbourhood amenity. Almost equally important with the effects which power lines may have on the areas they pass through is the simple fact of the tremendous amount of land which they use and alienate for most other urban uses.

The study is concerned with the impact of overhead electric transmission lines on suburban areas, and not with electric lines at distribution voltages. Extra high voltage

lines are of special interest to planning, for they present technical and economic problems which either preclude or make impractical converting them to underground forms.

Accordingly, as overhead transmission lines are likely to have continuing effect, the following hypothesis is advanced. Because the location of overhead electric transmission lines has had considerable influence (sometimes adverse) on the spatial pattern of residential development, there is need for coordinating the requirements of the utility agency and the appropriate planning agencies.

The study describes in some detail those locational requirements and standards of electric transmission lines which have a bearing upon the use of land. The optimum locational requirements for overhead electric transmission line rights of way and suburban density and types of residential development are shown to be nearly identical. The two are therefore in competition for the use of land, and this competition is most marked in suburban areas where land values are lower than in the central city.

A specific examination is carried out of transmission line effects on the suburban residential area of Surrey, British Columbia, which is an urbanizing municipality on the fringes of the Vancouver metropolitan area. The case study shows that there is a significant correlation between the present pattern

of residential development, as measured by assessment values and population distribution, and the presence of transmission line rights of way. The study concludes that the presence of the lines is the most likely causal factor. That the influence has been sometimes adverse is not as definitely established, but the conclusion may be inferred from subjective evaluation of the aesthetic evidence presented. Further study of objective evidence is called for.

The statement in the hypothesis that it is necessary to coordinate the requirements of the utility agency and the appropriate planning agencies is basically valid, but is felt to be inadequate. It is concluded that the activity must, wherever possible, be an integrative one, and involve many other departments of government, including the federal. It is suggested that an integrative Provincial Development Department could well be the most effective method of controlling the more unfavourable aspects of electric transmission line right of way location and appearance.

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The writer finds that he has after all adopted certain subtle changes in attitude which can only be ascribed to Professor H. Peter Oberlander, Head of the Community and Regional Planning program at the University of British Columbia. It is hoped that these changes have enriched the technical information contained in this thesis which the writer gained while working under Mr. J. C. Carabetta, Superintendent of Transmission Line Construction, International Power and Engineering Consultants Limited. Professor Kevin J. Cross has shown great patience in directing the efforts of a plodding writer. The writer also wishes to thank Mr. Louke B. Kleyn, Planning Director in Surrey, and Mr. Gary Harkness of his staff. In addition to providing useful advice on sources of information, Mr. Kleyn has kindly supplied base maps from which the cartographic illustrations were made. Finally, the writer also wishes to thank his wife, Diana, for her knowledge of B. C. Electric Land Department matters which she gained while employed by the Company.

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CHAPTER I

ADVERSE EFFECTS OF OVERHEAD ELECTRIC TRANSMISSION LINES UPON SUBURBAN AREAS

The general subject area of this thesis is an investigation of the possible adverse effects upon residential development which electric overhead transmission lines may have. A particular area of residential development which has certain distinctive characteristics will be drawn upon for illustration, namely, a rather low density suburban area located on the fringe of the Greater Vancouver Metropolitan Area. This area centres on Surrey Municipality south-west of the city of Vancouver, British Columbia. For various reasons (which are explained in section 3 of this chapter), it is considered that this area presents a fairly complete range of situations and conflicting forces which will be used for illustration of the thesis subject.

1. SOME PROBLEMS FOR RESIDENTIAL LAND USE AND THEIR SIGNIFICANCE

Overhead electric transmission lines raise many problems for urban and suburban areas through which they pass, but those which have particular relevance for suburban residential areas are as follows.

It is often the case that large overhead power lines - or rights of way for them - were established before effective planning policies for urban development came into being. The effect in many of these cases has been that the existence of these large works has tended to establish land use patterns arbitrarily, that is, without relation to the long-run land use needs of the community. When first built, these large works were often the only alien development in an otherwise homogeneous rural area, or perhaps the only development in an otherwise undeveloped area. Subsequent urban growth has often been severely restricted in its pattern of development, or even its location, as a result. It may be suggested, in fact, that the existence of a large power line has some of the spatially determining characteristics of certain prominent natural physical features, such as water courses or escarpments, to use two examples. To use a man-made example, a large power line may inhibit or shape residential development much as a railway does. The comparison with the railway as a determining force should not be drawn too closely, however, for the parallel breaks down somewhat when comparing the barrier characteristics of these two types of works. Whereas the railway has a focusing or channelling aspect which is manifested by stations at intervals, dependent industry, and other immediately useful services,

the transmission line does not attract urban uses immediately to it owing to the service it provides. That aspect of the railroad which constitutes a transportation focus for the community through which it passes is absent for transmission lines. In short, whereas the railway tends to divide areas owing to its capacity to foster specialized land uses dependent upon it, uses often in conflict with residential uses, the power transmission line tends rather to divide areas spatially. The "wrong side of the tracks" characteristic tends to be lacking in cases of power line separation and similar residential development often begins again on the other side of the "tracks". This is not to suggest, of course, that the quality of residential development immediately adjacent to large and obtrusive lines may not be affected.

Yet the fact remains that a large power line, or lines upon a single right of way, does inhibit or shape patterns of residential development to a significant extent. The point to these observations is that urban development patterns may be a result of some man's or some agency's decision made upon the basis of relatively restricted economic or technological criteria, that is, for different purposes or objectives than community goals. By contrast, the patterning which results from prominent physical features can be adjusted only slightly by man, and even that which results from the prior location of

a railroad is more justifiable than power line pre-determination for railroad locations at the micro scale are determined by topography and gradient standards which are of relatively small importance when locating power lines.

A second problem corollary to that of pre-determining residential patterns, is that large power lines have a fragmenting effect upon potentially homogeneous residential areas in which residential development has begun either on a small holding basis, or on a scattered or sprawled basis. The tendency is for the utility agency to choose that route which strikes the fewest houses. The criterion is, of course, an economic one, but again the long-run land use needs of the community may not be adequately considered. Indeed, it would be very difficult for the utility to consider any such needs if the community's objectives have not been explicitly identified.

A third problem, one of no small importance, is that large overhead power lines as we know them today are usually deemed a visual disamenity for housing, with a consequent lowering effect on the values of residential properties closely adjacent to the lines.

There is also a group of technological problems involved in high voltage power line construction and power transmission which will be merely mentioned at this point. The problem most

people are aware of is the extra cost necessary for undergrounding electric lines. The argument is often advanced that the extra costs are a small premium to pay for the amenity. Unfortunately, however, these arguments are usually based upon undergrounding residential distribution lines, and occasionally upon undergrounding the lower voltage transmission lines. The problem of undergrounding extra high voltage lines (a type of line which is becoming more common) is one of much larger magnitude.

A complex problem stems from the exceedingly rapid advance of electric transmission and generation technology at present. The situation now exists that extra high voltage transmission facilities are partially obsolescent within as little as ten years, yet the utilities expect them to remain in operation for at least forty years for that is approximately their design life. The result is that power lines will continue to proliferate both in mere numbers and in visually distinctive types, a result which may be somewhat confusing and distasteful to the citizen.

There is the further technological problem of radio and television reception interference, but this is not as serious as many think.

High voltage power lines have a distinctive characteristic which helps to set them apart in any comparison with other

obtrusive ribbon-like utilities or facilities such as railroads or highways. The disamenity for residential areas of the latter may be slightly justified by the fact that they can provide some service to the areas through which they pass. There may be for instance, a railroad station or a freeway interchange which will benefit at least some of the occupants of residential areas. A high voltage power line, however, gives no immediate service to the areas through which it passes. The extremely high cost of transforming high voltage power to usable voltages precludes use along the line - even for industrial usage, although here there is the rare exception. The conclusion may be drawn then, that the mitigating feature of obtrusive railway lines or freeways which result from their servicing characteristic (however slight the argument) is lacking entirely for the high voltage overhead power line. This distinctive characteristic tends to emphasize other adverse effects which power lines may have on residential areas through which they pass.

A further problem stems from the often large amount of land taken up by transmission line rights of way owing simply to their great widths as compared to the rights of way of other utilities. Though the right of way of a low voltage transmission line may be little wider than the conductor support structures, especially when it is located upon an easement along a road or street, such lines increasingly constitute a smaller proportion

of transmission facilities in urban areas for reasons which are explained in Chapter II. On the other hand, a main electric transmission right of way large enough to accommodate two or even three extra high voltage lines may be three to five hundred feet wide. Only limited access divided highways approach this width, and if several such transmission rights of way occur in a district some idea may be gained of the amount of land alienated for other urban purposes.

There is the over-riding problem that any ill effects and conflicts of land use which now exist will tend to increase with the passage of time owing to more intense use both of neighbouring areas and of the power line rights of way themselves for further and larger transmission lines. It is common knowledge that the demand for electric power in urban areas is rising at a much faster rate than the rate of population increase, and this is a fact which has strong implications for transmission as well as distribution facilities. In British Columbia, for example, the increase in electrical consumption in the nine-year period between 1950 and 1959 was 193 per cent, whereas the increase in population in the ten years between 1951 and 1961 was 39.8 per cent.[1]

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[1]Derived from Inventory of the Natural Resources of British Columbia (B.C. Natural Resources Conference, 1964), p. 457

2. OBJECTIVES OF THE INVESTIGATION

In view of the problems listed above, problems which are common to many urban areas, there would appear to be considerable need for a comprehensive approach to alleviating those that exist and to prevent the occurrence of new ones in the future. Many of the existing problems have their origin in times and conditions in which simple economic considerations were deemed to supply sufficient criteria for deciding the form of development and such an approach is here felt to be quite inadequate. An assessment of the social costs and benefits of alternative forms of transmission line development upon different forms of residential development is therefore mandatory in any final analysis leading to decision making. A significantly useful cost-benefit analysis to show how a choice may be made between alternatives cannot be carried out in this thesis. However, since the keystone to any effective action along these lines lies at the administrative level, the object of this thesis is to examine and evaluate how present conflicting demands are resolved, and to suggest a general structure for coordinating conflicting demands at a higher level and on a larger spatial scale, where it is felt that administrative machinery is lacking or inadequate.

The proposals for administrative coordination are tested by their application to the Municipality of Surrey in the Greater Vancouver area. To that end, residential patterns of development are examined, and likely or desired development is ascertained or suggested. Present transmission line and large substation development are also examined in Chapter III. Also examined are certain significant aesthetic elements of electric utility development, the possibilities for multiple use of rights of way and certain other aspects, principally the overall role and relation which overhead lines and their rights of way desirably could have in the suburban residential community. For instance, it is not true that the best design of a utility structure dictates that it be self-effacing. "Rows of pylons cannot be made to melt into the background and . . . they have a certain grandeur," suggests a prominent British planner.[2]

3. LIMITS AND RANGE OF THE STUDY

This study is concerned with the effect of overhead electrical transmission lines upon residential areas only, with particular emphasis upon suburban residential areas, but consideration is given to the effect of such works upon amenity

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[2]Lewis Keeble, Principles and Practice of Town and Country Planning (London: The Estates Gazette Ltd., 1952), p. 265.

areas which are closely related to residential use - local parks, primarily. A great deal of investigation could be carried out relating overhead lines to the whole range of uses which occur in urban and urban fringe areas with a view to optimizing line location within the whole community. It may be desirable, for example, to relate large overhead lines to industrial areas simply to reduce the effects of disamenity for residential areas. Location along railways and primary highways might in some circumstances prove desirable alternatives, all effects and benefits being weighed. Detailed investigation of effects on non-residential areas is beyond the scope of this study, however.

A second major limit to the scope of this study is that it is concerned with the effects of only a very specialized group of electrical "transmission" facilities, namely with high voltage transmission, and not with the local services. Both secondary and primary distribution systems are excluded from consideration. There are two reasons for this exclusion. Firstly, a relatively large amount of planning and related technical literature is available dealing with the problem of overhead distribution systems, whereas there would appear to be a definite lack of study into the problem of the effects of high voltage overhead transmission systems upon neighbouring land uses. There is still a great deal of wiring, poles and

other paraphernalia overhead in our cities, but this is being gradually decreased, and it is now becoming increasingly common to construct first class subdivisions with underground systems. This problem, if not as yet entirely surmounted, is being considered and dealt with on all sides.

The second reason why this study is confined to high voltage transmission is that those forces which make the undergrounding of distribution lines economically sound are to a great extent lacking for the higher voltage transmission lines, especially in suburban areas as opposed to the denser urban areas. For example, the very rapid technological advances which demand and permit constantly rising higher transmission voltages are outstripping technological capabilities for undergrounding these voltages. There are other important technological determinants as well which are important for planning in suburban areas, and these are examined in Chapter II.

Some attention is devoted in this study to the need for more visually satisfactory designs for overhead lines, including siting and grouping considerations. However, an outline of the general possibilities must suffice, for a full list of the design alternatives available would be impossible. In any event, it is thought that it is more useful to emphasize an approach to the problem rather than to attempt to compile a handbook of information.

Alternative forms or types of electrical transmission facility (underground versus overhead, for example) as well as alternative locations for all the types within residential areas would be best evaluated by numerical benefit-cost analysis which would consider intangible aspects along with the tangible. Again, this study cannot go into the detail necessary for this form of examination.

The complexity of such an approach results from a number of factors. Sewell gives an outline of the elements which would be involved in a full benefit-cost analysis.[3] On the benefit side there are direct benefits, secondary or indirect benefits, intangible benefits (not quantified in everyday use but which can be assigned reasonable numerical values) and unmeasurable benefits such as amenity or view. The principal elements on the cost side are primary or direct costs, associated costs which may be either subtracted from primary benefits or added to the costs total, secondary costs involved in the production of secondary benefits, and intangible costs. Within fairly narrow limits primary and secondary benefits are almost a constant regardless of transmission line form or route, for a large urban area requires a more or less given amount of electric power, the

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[3] W. R. D. Sewell et al., Guide to Benefit-Cost Analysis (Ottawa: Queen's Printer, 1962), pp. 1 - 13.

use of alternative forms of power being variable in practice within a relatively narrow area.[4] Being relatively constant, they could be omitted altogether. Primary and secondary costs are more variable, but with some work, reasonably measurable.

Associated and intangible costs are more complex elements. Here would have to be included the removal of land from other uses, the adverse effects upon the values of residential properties immediately adjacent, impairment of view or amenity, and so on. It will be obvious that a great deal of careful and detailed study would be necessary in order to arrive at realistic estimates of these elements. In fact, the intangible costs involved in alternative routes for transmission lines, as compared to a similar area of costs involved in primary resource development, constitute such an important part of all costs that an estimate of total cost must necessarily be highly subjective and arrived at only with great circumspection. Intangible and unmeasurable benefits present a similar complexity and difficulty. The assignment of value to amenity, to consider the subjective extreme, would be a very difficult matter, though a very important one.

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[4]The development of electric power sources within an urban area has only a limited effect upon the need for high voltage transmission line facilities, as is explained in Chapter II of this study.

In summary, an appraisal of the social benefits and costs of alternative transmission line routes and structural types, though the concern of planning agencies both local and regional, cannot be carried out without detailed and qualitative examination of all possible routes, types of lines, types of residential development, and the forms of aesthetic adaptation which may be possible. This study will not go into this detail; it will attempt merely to demonstrate the general necessity for such an approach, and indicate where and how the approach could be used in the study area.

Overall patterns of residential development, principally as they have been recorded by Surrey Municipality, are examined. As has been suggested above, an examination of residential land values is not undertaken, except in general and in somewhat qualitative terms. Very useful conclusions could be drawn from a detailed examination of the effects of certain large overhead lines upon the values of immediately adjacent property as evidenced by assessment evaluations. Significant conclusions, however, would have to be based upon a wide range of situations including control areas, and this study has not the resources to carry out such an examination.

4. DEFINITIONS OF SPECIAL TERMS

Suburban. Suburban is defined here in a special way for lack of a more suitable term. A simple spatial concept is the

one desired; one which does not denote planning qualifications such as suburban industrial as distinct from suburban residential, for example. Nor does it imply any of the sociological implications such as "bedroom community". "Urban peripheral" is a term which comes close but is unduly awkward. In other words, the intention is to include those expanding areas on the fringe of large metropolitan areas.

Utility. The utility in this study is the electric utility company or agency which operates the electric system. The utility referred to in the case study is the former British Columbia Electric Company Limited which in 1961 became the publicly owned British Columbia Hydro and Power Authority.

Transmission line means any electrical transmitting facility which transmits electrical energy at voltages higher than distribution voltage. In North America the present usual upper limit for primary distribution lines is approximately 12,000 volts, or 12 kv. (The other size of distribution, secondary distribution, carries power directly into houses at 120 and 240 volts.) A transmission line may be overhead or underground. Overhead lines are supported on structures which commonly may carry one or two circuits, and less commonly (usually at the lower transmission voltages) three or four circuits. It has been customary on this continent to refer to lines by voltage size, "transmission line" referring to transmission

lines of up to about 130 kv. These were the largest lines in use up to about 1940. "High voltage" lines (HV) were developed after the war and were around 230 kv. In the nineteen fifties "extra high voltage" lines (EHV) were developed and are from 345 to 360 kv. In British Columbia at the present time 500 kv lines are under construction, including one within the study area, and no distinctive name for this voltage has been adopted. All the above lines are for alternating current power (AC) but studies are currently in progress in the province to determine the feasibility of building direct current (DC) circuits at about 900 kv. On the other hand, the nomenclature convention in the United Kingdom has been the "grid" at 132 kv, the "supergrid" at 275 kv, and the "380 kv" system. This study will refer to lines by voltage only, for example 60 kv, 130 kv, et cetera, and AC or DC where pertinent.

Structure means (in addition to the definition included in the above section) any sort of wooden pole device in addition to the many designs of metal structure. It includes guy-wires as well. In addition, "structure" may refer to the often complex mass of metal supporting frames which occupy sub-stations and switching stations.

A circuit commonly consists of three wires (or phases) in transmission lines up to 230 kv. Large tower lines are usually single circuit or double circuit with three or six

phases respectively. A DC circuit on the other hand, requires only two phases (though it should be remembered that such circuits are at this time only in the planning stage). A distinction is made between "phases" and "wires", for at voltages of 360 kv and up, more than one wire is used per phase. For reasons of electrical efficiency, the two, three or four wires (or conductors) of each phase are spaced about one foot apart in a flat, triangular, or square cross-sectional pattern. At the extremely high voltages involved, the air space within the pattern is energized, resulting in a large air-metal conductor, or "bundle". In such circuits (and usually such large transmission lines have only one circuit) the spacing between the phases must be very large. For instance, 360 kv requires a phase spacing of at least 28 feet for a total width of the three phases of 56 feet, and this dimension governs the length of the "cross arm" on a large single circuit, straight line tower.

5. HYPOTHESIS

Land planning has been properly concerned with the growth and development of large urban areas, and very often its "sprawl" into the surrounding countryside. It has often been the case that one or two decades ago the electric utility agencies established terminal facilities for their cross-country transmission lines in what was then a predominantly rural area not far from the urban fringe. Such a terminus became a focus

for numerous transmission lines which gradually were tied together into an extra-regional grid. Given, then, the rapid growth patterns of large urban areas, the rapidly increasing per capita demand for electric power, the technological changes in transmission of power, and the trend toward building more lines to tie small systems into large grids, conflict with enlarging residential areas must frequently result.

This study therefore advances the following hypothesis: Because the location of overhead electric transmission lines has had considerable influence (sometimes adverse) on the spatial pattern of residential development, there is need for coordinating the requirements of the utility agency and the appropriate planning agencies.

CHAPTER II

CONFLICT OF FORCES AND NEEDS: OVERHEAD TRANSMISSION LINES AND RESIDENTIAL LAND USE

A general appraisal of the forces and needs operative in suburban fringe areas in questions of conflict of land use between overhead electrical transmission lines and residential development is undertaken in this chapter. The technical requirements of the electric utility merit examination, but equally important are the requirements of residential land use. Accordingly, some optimum conditions and objectives are outlined for each, specifically those which may lead to conflict. The situation in south western British Columbia under the jurisdiction of British Columbia Hydro and Power Authority has provided many examples, but this situation is fairly typical in North America.

1. THE ELECTRIC UTILITY VIEWPOINT

Historically, at least, it is possible to find some exoneration for the more questionable power line development which appears throughout our landscape. It is in places ugly, though perhaps one should not go quite so far as an English landscape architect who described overhead wires and structures

as "spreading as litter through every type of landscape."[1] As will be established later in this study, the fact remains that there are innumerable examples of incongruous and deleterious transmission lines in British Columbia and North America. Many of these lines, however, were built under former economic philosophies which were almost universally accepted and generally supported.

The conception of the electric utility as a public service under public control is relatively new, though the conception gained support at different times in different areas of the continent. Ontario Hydro, for example, dates back to the first decade of this century and as a publicly owned utility set an important and controversial example for the rest of the continent.[2] On the other hand, the acceptance of public ownership and control of utilities has been much slower in the United States than in Canada.

A privately owned utility is necessarily governed by a different value system than a public one, though the difference may be subtle. Regardless of any convictions that its directors

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[1]Sylvia Crowe, Tomorrow's Landscape (London: Architectural Press, 1956), p. 74.

[2]Merill Denison, The People's Power (Toronto: McClelland, 1960), passim.

may have that their overriding concern is the overall public benefit, the fact always remains that the final arbiters of utility expenditures must be the owners, that is, the shareholders. It is inevitable in such organization that the public benefit really takes on a rather narrow economic breadth, and even though the general good is sincerely kept in mind, this general good simply takes the form of least possible rate charges. Under this philosophy, one which is still often adhered to by publicly owned utilities as well, the cheapest way of developing and transmitting power makes for the general good and is the best way. It is suggested here that those transmission lines which were developed under this philosophy and which are now viewed as incompatible with certain other uses in our metropolitan fringe areas, are to be exonerated from any present deleterious effects which they may have. That is, earlier practice went almost unquestioned, and as a consequence the builders of those times were under no pressure, and therefore moral injunction to build differently. This is not to suggest that the deleterious effects which these old lines now cause should not be corrected now that urban development has occurred around them.

Increase in Electrical Demand and Transmission Needs

Increase in electrical usage. In Chapter I figures were given which showed that the increase in electrical consumption in British Columbia was approximately five times that of the increase in population for a similar period. Industry used about two-thirds of all electric power in 1959, and though this proportion is down from about three-quarters in 1950, the fact remains that industrial usage continues to be a more important determinant for the rate of electric utility development than residential demand, the tremendous increase in residential usage notwithstanding.[3] The consumption of electric energy is increasing much more rapidly than other forms of fuel energy in British Columbia. The consumption of all forms of energy increased by thirty-nine per cent in the nine-year period up to 1959, but electric energy, one portion of the whole, increased by 193 per cent in that time. Dr. H. L. Keenleyside has stated that British Columbia's need for electrical energy is increasing at a compound rate of about 7½ per cent per year, and he suggests that this rate may rise substantially in the near future.[4]

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[3] Inventory of the Natural Resources of British Columbia (B.C. Natural Resources Conference, 1964), p. 455.

[4] H. L. Keenleyside, Columbia River Agreement, published address to the Advertising and Sales Bureau of the Vancouver Board of Trade (10 February, 1964), p. 4.

Need for transmission networks. One of the distinctive characteristics of any large modern transmission system is the development of elaborate connecting links between different parts of the utility system. In earlier times, generating plants each tended to serve its own service area, but merely for purposes of emergency some connections would exist at lower voltage levels between different service areas. Later, connections at the transmission level began to be made between generating systems serving a single large load centre area, the connecting lines being just outside the load centre, that is, just outside the urban area. The result has been to integrate all generating sources serving such an urban area into a single complex system. Present developments have seen a still higher level of integration between two or more of these systems.

In general terms, two basic technical needs underlie this progression. Firstly, there is the need to make more efficient use of resources, whether thermal fuel or water. Given an existing combination of such power sources, hydro will be used for peak load demands. Even between several hydro sources, however, efficiency may call for varying the load between them, for reservoir filling patterns may fluctuate differently during the year for example. Among thermal plants the most efficient units, usually the most modern, will be used first.

The second need to be satisfied is equally as important. It is the need to achieve reliability of service of the principal supplying elements: of generation equipment, of transmission and of high voltage transforming and switching. The patrons of present day electrical utilities do not tolerate frequent outages; in fact only the infrequent "act of God" as an outage cause is considered tolerable.

These two needs - efficient use of power resources, and reliability of service - manifest themselves in modern transmission system in two principal ways. Firstly, elaborate ring systems have been built or are planned around the large urban load centres. Up to a point, a parallel may be drawn with a ring freeway system about an urban area. It may be considered a high pressure, mass movement facility from which small branches or feeders distribute small amounts into localities and neighbourhoods. The electrical ring system has a further use, however, which rather stretches the parallel. Whereas difficulties of movement which may be encountered at a spot on the ring road usually mean a slowing down or slight dislocation of traffic, parallel difficulties in the electrical ring usually mean that a portion of the line must be shut down completely. In practice, in such an event only a segment of the ring is shut down, and the portions on each side of the isolated segment are still capable of supplying power to the stations through which

the ring passes. In this way the ring provides reliability of service. In addition, the ring may sometimes serve as a collector system for several generating sources.

In modern transmission systems, these two needs of efficiency and reliability also manifest themselves in the current development of long distance intertie transmission lines between formerly self-contained systems. The purpose of these lines is frequently to transmit power on a regular basis from one system to another. Very often, however, they exist merely to make even more reliable the power supply in any one system. Such a line may very infrequently be actually transmitting power, but the possibility of emergency conditions may justify its existence.

Efficient resource use, though not as yet a principal justification for interties, will undoubtedly become one in most parts of North America as power need increases. Studies have already been carried out to appraise the practicability of transmitting electrical power from the Pacific Northwest to the California area.[5] Inter-provincial interties have been mooted in Canada. These would have the further interesting

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[5]United States, Bonneville Power Administration, Study of a High Voltage Interconnection between the Pacific Northwest and California, submitted to the Senate Committee on Interior and Insular Affairs (February 1960).

efficiency characteristic of evening out peak-load conditions stemming simply from the difference in peak-hour which results from different time zones. As yet, only single intertie lines usually have been developed between systems, but present trends point to development of a system of multiple interties, again partly to increase reliability. Such a complex system is commonly known as a grid.

Load centre generation and transmission needs. It has been suggested by the foregoing that the requirements in transmission facilities in and close by large urban areas are increasing faster than the growth of these areas. On the one hand, there is a rapidly increasing per capita demand for power, and on top of this increase there is a trend toward building transmission facilities simply to supply greater reliability and greater efficiency of resource use.

However, the thought that may occur to the interested layman who is, perhaps, appalled at this great network, might well be that there is much justification for on-site generation by the most modern thermal methods, such as the nuclear. However, the need for completely reliable service would require a completely coordinated network involving several such stations. Dr. Keenleyside points out further qualifications for use of nuclear power in the British Columbia situation. He states that although nuclear energy has brought a new element

into all power calculations, it will not make obsolete the present hydro system. The cost of nuclear energy will continue to decline and at some period estimated at from ten to twenty-five years, nuclear power will make most other new installations uneconomic.[6] However, "Once developed and the capital costs paid, hydro plants can produce power for anything from 100 to 200 years with no cost for fuel and with a minimum expenditure for maintenance and operate at a price that no nuclear installation could ever match."[7] This substantial argument is, of course, based on the assumption that the economics of production alone is the determinant.

Engineering Location Determinants of Transmission Lines

Apart from the extra costs involved in construction transmission lines underground, certain technological factors demand close scrutiny. There are limitations to the possibilities for undergrounding, and there are limitations to overhead line locations, though these are not so critical.

Problems of undergrounding. The central problem is that the technology for undergrounding high voltage lines is lagging behind power development and electrical needs. An illustration

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[6] H. L. Keenleyside, op. cit., p. 5.

[7] Ibid.

may be drawn from the City of Vancouver in British Columbia. In 1948 the city applied to the Public Utilities Commission to force British Columbia Electric Company Limited to build its 230 kv Boundary Road line underground. The Commission decided at that time that the request was not technically feasible.[8] However, within a dozen years, B. C. Electric had more 230 kv lines underground than overhead. Great technological advances had been made only in that short interval. These lines have been built underground for reasons of economics rather than amenity however. The right of way required within a city for new overhead lines of this voltage makes an overhead line more expensive than underground cable installation.

However, now that underground technology can handle 230 kv, large transmission lines leading into fringe areas of Greater Vancouver are no longer of this voltage but are 360 kv, with 500 kv actually under construction. No cables exist for these voltages except for special short installations such as from underground power houses to the surface. It may be reasonably anticipated that technology will make cables of some sort economically feasible at some time in the future. It should be pointed out, however, that from the strictly economic

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[8] British Columbia. Public Utilities Commission, Annual Report 1948 (Victoria: Queen's Printer), p. 8.

point of view, underground high voltage lines of 230 kv, while feasible in fairly densely built-up urban areas as mentioned above in the Vancouver case, are not often practicable in the suburban fringe areas of our large metropolitan centres. The density in the fringe areas is still not so high as to preclude the acquisition of overhead rights of way; neither land costs nor dislocations to existing development would act as effective barriers, given the traditional economic determinants. Furthermore, new power line developments in those areas is very often a matter of building an additional line on an existing right of way which may have been acquired for this purpose at some time in the past.

However, economic considerations aside, there are practical limits to the distance which high voltage AC power can be transmitted through underground cables. The problem is the inductance effect of cables. In short, the introduction of power into a cable results in a charging current in it, that is, current is actually consumed in the cable. The engineers of British Columbia Hydro and Power Authority state that the limit for 138 kv cable is twenty eight miles, and that for 230 kv is eighteen miles.[9] There are methods and devices which can overcome this problem, but the costs are truly formidable, in

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[9]L. R. Horne, Cable Engineer, British Columbia Hydro and Power Authority, by interview, March 1965.

the view of the County Planning Officer of Hertfordshire in England.[10] The answer to this problem is DC transmission, but as yet practical devices for converting high voltage direct current to usable AC do not exist. A break through in this matter appears to be not distant, however, and a great deal of research is presently being devoted to it. In fact, many transmission line engineers hold that overhead lines at voltages higher than 500 kv will have to be DC, for AC has nearly reached its practical voltage limit.

High voltage transmission line construction costs. Even though overhead construction of high voltage lines is generally

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[10]"It is not practicable to transmit electricity for very long distances by cable because the insulation gives rise to a wattless current called a high leading power factor. Because the conductors are surrounded by an insulating material which is itself surrounded by a metal sheath, the cable acts as a condenser which can hold a charge of electricity. This electrical capacity of the cable acts as a resistance to alternating current.

"To some extent this leading power factor can be counteracted by what is known as the lagging power factor in overhead lines, i.e. where the current gets behind the voltage. To ensure that a leading power factor is not experienced at night, when industrial motors are shut down, it may be necessary to run the generating stations to cancel the charging current in the cable or to install expensive special apparatus at intervals along the length of the cable.

"Thus the Board are faced with 'mis-employment' of power stations or the provision of corrective plant said to cost £250,000 for a 2-mile length of 275 kV. double circuit cable. With 0.3 sq. in. copper conductor underground the electrical charge set up in the cable will be equal to and cancel out the whole carrying capacity of the cable when the length of the cable

much cheaper than underground in suburban fringe areas, yet the cost remains a formidable part of total hydro power development. The Fraser River Board in its Preliminary Report on Flood Control and Hydro Electric Power in the Fraser River Basin stated that "the capital costs that would be incurred for facilities to transport the power from the generators to the load center will be a material part of the estimated cost of the whole system and could be the limiting factor in determining the economic feasibility of many projects."[11] The cost of 500 kv lines presently under construction in British Columbia is estimated to be in the neighbourhood of $90,000 per mile.[12] It should be

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is 27 miles - a sobering thought whether one is electrically or amenity minded!

"With 0.75 sq. in. cable the same result is reached with 31 miles. This means that in general circumstances 1-1/2 - 2 miles of underground cable would compel the Board to install corrective plant. In the extreme case of 30 miles of cable, this plant would have the effect of doubling the generating plant needed to fill the cable. 33 kV. lines are economical for loads of 15 MW. for distances up to 15 miles of underground cable and 11 kV. for loads of 5 MW. up to 5 miles. The problem does not arise with low tension cable, but the voltage drop in long lengths of all low tension work is formidable." E. H. Doubleday, O.B.E., and W. Orbell, Electricity and Amenity (London: paper delivered to Public Works and Municipal Services Congress, 1958), p.7.

[11]Fraser River Board, Preliminary Report on Flood Control and Hydro Electric Power in the Fraser River Basin (Victoria: 1958), p. 75.

[12]J. C. Carabetta, Superintendent of Transmission Line Construction, International Power and Engineering Consultants Limited, by interview, March 1965.

pointed out, however, that this cost really becomes appreciable only in terms of the total lengths of these lines. The Fraser River Board was no doubt considering lines of perhaps two hundred miles, and the line about to be constructed between the Peace River and the Vancouver area will be about six hundred miles in length.

A comparison of overhead line construction costs with underground costs is the point of interest for urban and regional planning, however, and not absolute costs. Generally the questions which arise are where lines are to be built and what form they are to take in order that the best long-term interests of the whole community are considered. The question whether power is needed is rarely the issue.

There is the problem that the cost of constructing an underground line is not a fixed multiple of the overhead cost. Unfortunately, it costs proportionately much more to underground the higher voltages - that is, the higher the voltage, the higher the multiplier. In view of the very large technological problems for undergrounding the very high voltages which were mentioned above, it will be realistic to compare overhead with underground only for voltages of 230 kv and below. (It is recognized, of course, that special circumstances could justify the undergrounding of higher voltage lines, but only for short distances, conceivably only where very strong arguments for

social need or amenity could be advanced.) A need to weigh the alternatives assumes that both are possible. Obviously the urban situation in which land is intensively developed will not place an overhead solution in a competitive position for simple economic reasons; only in suburban fringe areas is a weighing of alternatives realistic.

British costs for both forms of construction yield ratios which are very close to those which follow from a comparison of practice in British Columbia.

Table 1

COMPARATIVE CONSTRUCTION COSTS OF OVERHEAD AND UNDERGROUND ELECTRIC POWER LINES IN GREAT BRITAIN IN 1957

Size of line	Average costs per mile		Ratio
	Underground	Overhead	
	(pounds sterling)		
275 kv	350,000	25,000	14.0
132 kv	65,000	10,000	6.5
33 kv	12,500	2,500	5.0
11 kv	6,000	1,350	4.4

Source: Doubleday and Orbell, op. cit., adapted from Appendix I, p. 17.

Very comparable ratios apply at this time in British Columbia practice, though the voltages differ. 230 kv is approximately twelve times as expensive in the underground form, and 60 kv is roughly six times. It must be strongly emphasized

that these ratios are only roughly approximate. The averages from which they are gained assume fairly good construction conditions. In actuality, transmission line construction costs can vary fully as widely with ground conditions as can highway construction costs. No substation costs are included.

Technical location determinants for overhead lines. Unlike highways which can be built almost as cheaply on a curved alignment as in a straight line (difference in ground conditions aside) large overhead lines become much more expensive with sharp changes in direction. The standard "straight line" tower is usually limited to a horizontal change of three degrees, and occasionally five. Slightly larger deflections require a heavier structure, but larger changes, say twenty-five degrees and more, require a "dead-end" structure which can easily cost ten times as much as a straight line tower.

The design engineer is often anxious to take advantage of ridges and knolls for towers, providing that location on them does not mean undue bending of his route. Transmission line costs are strongly affected by the number of towers per mile, and high locations for structures relative to surrounding ground can mean lengthening the standard span length which in flat country is in the neighbourhood of 1200 feet. A standard straight line structure is usually capable of supporting the load of conductor in spans up to 2000 feet in length.

The ground clearance of the conductors at mid span is, of course, an important controlling factor. The actual distance will vary both with the type of land use expected below the conductor and with the voltage. Minimum clearances for high voltage lines usually vary between twenty-five and thirty-three feet. By universal regulation no structure higher than about four feet is allowed under a transmission line.

Footing conditions for the towers are also important location determinants. Marshy conditions are not as important a deterrent to building as they are for a highway, however, for a few piles will support a tower. Potential slide areas are avoided at almost all costs, on the other hand, for high voltage lines are expected and designed never to fail structurally. In fact, the very few which have failed in British Columbia in the last few decades have been brought down by circumstances (usually natural) which could not have been reasonably predicted.

A high voltage overhead line right of way is much wider than that for any standard roadway, and they are often wider than freeway rights of way. One reason for this is to have complete safety from falling trees, for a design requirement is that no tree may be high enough to strike the outside conductor in the event that it falls straight toward the line. It is worth noting that this safety from falling trees is almost a defining characteristic of a transmission line, as compared to

an overhead distribution line.[13] In an area of exceptionally high trees, however, it is frequently the practice to fall the very highest "danger trees" which are just outside the fully cleared right of way. The reasons for this practice are purely economic, however, for it is cheaper to do this than to widen the cleared area. For obvious reasons, steep side-hill locations through forested areas require a wider right of way than flat ones.

The other reason for great width of right of way is simply the requirements of the lines which are planned to be built on it. It has been mentioned above that electric utility practice is to acquire right of way for final development which may be many years in the future. For example, much of the Wahleach right of way in the Lower Fraser Valley is six hundred feet wide, but only part of this is cleared and in use by one large line.

However, even without plans for future additions to present rights of way, the very largest lines each require a considerable width. A 500 kv line running through unimproved wooded land requires a minimum width of 250 feet. In this case the width of the conductor pattern (and therefore the tower cross-arm) is eighty feet, and the remaining eighty-five feet

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[13]Electrical "outages", or power failures, which occur during storms are usually caused by trees striking distribution lines. It is considered impractical to design distribution lines to be entirely safe from such mishaps.

on each side allows safety from falling trees. Rights of way in partially improved and farm areas tend to be narrower, not only because there is less danger from falling trees, but because the economics of easement costs discourage the acquisition of any width over the barest minimum required.

Great width is also due to the need for considerable space between circuit centres (that is, between tower line centres on the largest lines, for such lines usually have only one circuit). The reason is not so much to prevent one line fouling its neighbour in the event of possible disaster, as to overcome the electrical effect of one circuit upon the other. Consequently, from 125 to 150 feet circuit spacing is required between the highest voltage lines.

2. RIGHT OF WAY ACQUISITION PRACTICE

The outline which follows is drawn from the practice of British Columbia Hydro and Power Authority, a publicly owned utility which replaced British Columbia Electric Company Limited in the south western part of the province in 1961. The practice of this organization is very similar to general practice in North America. This outline indicates some evolution in this practice in keeping with the changing realities of land ownership expectations.

In shareholder owned utilities the first step in right of way acquisition is usually to obtain a certificate of public necessity and convenience from the appropriate regulating body of one of the senior governments. In British Columbia, this body is the Public Utilities Commission. Publicly owned utilities may not need to make any application for certificates to a public utilities commission. Again, in British Columbia, as a result of government expropriation of the shareholder owned company, the succeeding organization, British Columbia Hydro and Power Authority, is not required to obtain a certificate.

Until sometime in the late fifties standard practice when about to acquire a new right of way, was the engineering department of the utility decided upon a fairly precisely located route plan. This plan, together with land parcel prints from the surveyors, was given to the utility's land department. In these circumstances the land department was instructed to acquire the designated right of way. Latterly, however, this precise location from the engineering department has tended to be replaced by a more generalized route plan. Now very often the land department receives from the Chief Engineer perhaps merely runs of air photos which have coloured lines drawn on them indicating a rough centre line. In this event, the land department acquires the cheapest possible route within the limitations of its understanding of technical requirements.

In the last few years the next step has been an approach by members of the land department, perhaps a "land man" and an engineer, to the responsible officer of each municipality involved. If there is no planning department in the municipality the engineer or reeve would be interviewed. This procedure results in some coordination between the needs and objectives of the utility agency and the municipality. Though the utility agency initiates this coordination, its motive is not entirely altruistic. Originally the motive was simply a desire to have assistance in carrying out the land acquisition project. For instance, diplomatic conversation with the senior municipal officers could result in learning which properties might be unduly expensive or could present difficulties in acquisition. It must be remembered that in the earlier period the balance of negotiating strength has been rather in favour of the utility agency.

Gradually, however, as planning departments have become more effective, this confrontation has tended to become more a bargaining process with some changes in routes to suit the municipalities. For example, much vacant land is being held for school and local park sites, and the utility's land department is usually not aware of this beforehand. Some trading of land may occur at this point if the line must go through a public site; the utility may offer the municipality an equivalent parcel of land somewhere nearby over which the utility has the develop-

ment rights.

In this way the land department determines routes which are possible of acquisition. However, it must be remembered that, within the utility agency, engineering has the first and last word on location decisions.[14] It will be appreciated that engineering considerations generally have much weight in conflicts which arise with many outside agencies and persons. The land division must, of course, bring to the engineers' attention those cases where acquisition is impractical. Usually these are instances which involve property under the jurisdiction of the two senior levels of government; Indian Reserves are a case in point. Occasionally very large private commercial organizations can force a change of route, either through their status as "public utilities" (primarily the railroads) or through economic compensation requirements. Very large land development companies sometimes have this power.

In the British Columbia situation, all matters of crossings of other utilities and technical agencies are handled directly by the engineering division. These are bodies such as the railroads, the provincial Highways Department and the Harbours

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[14] R. W. Gross, Land Division Manager, British Columbia Hydro and Power Authority, by interview, March 1965.

Boards, in the main. Requirements for crossing the works of these agencies is defined technically in general terms by statute or government regulations.

It will be realized that the right of way acquisition process is usually a very protracted matter. Only when a possible route is determined through the above steps is it possible to embark upon the final time consuming process of contacting property owners. Before contacting owners, however, some scale of land values is arrived at for the areas through which the line will pass. Generally an easement offer is made rather than an offer for outright purchase. The easement price is a variable percentage of the full market value of the right of way portion of the owner's property.

In former times, it was much more common to purchase the whole of each individual's property if the parcels were not large. Subsequently the portion of each parcel not needed for the right of way was sold on the open market. Increasing land costs have tended to militate against this practice, except when the present use of the land conflicts with the projected right of way use.

3. RESIDENTIAL LAND NEEDS AND OBJECTIVES IN SUBURBAN FRINGE AREAS

As was noted previously, this study is restricted to the effect of high voltage overhead electric transmission lines upon

residential areas only, with particular emphasis on suburban residential areas. It is well known that the population growth of suburban areas is increasing much faster than the growth of central urban areas. It is pertinent here to describe in outline this growth rate and some of the reasons for this growth pattern. The purpose of this section is firstly to give some indication of the growing areal demand for residential land, and secondly the aesthetic requirements of this development where it comes in contact with high voltage line rights of way.

Suburban Growth of Metropolitan Areas

The sociologist R. L. Warren has recently described "the great change in American communities" as in part, fundamental changes in urbanization and suburbanization. Whereas Standard Metropolitan Areas in the United States have grown very rapidly the outer, or suburban rings of these areas have grown even more rapidly. In 1940, the Standard Metropolitan Areas comprised 51 per cent of the United States population, but two decades later in 1960, these Areas comprised 63 per cent of the total population. However, in the United States,

> In recent decades the principal growth has been not in the central cities themselves, but rather in the surrounding areas. Actually, a large number of central cities have declined in population, especially since 1940, despite the growth in the Standard Metropolitan Area of which the city is the core. Thus where earlier it was accurate to speak of the growth of cities, it is now more

> appropriate to speak of the growth of that part of the Standard Metropolitan Areas outside of the central cities.[15]

The United States Yearbook of Agriculture, 1963, referring to land use on the national scale, notes that "the greatest change in land use since 1920 has been the doubling of areas in special-purpose uses, such as urban areas, highways and roads, parks and wildlife refuges."[16] However, urban uses and highways and roads accounted for about 90 per cent of this category in 1959. Urban uses and other built-up areas have increased by two-thirds since 1920, and though this increase may not be very impressive in view of the time span involved, it should be remembered that large urban areas in North America have grown at a faster rate than the smaller. The point of importance for this study, however, is that it is precisely in the expanded portions of the larger urban areas that large electric transmission lines presently terminate. In almost all cases these large lines and their terminal switching and transforming stations were located there before the intensive urban development which now often surrounds them.

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[15] R. L. Warren, The Community in America (Chicago: Rand-McNally, 1963), p. 75.

[16] M.M. Regan and H.H. Wooten, "Land Use Trends and Urbanization", A Place to Live, Yearbook of Agriculture, 1963, United States Department of Agriculture (Washington, D.C.: Government Printing Office), p. 62.

In those cases where urban development has not "caught up" and surrounded these electric works, there is much likelihood that they will be overtaken in the future. In the next two decades in the United States, urban and built-up areas are expected to undergo a further two-fifths areal increase.[18] That these trends apply also to the Canadian situation is of course an assumption, but it is probably legitimate.

The rapid growth of the outer portions of the metropolitan areas in Canada is owing at least partly to the housing mortgage policies of the federal government. Most working class persons are restricted to National Housing Act loans for the purchase of housing. This class cannot afford the down payments necessary under a prime institutional lender loan. Though the statutory loan-to-value ratio maximum of this lending group has recently been increased to seventy-five per cent, only uncommonly were mortgage loans made at the former statutory maximum of 66-2/3 per cent. Sixty per cent has been a commonly used ratio, and this may increase under the revised statute, but not likely to seventy-five per cent. As the effective interest rate on second mortgages currently starts at twelve per cent and is often higher, it can be seen that the public is

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[18] M. M. Regan and H.H. Wooten, op. cit., p. 63.

not anxious to take out second mortgages to complement a prime loan.

The moderate income group is in effect forced to rely upon the government insured loans of the National Housing Act, but these loans are available only for new housing. These loans have a higher loan-to-value ratio for modest houses, being ninety-five per cent of the first $13,000, and seventy per cent of the next $1,900 on a three bedroom house.

The situation in the United States differs in that the Federal Housing Administration finances old houses exactly like the new, and "in 1962 sixty-three per cent of the Administration's insured loans were for older properties."[18] The forces for residential growth in our metropolitan fringe areas brought about by federal policy will be apparent. J. B. Milner states the case briefly. "Our whole financial structure under the N.H.A. forces people to the outskirts in search of new houses with low down payments, whereas many might prefer to purchase in more central locations if refinancing were available."[19]

Quite apart from this apparent housing policy of the Canadian federal government, the demand for residential land

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[18] J. B. Milner, Community Planning: A Casebook on Law and Administration (University of Toronto Press, 1963), p. 291.

[19] Ibid., p. 290.

around large cities will continue if only because vacant land within the central cities is becoming more scarce. Trends to redevelopment of the older single family areas within the central cities with multi-family housing will merely slow down the demand for single family housing, for there will always exist the young families with small children who will rely upon the latter form.

Some General Objectives for Suburban Residential Areas

In the broad context, F. Stuart Chapin has listed the general principles of location requirements for residential areas, and these are as follows:

> Living areas should be located in convenient proximity to the work and leisure-time areas where there are nearby transit and thoroughfare routes to insure easy access back and forth. They should be in convenient proximity to large open spaces and should include smaller open spaces to insure an open-order character of development, with residential areas in easy walking distance of accessory community facilities. They should be located in areas protected from traffic and incompatible uses, in areas economic and attractive to develop, and in areas where desirable residential densities with a range of choice can be assured.[20]

These guiding principles require further refinement in those particular aspects which are possible of being related to

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[20]F. Stuart Chapin, Jr., Urban Land Use Planning (Urbana, Illinois: University of Illinois Press, 1963), p. 291.

high voltage power lines and their rights of way. Residential area terrain should offer variety, specifically fairly level, rolling and hill-side sites, depending on topography characteristics of the urban area, but avoiding steep or irregular sites and low or poorly drained areas; the slope should usually be under fifteen per cent.[21] It will be apparent that optimum locations for large overhead power lines have the same requirements.

Residential areas have a need for playground areas and parks in some variety. Needed are "quiet parks on steep, level, or low sites and fingers of open space. . . integrated with active and passive recreation areas and the larger open space system according to the opportunities offered by land forms in locale."[22] It will be apparent here, too, that rights of way of large power lines in practice very often occupy land in ways which are remarkably similar to ideal open space and park area needs. The objectives of residential public open space on the one hand, and the needs of high voltage power line rights of way on the other are not necessarily in conflict. The possibilities for joint use merit detailed examination, and are undertaken later in this study.

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[21] F. Stuart Chapin, Jr., op. cit., p. 294.

[22] Ibid., p. 295.

Residential neighbourhoods, whether urban or suburban, are generally more efficient and more satisfying to live in if they conform to a certain optimum size. They are more efficient if, for example, they coincide with the catchment area for a public school, and certain other neighbourhood facilities such as shopping area, local parks, library and churches, all within walking distance. The neighbourhood may constitute a more satisfying environment if it provides a sense of place to its residents, that is, if it has definable boundaries, or edges. However, the concept of having a boundary implies that the neighbourhood is built-up within its boundaries in a continuous and rational way. A residential area which is split by a highway or some very extensive non-residential land use can only in exceptional cases be a unified neighbourhood.

It will be apparent that a large power line right of way can conceivably have pronounced divisive effects upon a potential residential neighbourhood. An ill-kept right of way with unattractive structures will have a strong dividing effect. It will be apparent, too, that such a right of way can quite possibly have a detrimental effect upon residential property values.

Case for Amenity in Residential Areas

In his discussion of the public interest as a determinant of land use, F. Stuart Chapin examines amenity as one of five

elements "prompting the use" of land controls.[23] The first four, health, safety, convenience, and economy, are beginning to be accepted with little question as aspects of urban life requiring control in the public interest. As a measure of their acceptance, it is sufficient to examine the frequency with which the legal tests have supported them. However, as this same writer points out, "For planning purposes a more advanced concept of the public interest is warranted, one which builds on the legal tests but which seeks forward-looking guideposts taken directly from the social currents of the times."[24]

Though from the point of view of legal acceptance of these five elements amenity is a newcomer, from the social point of view it should be of equal importance with the other four. No doubt one of the main reasons why our society has been slow to accept it is owing to the fact that aesthetics and most other aspects of amenity are often either "matters of taste", or they are points on continua which are subjective and difficult to quantify.

The need for amenity in residential areas is nevertheless real. It has not been long since we justified most large de-

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[23] F. Stuart Chapin, Jr., op. cit., pp. 42-56.

[24] Ibid., p. 42.

velopments simply on economic results. The creed has been production at minimum cost, however, "the fallacy lay in the fact that the real cost was hidden."[25]

The detrimental effect of ill-kept rights of way upon adjacent residential areas has been touched on above. Sylvia Crowe lists three reasons for the unpleasant aspect which oppressive tower lines may have.[26] They may be intrinsically ugly, she suggests, and naturally the answer to this is simply good design. Secondly, they may make an unpleasant composition with their surroundings, and the answer here would appear to be attention paid to proper siting. Thirdly, however, the objection may be psychological rather than visual, meaning principally that we tend to have a traditional ingrained objection to any obtrusive man-made work in either a natural or a traditional setting. To the extent that the psychological objection still prevails, even though an overhead power line may not be open to criticism on the first two counts, it would seem that only re-education, time, and good example can overcome it.

Suburban residential areas and the people who live in them may reasonably demand of transmission lines and their rights

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[25]Sylvia Crowe, The Landscape of Power (London: Architectural Press, 1958), p. 10.

[26]Sylvia Crowe, Tomorrow's Landscape (London: Architectural Press, 1956), p. 74.

of way certain basic amenity and aesthetic characteristics, in the event that the overhead line is to remain as a utility form. One of the most obvious requirements is the improving of the actual right of way surface. A jungle of brush, stumps and weeds can hardly be justified in even undeveloped areas. It would appear that even economics are now militating against the traditional maintenance approach, which is to slash the brush when it is in danger of short-circuiting the line. In the Cariboo district of British Columbia, B. C. Hydro and Power Authority is now seeding its electric transmission rights of way with a hardy grass which will choke out weeds, hold back encroachment of trees, prevent soil erosion, and at the same time provide grazing for cattle. The seeding by helicopter is expected to be expensive, but the cost will probably be offset by savings in maintenance clearing.[27] It may be thought unfortunate that economics must play such an important part in attaining a result which social values should be able to justify.

Some other disadvantages for residential areas are the ugly pole structures so often used for lines of up to 230 kv, and the disorderly array of these structures on wide rights of way, for often many of these relatively small transmission

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[27]News Item in the Vancouver (British Columbia) Sun, February 10, 1965.

lines exist side by side. These may exist on a right of way along with one or more steel tower lines which are themselves frequently unattractive. The non-complementary quality of these conflicting designs produces an overall effect which a good residential area could not tolerate.

Large overhead transmission lines can be stimulating and attractive. At their best they can be representative of man's imagination and daring. There are a few situations, however, when even the best may be out of place. For example, it would be injudicious to group these inherently large constructions close to focal buildings of architectural value, for they would be dwarfed and oppressed by them.

It may actually be the case that the design shortcomings of the majority of our tower lines are owing to the speed of technical progress and manufacture today. Sylvia Crowe suggests that in former periods there was time for the craftsmen to perfect our artifacts.[28] This writer is undoubtedly correct when she goes on to say that "the solution lies in several directions which will all have to work together if we are to bring order to our surroundings."[29]

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[28]Sylvia Crowe, Tomorrow's Landscape, op. cit., p. 74.

[29]Ibid.

4. RESOLVING LAND USE CONFLICTS

The building of transmission lines, as with most other large utilities, in developed or partially developed land, necessarily involves a competition for the use of land, and very often conflict ensues. A description of these competing demands and conflicts can be discussed under three headings. At an elemental level, the electric utility settles questions with individual property owners directly through utility agents. Those that cannot be settled quite so simply are often appealed to special purpose boards and commissions. At a more complex or larger areal level, conflicts are increasingly being settled by municipalities and planning agencies.

Utility-property Owner Negotiation

It is necessary first to describe some of the mechanics of rights of way acquisition. The individual property owner's first notice of the intention of a utility agency to acquire a right of way, whether by easement or otherwise, is usually a visit from a land department representative of the agency. In British Columbia generally only an easement is desired for which the owner is offered an easement fee which is a certain percentage of the market value of the land which makes up the projected easement. This easement fee is a one-time only payment, that is, there are no further periodic payments accruing to the owner from an easement. The owner is also offered a sum for

each utility structure which may be built on his property and he is promised remuneration for any damage to his land owing to construction at any time. If the residual value of the property outside the easement area is significantly affected, the utility agency will usually offer to purchase the whole property. The easement becomes a permanent charge against the title.

As may be imagined, resistance to acquisition is frequently encountered, and the utility will often go to some lengths in offering assistance in the form of advice as to how the owner may best use the remainder of his land. One of the most frequent complaints of land owners in suburban fringe areas is that they are being deprived of land which has subdivision potential. Owners usually have some general notion of the physical pattern which subdivision may take; the utility's land agent may at this point use some ingenuity in showing the owner how he may profitably incorporate the easement into a lot pattern so that the backs of lots only are within the easement, leaving buildings outside the right of way boundary. The assistance and advice that agents give are kept deliberately on an informal and advisory basis.

Failure to agree on a price usually results in a suggestion by the agent that both the owner and the agency should agree to submit to an independent appraisal, with the appraisal costs at the utility's expense. Failure to achieve agreement

with this suggestion usually leads to expropriation procedures, if agreement has already been reached with owners of neighbouring properties. Resistance by several owners in one area may at this point cause a relocation of the projected easement, especially if it is a new easement and not simply a matter of widening an existing one. Expropriation price is usually determined by arbitration.

It may be appreciated that in some cases owner assent is not achieved by these methods. Expropriation usually prevails in these cases but in many jurisdictions owners have the right to state their cases before a Public Utilities Commission or Board.

In British Columbia, it has been customary for utility agencies to take easements only. In Manitoba, however, there has recently been a policy to purchase the fee simple of the right of way property required. This property is then offered to the former owner on a lease basis.[30] Land which is agricultural or developed on a non-intensive small holdings basis is well adapted to this technique for "really there is nothing the owner can do with this right of way except cultivate it."[31]

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[30] J. Galt Wilson, Solicitor, by interview, April 1965.

[31] Ibid.

There would seem to be logical justification for the practice of purchasing the fee for, after all, the right of way is for a public use and the public should own it.

Roles and Powers of Special Purpose Boards

Public Utility Commissions generally have both legislative and judicial powers. As a result, they operate under a broad grant of power from the legislature, and in issuing orders they have legislative authority, for these orders assume the force of law. At the same time, in granting hearings and handing down decisions, the typical commission takes on the role of a judicial or quasi-judicial body.[32] M. G. Glaeser, however, points out that the administrative commission generally has jurisdiction over only those utilities which are quasi-private corporations.[33] Much more common in the United States, though they exist in Canada too, these utilities are privately owned to the extent that their shares are owned by the public but they have ostensible objectives of public service. Public utilities operating as arms of government are only rarely regulated by public commissions. This general rule is borne out in British Columbia; the present British Columbia Hydro and Power Authority

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[32]W. E. Mosher, "Public Utility Regulation", in Regulatory Administration, G.A. Graham and H. Reining, editors (New York: Wiley, 1943), p. 130.

[33]M. G. Glaeser, Public Utilities in American Capitalism (New York: MacMillan, 1957), p. 590.

is not controlled in any significant matter by the British Columbia Public Utilities Commission. However, British Columbia Electric Company Limited, which was the principal body expropriated in 1961 to form the above mentioned authority, was regulated by the Commission.

Where a regulatory and administrative commission exists, however, its broad grant of powers may be used to settle conflicting demands in questions of the public interest. For example, in early 1961 in the District of Burnaby, British Columbia, a Burnaby rate payers' council urged the Commission to consider recommending legislation to compel electric utilities to place high voltage lines underground. In this case the Commission carried out a study and delivered an opinion and judgement. It concluded that the undergrounding of high voltage lines was impractical from a costs point of view except in particular cases.[34]

The Commission may have strong persuasive powers. Also in Burnaby, in 1959, the Standard Oil Company and certain residents in Burnaby, in a deposition to the commission, objected to a proposed route for an overhead power line. During the hearing, however, Standard Oil was persuaded to allow a line

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[34]British Columbia. Public Utilities Commission, Annual Report 1961. (Victoria: Queen's Printer).

through its property. This location eliminated "most of the objections of the residents in North Burnaby."[35]

The Commission may also perform the valuable service of informing people of their rights. In the Chilliwhack District in 1951, a group of farmers objected to the route to be taken by a 360 kv overhead power line. Investigations were made and the complainants were informed of their rights. The matter was then left to the parties for negotiation and settlement.[36]

As the Public Utilities Commission no longer has jurisdiction over the major public utility agency in British Columbia, it will be seen that a certain vacuum now exists in settling questions of the public interest.

The role of the National Energy Board in Canada in matters dealing with electric transmission lines is an important one within a narrow scope. It regulates questions and conflicts which arise when transmission lines cross provincial and international boundaries. It will be seen, however, that a decision on where a line should cross a boundary will have ramifications, even important ones, for the use of land where the line leads up to the decided crossing point.

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[35]British Columbia. Public Utilities Commission, Annual Report 1959. (Victoria: Queen's Printer).

[36]Ibid., 1951.

Roles and Powers of Municipalities and Planning Agencies

In this area, there has been much less specification of powers for regulating questions of the public interest dealing with transmission line rights of way than in the preceding. The limitation is probably deliberate on the part of legislatures, however, for "cheapest power at the lowest cost" considerations have usually meant to legislatures that any side effects (that is, non-economic criteria) must take a minor place to the objective of providing cheap power to the main load centre. Moreover, in the past, the absence of plans, or even expectations for urban growth in fringe areas, has tended further to depreciate the demands of these municipalities that utility works be developed in an orderly manner.

In British Columbia generally, the municipalities hold a minor role in deciding utility land use. The District of Surrey's solicitor holds that basically the Public Utilities Commission prevails over the Municipal Act.[37] British Columbia Hydro and Power Authority, which is not regulated by the Commission, is "beyond the reach of the municipality." In the following chapter, mention is made of an attempt by the Municipality of Surrey to regulate the location of a utility line.

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[37] J. Galt Wilson, by interview, April 1965.

Municipal powers to affect at least location decisions are gradually increasing in the Lower Mainland area of British Columbia. It was mentioned in section 2 of this chapter that the approach of utility land officials to municipal officers prior to acquiring right of way has changed subtly. Whereas formerly the objective of the utility was essentially to learn which route would be the cheapest, latterly the relation has taken on rather a bargaining flavour. Though the position of ultimate strength continues to be held by the utility, the latter has come to realize the force of an aroused public.

Regional planning agencies, which by the extended nature of the utility right of way problem, should perhaps have the largest role in location decisions. Matters of purely local effect conceivably could best be handled by local planning agencies. A purely advisory regional board, the sort which as yet prevails in British Columbia, will naturally carry far less weight than one with powers of control and development.

5. SUMMARY

The groundwork of most of the older electrical utility systems was laid when the quasi-private corporation was the rule. Owing both to this private element, and to a simpler public philosophy, the criteria for the forms of development which electric transmission lines took were generally simply

economic: the cheapest form of electrical supply was the best.

The future need for transmission facilities will increase more rapidly than the growth of population in metropolitan areas for a variety of reasons. Per capita consumption of electricity is rising, and shows no sign of levelling off. Expansions to transmission networks will be required both to make more efficient use of power resources, and to provide greater reliability of service. There is also a present trend to develop very long distance intertie lines between major continental areas.

The undergrounding of the highest voltage lines will not only be very expensive, but at present involve technical problems which have not yet been overcome. The optimum engineering criteria for locating high voltage overhead lines are in general the same as those which hold for optimum development of residential areas, especially residential development in suburban areas. Furthermore, high voltage overhead line rights of way may be from 200 feet to 500 feet in width.

The factors which govern the location of new rights of way have undergone some evolution. Whereas engineering determinants at first governed almost exclusively, of late, the high cost of land resulting from the competition for its use has become an important element. Also of late, but not as yet an

important determining factor in the generality of location decisions, is the criterion of the community interest stemming from the effects which large utility works, such as transmission lines, have upon the areas they pass through.

The need for residential land on the fringes of metropolitan areas will increase. Whether the pattern of development is guided by overall plans, or merely follows the traditional method of in-filling and patch development, conflicts with transmission lines in their present forms will result. An examination of the requirements making for an optimum residential area or neighbourhood reveals that overhead transmission lines and their rights of way either may conflict with these requirements, or complement them. Suburban residential areas and the people who live in them may reasonably demand of transmission lines certain amenity and aesthetic characteristics in the event that the overhead line is to remain as a utility form.

The methods of reconciling the conflicting demands of the electric utility and the owners of potential residential land are described under three headings. An isolated withholder in the face of right of way acquisition will often face a forceful taking. Fully publicly owned utilities in North America are usually not regulated by a public commission, but property

owners, especially when they combine in groups, may make an effective deposition to a commission when the utility is a quasi-private one. The roles and powers of municipalities and planning agencies, in questions of conflict over the use of land by utilities, have been small but are increasing. Concerted public pressures are reinforcing this trend.

CHAPTER III

LAND USE COMPETITION IN THE DISTRICT OF SURREY: OVERHEAD TRANSMISSION LINES AND RESIDENTIAL USE

The District of Surrey is in general experiencing many of the problems which presently beset many former rural areas which are on the fringe of a rapidly growing metropolitan complex. Not surprisingly, Surrey's problems stemming from the many utility rights of way which pass through residential areas are pronounced, in comparison to the rest of the Greater Vancouver Metropolitan Area. Before examining the details of these rights of way and the residential areas they pass through, it will be necessary to describe Surrey briefly to determine why the electric transmission problem is more pronounced in this District.

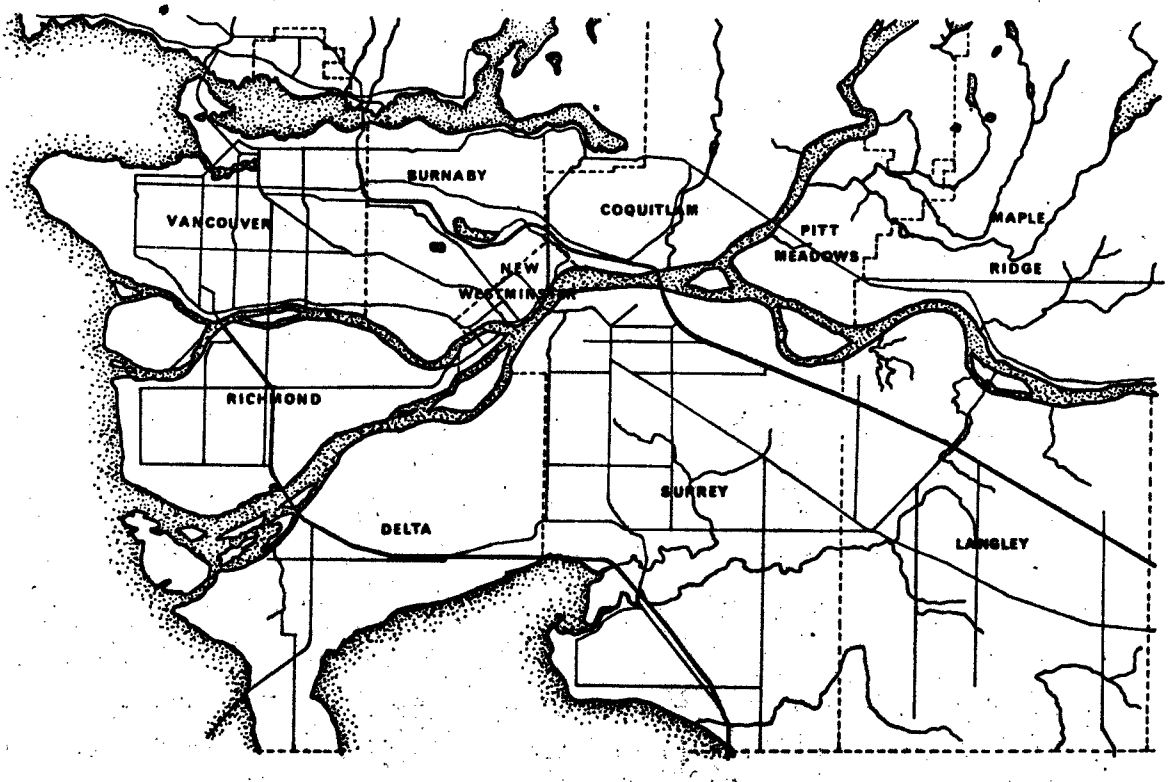
1. SURREY'S RELATION TO THE VANCOUVER METROPOLITAN AREA

From any point of view, but especially from the point of view of this study, Surrey's most distinctive and moulding characteristic is its position athwart the great majority of access routes to the Vancouver Metropolitan Area. Figure 1 on page 66 shows Surrey's location in the metropolitan area. This metropolitan area is exceptional in that it is situated on the north west corner of a relatively small flat valley area bounded

on the north by a barrier of mountains and on the west by the Strait of Georgia. Aside from water transportation to the west and the main line of the Canadian Pacific Railway which approaches the metropolitan area from the east on the north side of the Fraser River, all major access is at least for some distance through the District of Surrey. All the major highways from the north, east and south, three railroads, the principal gas and oil trunk lines supplying the metropolitan area, and even the major air routes from the east and south, pass through or over Surrey. As might be expected, Surrey has proven to be an advantageous location for major long distance electric power lines as well. Figure 2 on page 67 shows the major electric, oil and gas line rights of way in Surrey.

It is necessary to make an important qualification at this point, however, for these large lines do not pass directly through the municipality. Surrey has such a favourable corridor setting that the main terminal switching and transforming station in south western British Columbia has been located there: Ingledow Substation.

Surrey's general role in the metropolitan area increasingly has been to accommodate residential expansion, especially the single-family suburban type. In conformity to fringe area trends common to most large centres, Surrey's population has increased faster than that for the metropolitan area as a whole. Between 1951 and 1961 the municipality's share of the population



LEGEND

—— Freeways

—— Other arterial roads

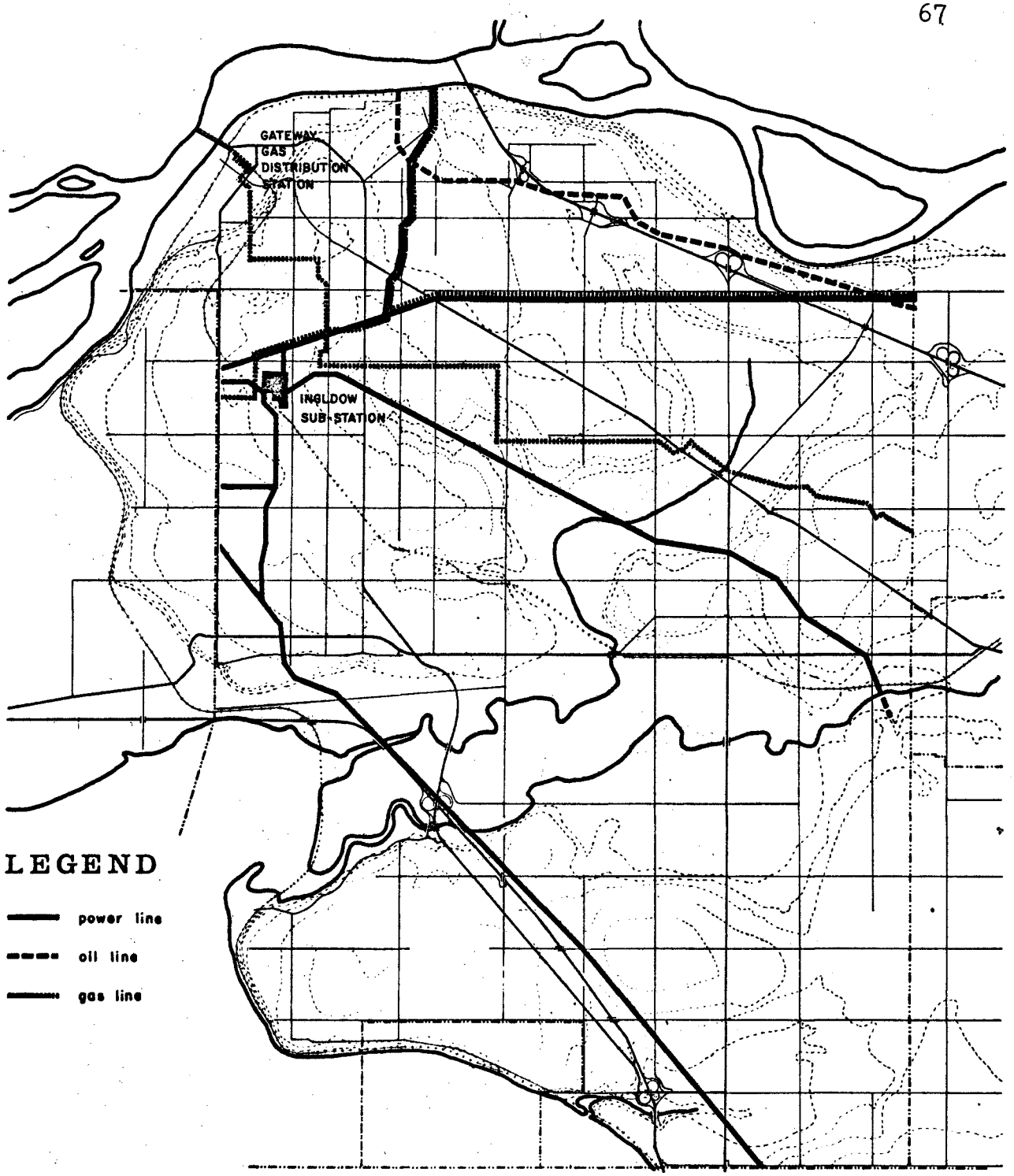
N

0 2 4 6 8 10

Miles

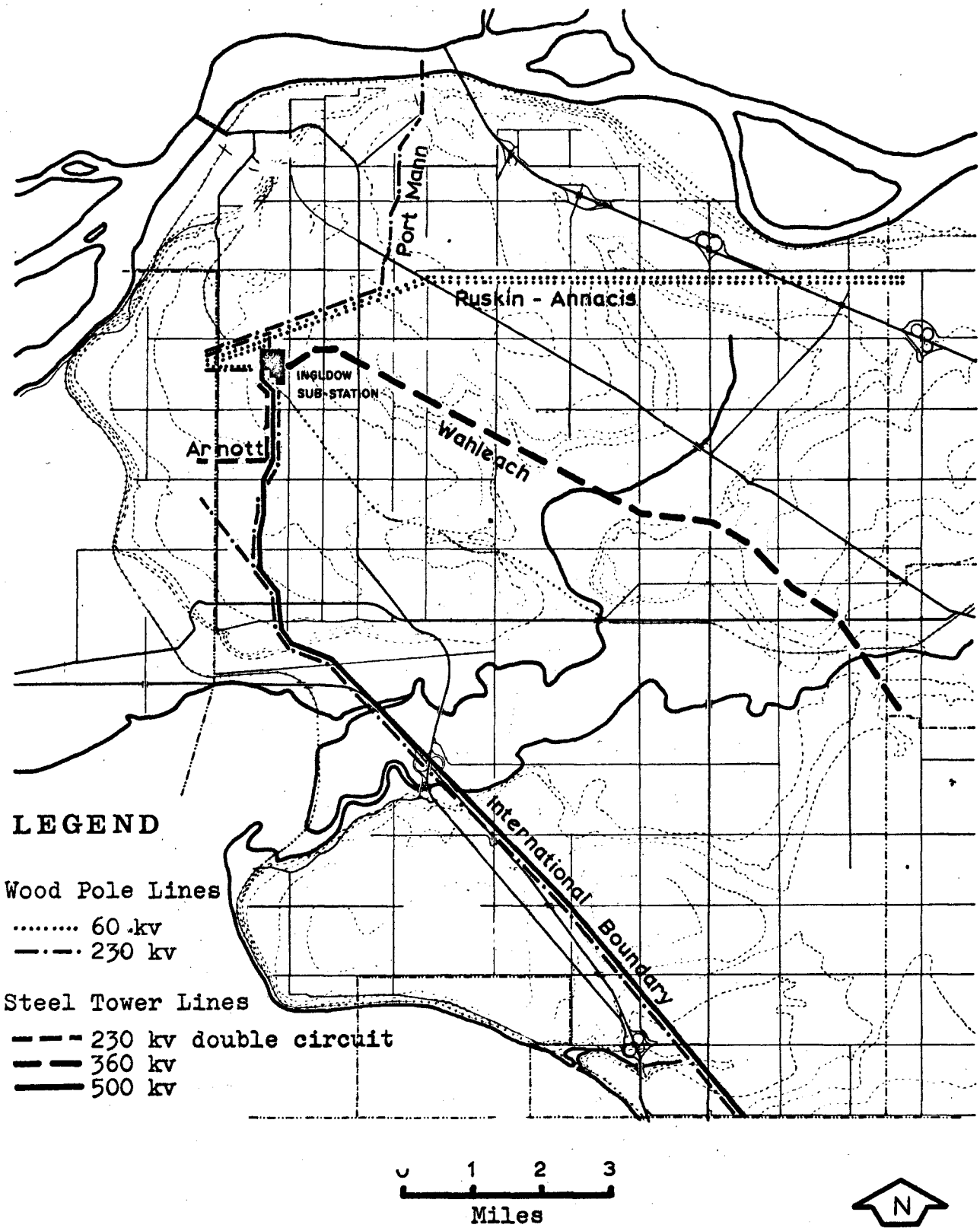
LOCATION OF THE DISTRICT OF SURREY WITHIN THE VANCOUVER METROPOLITAN AREA

FIGURE 1



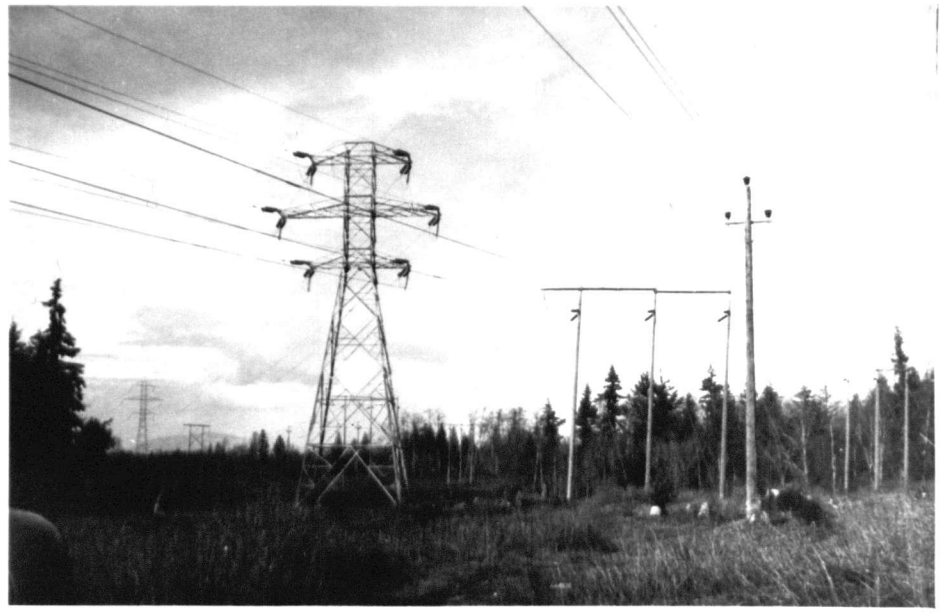
LOCATION OF MAJOR ELECTRIC, OIL AND GAS LINE RIGHTS OF WAY IN THE DISTRICT OF SURREY, 1965

FIGURE 2



LOCATION OF OVERHEAD ELECTRIC TRANSMISSION LINES IN THE DISTRICT OF SURREY - BY GENERAL TYPE

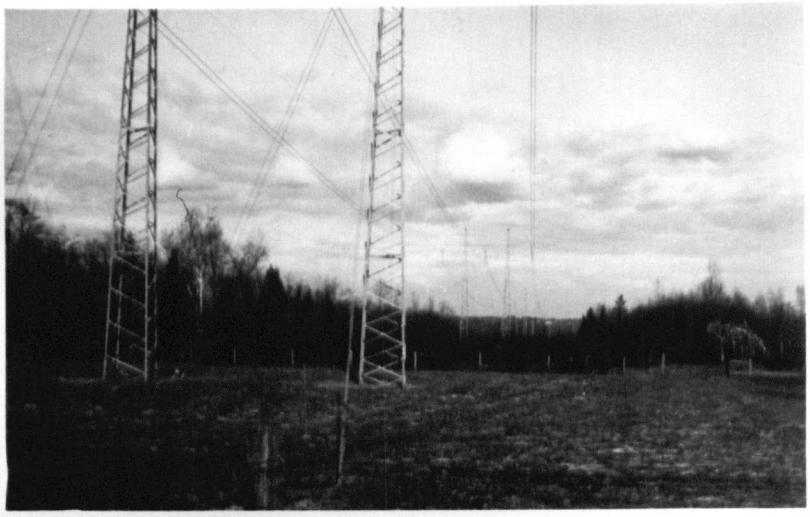
FIGURE 3

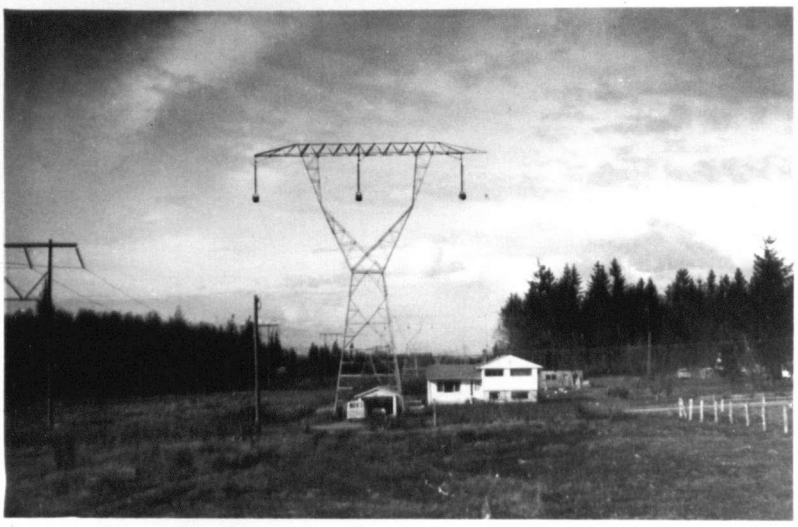


TYPICAL 60 kv AND 230 kv LINES

The structure on the left is a steel dead-end tower on a 230 kv double circuit line; a more graceful suspension tower can be seen in the left distance. The three-pole structure is also a dead-end on a 230 kv line, but single circuit; pole 'H' frame suspension structures can be seen in the distance. The single pole in the foreground is a 60 kv straight line structure.

FIGURE 4





360 kv AND 500 kv STRUCTURES PRESENTLY USED IN THE DISTRICT OF SURREY

The top photograph is of the 360 kv Wahleach Line, consisting of two-wire bundle conductors on 'portal' type steel towers. Below is a 500 kv 'cantilever' type tower line which is under construction. Each of the three conductors will consist of a four-wire bundle. Some idea of the size of the tower can be gained from comparing the house beneath it; the house will be moved.

FIGURE 5

increased from 6.5 to 8.9 per cent.[1]

2. ELECTRIC TRANSMISSION NETWORK IN SURREY

Pattern of the Network

Ingledow Substation (near the western boundary of the municipality) became the focus of the present pattern in 1952. Before that time the lines in Surrey were all of the wood pole type, some 230 kv, but mostly 60 kv. The British Columbia Electric Company Limited (which was then the organization with the authority to generate and distribute power in south-western British Columbia) decided on the Ingledow location for a variety of reasons. The importance of Surrey owing to its entrance corridor characteristic has been mentioned above. The reasons for choosing the Ingledow site over others in the municipality are the good hard-pan footing conditions, its contiguity to the company's electric railroad (which still has two 60 kv lines along it), its proximity to the crossing point of several of the existing wood pole lines, and to a decision around 1952 to build what was then an unprecedented high voltage line from Wahleach about eighty miles to the east.

The location of electric transmission line rights of way is mapped in Figure 3, page 68. There is often

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[1] Bridgeview: A Sub/Urban Renewal Study in Surrey, B.C. (University of British Columbia, Community and Regional Planning Studies, Student Project No. 4, Vancouver: the Department, 1965), p. 10.

a width variation for a right of way. Calculations based on these average widths indicate that a little less than 2.5 square miles of Surrey's total area of 133 square miles are taken up with electric transmission line rights of way. This is about 1.9 per cent of the total municipal area. Roughly three-quarters of these rights of way, 1169 acres, consists of easements on private property.[2]

Figure 3 also indicates the location of these overhead electric transmission lines in Surrey by voltage rating and general structure type. All these structures are single-circuit (that is, having only three phases) except the 230 kv. double-circuit, which has six conductors. Figures 4 and 5, pages 69 and 70, illustrate all these types as they presently exist in Surrey.

In Surrey there are presently fourteen overhead transmission lines. There are four 60 kv. lines on transmission line rights of way, plus two along the former electric railroad. These are generally on single wood poles, double pole (or 'H' frame) construction being used only at rare points such as long spans over ravines or rivers. There are five 230 kv lines on wood pole 'H' frames, including a short portion of the

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[2]G. D. Higgs, Municipal Assessor, Surrey, by interview, April 1965.

original North West Power Pool Intertie which was taken out of service when that line was diverted into the new Ingledow Substation. This disused section still remains. The 'H' frame for 230 kv is standard for straight lines and small angles; a three-pole guyed structure is used for heavy angles and dead-ends.

There are three types of steel tower lines presently used in Surrey. There is one double circuit 230 kv line, one 'portal' type tower line on the Wahleach line, and presently under construction, one 500 kv cantilever type tower line which will be an intertie to the North West Power Pool. Figures 4 and 5 depict these structures.

Visual Quality and Characteristics of the Network

For their effect on present and potential residential areas, it has been thought necessary to consider only the visual characteristics of transmission lines. The physical danger of these lines and their structures is negligible, as was pointed out in Chapter I. Radio interference for adjacent housing is either non-existent or insignificant. There is a slightly audible hum from an operating line which varies slightly in strength as weather conditions change, but it is steady and not displeasing to most people. There is a considerable hum from Ingledow Substation which is audible up to a quarter mile away, and

originating from there, too, is the occasional loud report, as from a gun, which occurs whenever the larger breakers (switches) are activated. Ingledow is located, however, in an industrial area which is expanding and taking over the scattered residential development nearby.

From the hypothetical point of view of orderly residential areas through which such lines might pass, these lines and their rights of way would be generally undesirable. There would, firstly, be a confusing variety of structures which are frequently ugly. As will be seen from Figure 3 on page 68, most of the rights of way accommodate at least two types of line with varying span lengths and widely varying structure types. Span lengths of all steel tower lines are similar, between 1100 and 1200 feet on the average, but 230 kv pole line lengths average around 700 feet, and 60 kv span lengths are shortest of all, being perhaps only 300 or 400 feet. Pole structures being what they are (frequently not upright, with crooked and discoloured poles), the close spacing makes a large right of way having several of these lines look like a brown forest when viewed down the line or at shallow angles.

Steel tower lines in the area, though not free from fault, do not suffer from most of the above disamenities. The wider spacing of the towers longitudinally allows an evident

and graceful sag of the conductors. This, together with the psychological importance of the structure results in a progression of long curves separated by strong nodal points. The curve itself cannot be altered, and should not be, for the catenary curve is naturally graceful. The towers themselves, usually lack gracefulness, though their symmetry gives them an advantage over pole structures.

No utility right of way in the municipality appears to receive any attention from the Authority simply for appearance. Some are covered by tall, jungle-like brush. On others the brush appears to be cut more regularly. Some of the latter, however, are vast deserts of weeds. Generally, only the rights of way through agricultural areas have an orderly appearance. There is an occasional example where the owner of a small holding has developed turf on his portion of the easement.

A right of way which has been acquired for a future use, especially if acquired from the municipality, becomes a sort of no-man's land. The acquisition amounts to a detriment to development, for though the utility is not using it, no one else sees any incentive to its use. The large right of way leading south from Ingledow is a case in point. The centre of it has lain empty for many years, though now the new 500 kv line will occupy part of it.

3. RESIDENTIAL AREA CHARACTER AND PATTERN

Residential Character in Surrey

The principal distinguishing characteristic of Surrey's residential development is the low density pattern, and 'scatteration'. Apart from an area around Whalley in the north-west, and a few small areas elsewhere, development may best be described as sprawling. Though formerly rural, the north-western portion (where most residential development and most of the transmission lines are located) has never had large-scale agriculture, for the soil is an upland type consisting of a thin gravelly mixture overlying glacial till. This area has attracted to it in the past residents who desired small acreage holdings, and who were willing, in return for the amenity of space, to provide many of their own services.

Now, however, this part of Surrey has become caught up in the general metropolitan expansion, and more and more people are occupying urban sized lots in the area. As was mentioned at the beginning of this chapter, the population of the municipality is increasing more rapidly than the metropolitan area as a whole.

Residential development in Surrey is not the middle class suburban type. A visual examination of development suggests this. A comparison of employment categories of employed persons in the municipality with those for the metropolitan area

tends to confirm the impression. The percentage of Surrey's labour force in the managerial, professional and clerical groups is significantly lower than in the metropolitan area, while the percentages in sales, primary production, craftsmen, and labourer groups are much higher.[3]

The population density in Surrey is illustrated in Figure 6, page 83, by quarter sections. It should be noted first that only one of these quarter sections has ten persons per acre or over. This density may be considered a rather low one for the established residential suburbs of a central city. An area of fity foot lots and single family dwellings would house about seventeen persons per acre. This quarter section is some distance away from the nearest overhead transmission line. The remainder of Surrey's residential area has generally a much lower density still.

In an important respect sprawl emphasizes the problem of transmission lines which are a disamenity for housing. The low density, and therefore the low per acre assessment, militates against the use of more desirable forms of utility construction whenever the latter imply higher costs. From the viewpoint of the larger overall community, an evaluation of social costs and

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[3] Bridgeview, op. cit., p. 39.

benefits will tend to allocate less funds to mitigate disamenity in a sprawled area than in a more dense and efficient area. The particular character of Surrey's residential development, insofar as it tends to be of a lower quality than in other suburban areas (as was outlined above) tends further to aggravate this problem.

There is evidence that contiguity to overhead transmission lines as they presently exist in Surrey, adversely affects the value of urban-sized residential properties. The Municipal Assessor is firmly of this opinion, and to illustrate his convictions, he cited the case of a large subdivision near Johnston and Townline Roads which was developed about 1958 by a real estate company.[4] A portion of this development takes in the full width of the Ruskin right of way which carries two 60 kv wood pole lines. Many of the lots are not yet sold, and the Assessor holds that the following three conclusions may legitimately be drawn. The last lots sold are those partly within, and those immediately adjacent to, the right of way. Secondly, the developers found it necessary to increase the size of those lots affected by the right of way in order to sell them at the same price as others more distant from the right of way.

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[4]G. D. Higgs, Municipal Assessor, by Interview, April, 1965.

Thirdly, the Assessor feels that the presence of a right of way will hold back a parcel of land from the subdivision market if alternative subdividable properties are available in the area.

Evidence demonstrating the effect of overhead transmission lines upon the sales prices of residential properties is very difficult to obtain. However, the conclusion which may be drawn from Surrey's assessment practice is much clearer. A schedule of assessment decrease due to easements of electric transmission lines was part of the municipality's submission to the National Energy Board in the dispute over the location of the 500 kv intertie to the North West Power Pool in 1964.[5] Of a 1962 assessment of $1,585,487.63 of all private properties having electric transmission right of way easement, a total of $215,802.65 was deducted owing to the presence of the easement. Obviously, pressures from property owners have been largely responsible for bringing about this decrease, for the municipality feels strongly that it is being deprived of needed income. The solicitor for Surrey, J. Galt Wilson, makes this case at length in the municipality's submission to the National Energy

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[5]Unpublished document, Assessment Department, District of Surrey.

Board.[6] Most of the land upon which electric transmission rights of way lie is zoned some form of residential.

A qualification must be made in this matter of adverse effect upon residential properties in Surrey. This is that the evidence for the existence of an adverse effect upon residential property values caused by an electric overhead transmission line is in general confined to urban sized properties. Both the Land Division Manager of British Columbia Hydro and Power Authority, and the Municipal Assessor are of the opinion that many of the resident owners of small acreage holdings regard contiguity to a right of way as an advantage, regardless of its inherent disamenity. Two motives are advanced. Some place a high value upon privacy and freedom from potential neighbours, and others value the openness of prospect which even the present rights of way generally afford. The independent appraisals carried out at the instigation of the Power Authority give weight to this factor, as might be expected.[7]

Though the Authority has evidence that the value of small holdings properties is not adversely affected in a con-

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[6]Unpublished submission of Solicitor for the District of Surrey to National Energy Board of Canada, In the Matter of the National Energy Board Act and In the Matter of an Application of British Columbia Hydro and Power Authority for a Certificate of Public Convenience and Necessity to Construct a Second Transmission Line to the Northwest Power Pool, November 1, 1963.

[7]Unpublished appraisals in the files of British Columbia Hydro and Power Authority.

sistent fashion, on the other hand, the Authority has little, if any, evidence that the value of urban-sized properties is not adversely affected. Such evidence is especially lacking in those portions of metropolitan Vancouver where orderly, non-scattered development has been the intent and apparent need. The fact that there is little direct evidence that the values of urban-sized properties have been affected by the presence of transmission lines should not be taken as proof that the effect does not occur. A positive answer to this question of effect on property value will only be attained as a result of detailed comparative study of various types of residential development. It should be emphasized at this point that effect on adjacent property values is only one aspect of the total possible impact which transmission lines may have on the residential community.

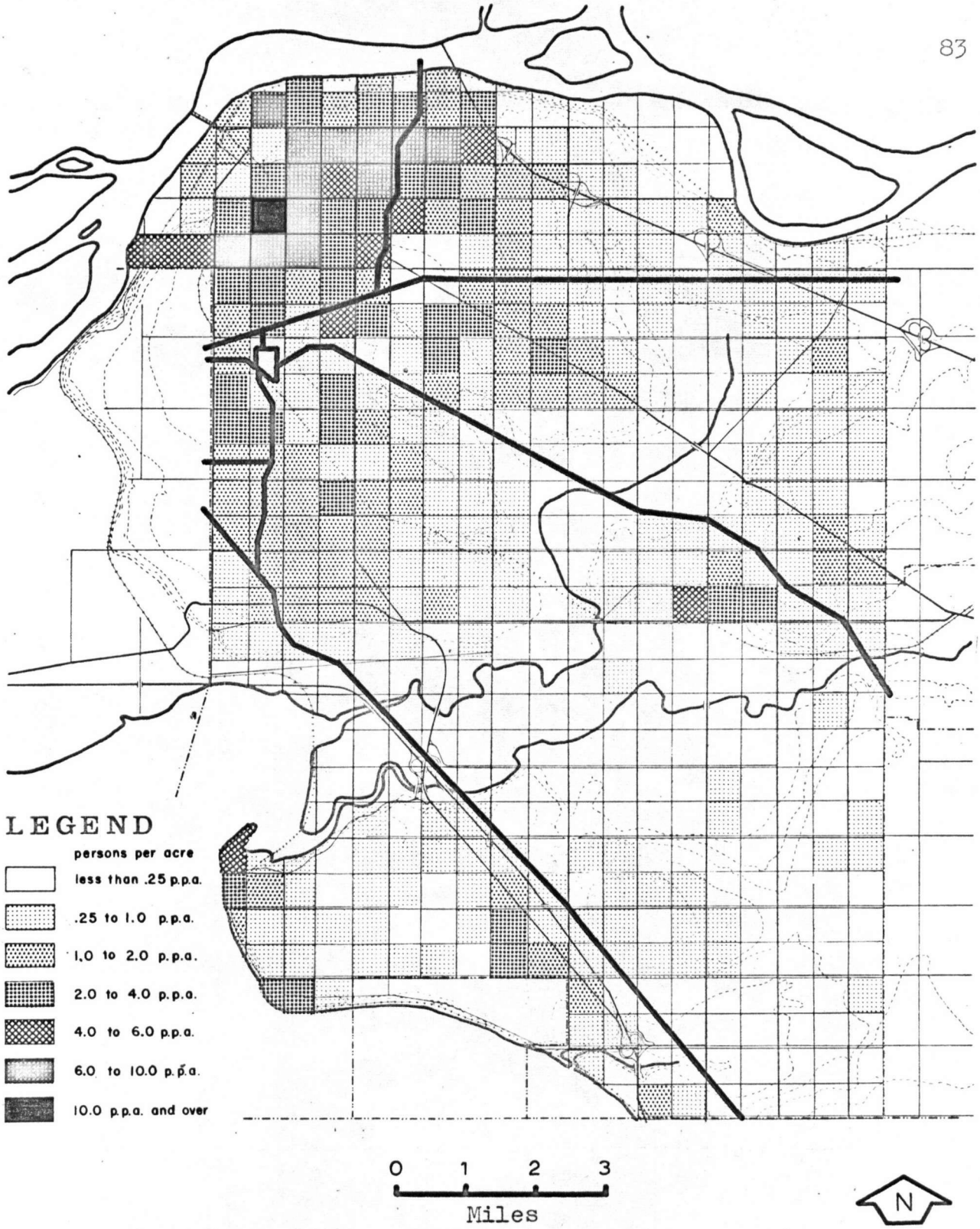
The impact of rights of way as they presently exist in Surrey upon adjacent housing cannot be fully described without consideration of equally important but more subjective elements. The general visual milieu created by these utility works is more difficult to describe than numerical property values, but is not therefore less deserving of examination. Though sprawl, scatteration of development, and the working class character of the Surrey suburban community may not be the results of the

presence of these large power lines and their rights of way, nevertheless, the existence of these features in their present form does nothing positive to overcome these limitations. The fact is that the condition of the rights of way is so unattractive as to constitute a disamenity for adjacent housing, and especially for housing at urban densities. The views shown in Figures 7 and 8, pages 84 and 85, are representative of rights of way in residential and small holdings areas in Surrey. Figure 9, page 86, shows two attempts at improvement by local property owners, but these attempts are rare.

The argument that the condition of rights of way in Surrey has no effect upon housing is in one respect ethically untenable. This is to argue that the present relatively low residential quality standards adjacent to the lines are proper for the area. Not only is this stand discriminatory toward the present residential community in Surrey, but it makes difficult any community action aimed at improving the general residential condition.

Residential Pattern in Surrey

Considering the Surrey residential community on a broader and more general canvas than the local residential development closely adjacent to overhead power lines, certain broad patterns appear. There is evidence that the location of these lines correlates



TRANSMISSION LINE RIGHTS OF WAY
AND POPULATION DENSITY BY QUARTER SECTION
IN THE DISTRICT OF SURREY, 1961

FIGURE 6

RIGHTS OF WAY IN FORMERLY RURAL SMALL HOLDINGS AREAS IN THE DISTRICT OF SURREY

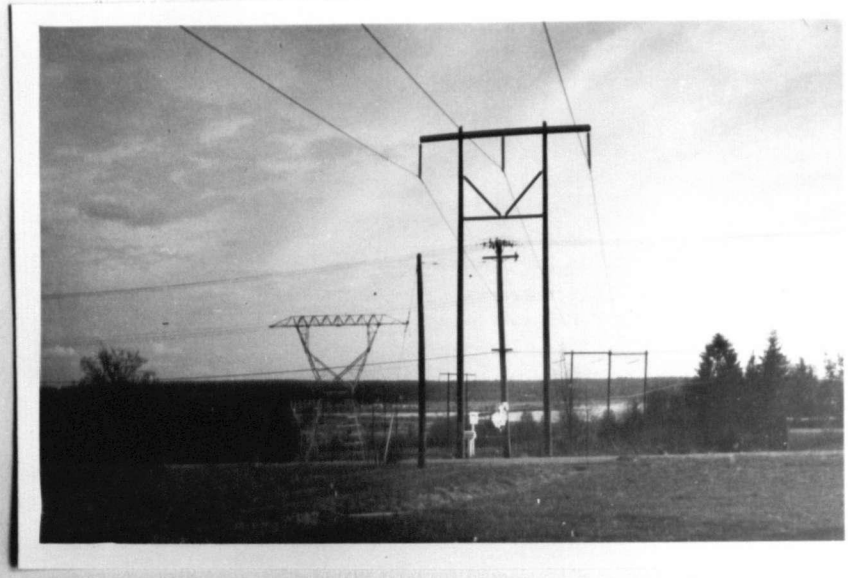
Both photographs are looking east from the King George Highway. Above is the Port Mann and Ruskin right of way, and below is the Wahleach Line. The lower view shows a joint use of a right of way, but it also illustrates a prevalent attitude toward electric transmission lines.

FIGURE 7

RIGHTS OF WAY THROUGH RESIDENTIAL AND SMALL HOLDINGS RESIDENTIAL DEVELOPMENT IN THE DISTRICT OF SURREY

The upper view illustrates a fairly good quality house and the quality of the adjacent right of way. The lower view shows a right of way which has been allowed to grow up in weeds and low brush; the effect is barren. In actuality, some quite high quality residential subdivisions border this right of way, but are separated from it by a screening of brush and trees.

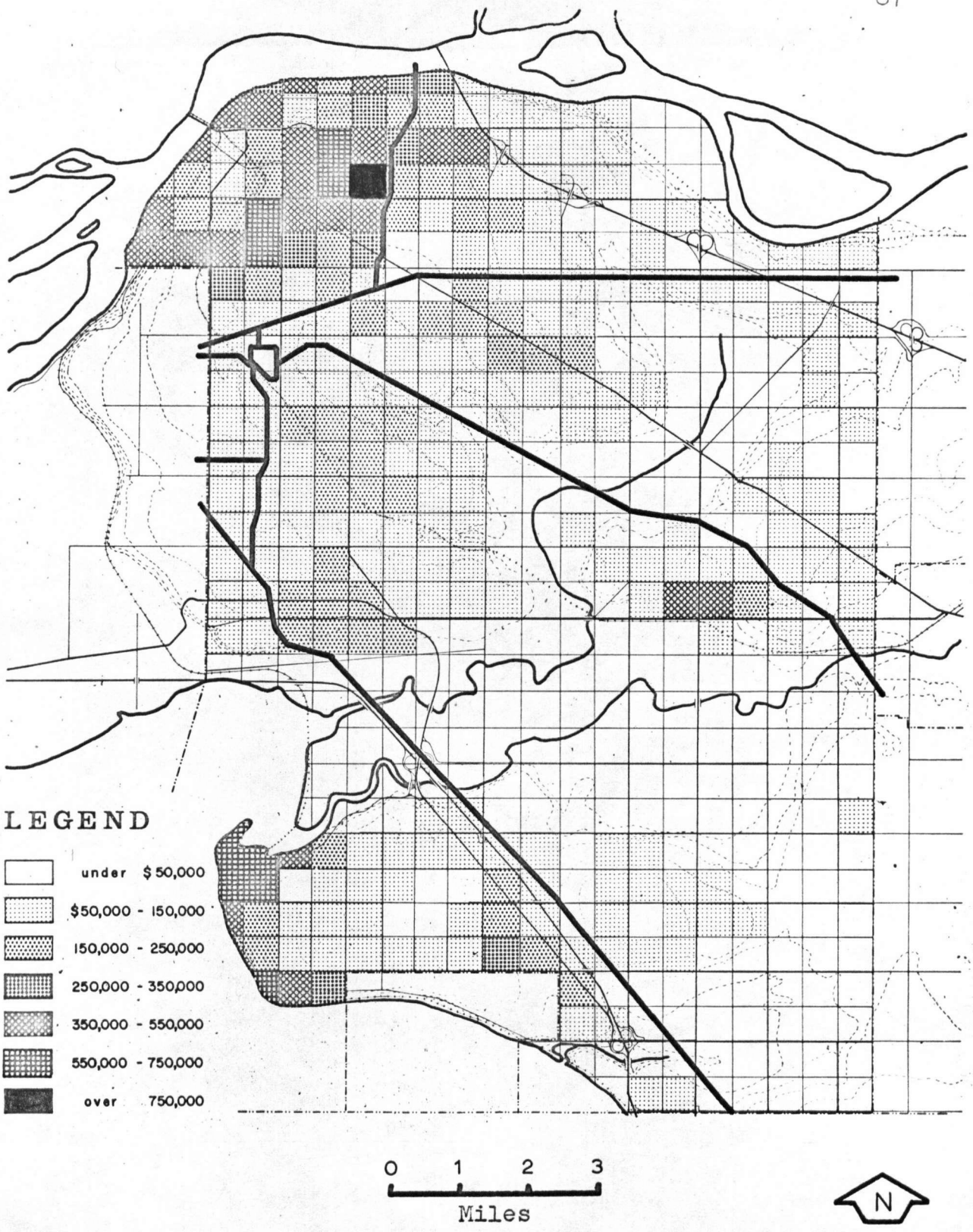
FIGURE 8



RIGHTS OF WAY WHICH ARE IN DUAL USE OR HAVE RECEIVED SOME ATTENTION FOR APPEARANCE

The upper view is from Panorama Ridge and shows an adjacent householder's efforts to maintain the turf. However, the unorganized array of structures places a limit upon the individual's scope for improvement. The lower view merely demonstrates the possibilities for dual use; such development does not lessen the unpleasant appearance of the forest of poles.

FIGURE 9



TRANSMISSION LINE RIGHTS OF WAY
AND ASSESSED LAND VALUE PER QUARTER SECTION
IN THE DISTRICT OF SURREY, 1964

FIGURE 10

negatively with both present assessed land values per quarter section, and gross population density per quarter section. Figure 6 on page 83 and Figure 10 on page 87 spatially relate these two elements to the location of overhead line rights of way in Surrey.

That there is correlation between transmission line locations and both these elements there is little doubt, but that the lines may have a causal relationship is a matter requiring examination. The question is: what other factors may have caused these distributions of population and assessment independently of overhead transmission line rights of way? The examination may reasonably be confined to evaluation on a quarter section basis. General topographical examination, for instance, reveals that both power lines and residential development eschew low-lying bottom land for the most part. It was demonstrated in section 3 of Chapter II that suburban residential areas have some of the same optimum requirements as large overhead transmission lines in matters of topography and soil characteristics.

The location of arterial roads has probably had the greatest effect upon the present distribution of population and assessment. These have been in existence for several decades, probably prior to the location of the earliest transmission lines. The latter have tended to have been placed intermediate

between these arterials and parallel to them where possible. However, a close examination of Figures 6 and 10 (pages 83 and 86) suggests that the variations between the quarter section units are so pronounced in the vicinity of the rights of way, that the presence of the latter must have had a significant effect. Other factors are insufficient to explain the full effect of the correlation.

It is necessary to observe that the quarter section line boundaries may not coincide with boundaries of actual land use, or with boundaries in terms of the elements of assessment and population. It should also be observed, however, that a quarter section is a small part of Surrey's total area of some 133 square miles; these units are 1/530th part of the whole area. The elimination of the non-urbanizing areas of Surrey from the fraction still results in the unit being quite fine, less than one per cent of the urbanizing area. The apparent coarseness of the quarter section unit does not, then, disqualify the conclusions that there is correlation between assessment and population distribution, and the presence of transmission line rights of way.

4. RESOLVING LAND USE CONFLICTS

In essentials, the roles and powers of the utility agency, the municipality of Surrey and its Planning Division,

and of individuals are as outlined in the parallel section of Chapter II, which has general application.

As is the case with most fully publicly owned utility agencies in North America, British Columbia Hydro and Power Authority is exempted by statute from regulation by the provincial regulating board, the Public Utilities Commission, with the exception of certain matters affecting public transit franchises. It will be seen, therefore, that those powers which the Commission may exercise over private utilities in restraining and directing the bodies involved, with a view to forwarding the public interest, are lacking where the above Hydro Authority has jurisdiction.

It was pointed out in Chapter II that, before the expropriation of the British Columbia Electric Company in 1961 and the consequent forming of the present Hydro Authority, the Public Utilities Commission prevailed over both the company and over the powers of the municipalities as set out in the Municipal Act. This has meant, in short, that the formal powers of the municipalities to achieve desired ends in the face of opposition by the electric utility, though not high before 1961, have been reduced still further.

However, counteracting this decrease in statutory powers of municipalities to have a voice in land use decisions involv-

ving the utility agency, through other channels there has been a slow and gradual increase of the powers of municipalities and coordinated citizen groups. Owing to the municipality's strategic location for long distance utility works, Surrey has been the battleground for several significant test cases involving municipal right to control utility development.

The first case to be described involved a natural gas trunk line, but the principle had equal implications for power transmission line location. In 1955 the British Columbia Electric Company applied to the Public Utilities commission to build an eighteen inch high pressure gas line which would cut diagonally across the District of Surrey. The municipal manager was informed (ill-informed, as it turned out) by an official in the Department of Municipal Affairs that the District could legislate by zoning by-laws to control the locations of utility transmission lines. The electric company succeeded in its case to the Supreme Court of British Columbia in having Surrey's by-law amendment quashed, as being ultra vires the council and bad for uncertainty.[8] In 1956, the British Columbia Appeal Court upheld this decision.

However, before the Appeal Court judgement was brought down, the municipal council and the newspapers made capital of

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[8]Norman Pearson, "Multi-Purpose Powers in Designating Land Use vs. Single-Purpose Public Utility Powers in Utility Location". (Unpublished graduate student paper, University of British Columbia, Vancouver, 1963), p. 5.

reports that company property agents were habitually misrepresenting facts to property owners. Supporting the municipality at this time, the Lower Mainland Regional Planning Board (an advisory body) delivered a report stating that diagonal construction would impair property values and reduce the possibilities for residential development.[9] The combined effect of these forces resulted in British Columbia Electric Company agreeing to construct its gas line in easements parallel to Surrey's street lines. Essentially, public pressures had succeeded in attaining this grid pattern location; it can be seen in Figure 2 on page 67. The legal issue was subsequently taken to the Supreme Court of Canada, and again the company was upheld.[10]

The second case occurred after the British Columbia Electric Company expropriation, the Public Utilities Commission then having no jurisdiction. The present Hydro Authority applied in January of 1964 to the National Energy Board of Canada for a Certificate of Public Convenience and Necessity to construct a 500 kv electric transmission line to the international boundary from Ingledow Substation, parallel to an existing 230 kv wood pole line. The latter had become inadequate as an intertie line connecting the British Columbia system to the remainder of the North West Power Pool. As the obsole-

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[9]Norman Pearson, op. cit., p. 9.

[10]Surrey v. B.C.E.R., 1957, SCR 121.

scent 230 kv line passed through some of Surrey's most valuable residential property, the municipality decided to press for a new location of the proposed line further to the east. Surrey's proposal involved parallelling the Wahleach line in the direction of Cloverdale for some four miles, thence due south through agricultural land until it met the existing right of way not far from White Rock.

Surrey therefore represented itself to the National Energy Board as an interested party to the application of British Columbia Hydro and Power Authority. The Board decided that Surrey was an interested party. Surrey's submission revolved around several arguments, essentially orderly development of the municipality, and amenity and costs for the community.[11]

Though the Board did not grant Surrey's application, the solicitor for the municipality holds that two important precedents have resulted.[12] Firstly, it is important that, for the first time in boundary crossing questions, a municipality

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[11]Unpublished submission in the matter of National Energy Board, loc. cit.

[12]J. Galt Wilson, Solicitor for the District of Surrey, by interview, April 1965.

could be considered an interested party. Secondly, it is important that a question of route has been established as a matter for a public hearing.

5. PROBABLE DEVELOPMENTS IN SURREY

There can be little doubt that Surrey will continue to grow more rapidly than the metropolitan area of Vancouver. It may undergo fundamental changes in the process, but the exact form that these changes will take is difficult to predict.

What can be predicted with more certainty is the building of new and larger transmission lines in this municipality which is already too well endowed with them. At least five more very large overhead lines are planned, one more to the international boundary, one beside the present 360 kv Wahleach line, and a third either to the north side of the Fraser River or again up the Wahleach line. It would appear that two more 230 kv double circuit lines are planned, one beside the present one to Arnott near Ladner, and one in the direction of Annacis Island.

As for residential development, the one certain prospect is that the area will become more urban, whether following a plan or not. Concomitant with this will be a decrease in the small acreage holdings. The requirements of this group for privacy above all else will have to give way for denser development, if only because of the rising costs of servicing. The

overall result will probably be less tolerance for the present pattern of disamenity rights of way and unattractive pole structures, especially of the smaller lines. Even partial implementation of the suggestions contained in Surrey Planning Division's reports will accelerate the conflict inherent in the contiguity of present transmission lines and residential areas.[13]

6. CONCLUSIONS

In conclusion it may be stated that the adverse effects of present transmission lines upon the values of adjacent properties is difficult to demonstrate, but it may be inferred. The subjective elements, principally the visual effect, cannot justifiably be ignored simply because they are difficult of quantification. It is possible to make a strong case for the overall pattern effect brought about by these large lines and their rights of way, but the effect is not absolutely provable. For though it is not possible to isolate the transmission line system from other possible causal factors, the correlation between the location of the rights of way and the distribution

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[13]District of Surrey, Planning Division, Perspective '81 (Community Plan Series, No. 9 Surrey, British Columbia: the Division, 1965), passim.

of population and assessment is so strong that the contention is difficult to disprove.

The outlook is for more lines to serve the metropolitan area at the expense of Surrey (for the municipality suffers notwithstanding the small financial payments accruing from these lines). It is inequitable that Surrey must pay, in the form of disamenity, a disproportionate part of the costs for a service which will benefit the whole of the metropolitan area.

CHAPTER IV

IMPACT OF TRANSMISSION LINES ON SUBURBAN AREAS AND THE NEED FOR THEIR ORDERLY DEVELOPMENT

Electric transmission lines are increasingly conflicting with residential requirements in the outlying suburban portions of expanding metropolitan areas. The effects of these lines upon the form and quality of residential development requires that there be some development coordination. Certain technical facts and limits should be borne in mind, however.

1. TECHNICAL PARAMETERS AND LIMITATIONS

As a first step in any comprehensive evaluation of the effects of electric overhead transmission lines upon our urban areas, it is necessary to recognize certain basic facts. It is all too easy to recommend that all overhead lines be put underground. This is, in an important sense, a failure to face up to the problems of lines. To sweep the power lines out of sight is simply to deplore them. A more positive approach is necessary. The following list of facts, at least, must be considered.

1) The apparently simple problem of population growth, apart from its obvious implication for greater power consumption, usually means in urban areas that the greatest growth

will occur in the land around the city where the large transmission lines are most common. Though this growth may be planned, its texture will not likely be as dense as that in the central part of the area. Low density raises the question of how much and what proportion of funds are justified as an expenditure to achieve amenity.

2) The demand for electric power is increasing much more rapidly than population growth. The result is a need for more lines at higher voltages.

3) Added to the above two elements of increase is the still further element of our increasing expectation of complete reliability of service. This implies reserve systems of transmission. Though often justified on the grounds of reliability, the long-distance intertie lines (such as those that join the systems within the North West Power Pool) are also developed simply to allow more efficient use of resources.

4) A large number of our present overhead transmission lines are decidedly unpleasant visually, and undoubtedly have some effect upon the potential of adjacent land for the more desirable categories of residential development.

5) Some of the forces which make the undergrounding of transmission lines economically acceptable in the central city are lacking in suburban areas, and they may remain so for some

while. The reasons are two. The utility agencies of two or three decades ago did not foresee the tremendous growth of future demand. The acquisition of further overhead line rights of way there now is more expensive than the high costs of building an underground system. The second reason is that there is a technical limit to the length of high voltage underground AC circuits, and the suburban area lines must often be larger than the limit.

6) There is an almost staggering number of official entities which are capable of making significant decisions affecting the routes and design of transmission lines. Federally there is the National Energy Board which controls all provincial and international boundary crossing points and routes leading to them. The Department of Transport controls all crossings of navigable waters and high spans which may endanger aircraft. The Departments of Indian and Veterans' Affairs, and the National Harbours Board are an additional three.

Provincially, the Public Utilities Commission is the principal body where it applies. The British Columbia Energy Board is empowered to carry out significant duties which could affect decisions. The Department of Lands and Forest, [illegible] and Water Resources often makes significant decisions through each of its separate services, and the Department of Highways may make important decisions, not to mention the Parks Branch.

Each railroad has its own crossing standards, some requiring heavy dead-end structures and others not. Locally, the water boards may make important technical stipulations. The school districts and the municipalities strive to control construction as they see their needs, but without an official voice. The regional planning boards may make recommendations which sometimes are effective.

The rapidly increasing need for power has presently outstripped technical abilities to build the highest voltage lines in cable form for undergrounding. This problem will probably be overcome, possibly in not too many years, and perhaps developments in DC transmission will facilitate this. However, costs may always be higher than overhead. In the non-intensive areas on the fringe of large metropolitan areas the question is raised whether undergrounding may always be necessary and justified.

In the long run, and in the overall community, the public interest must be recognized as an array of requirements which are far more complex than the criterion of cheapest possible power to the user. There are other costs than the purely economic, and the fact that costs and benefits may be secondary, and even intangible in dollar terms, does not lessen their significance. Only after the total costs are weighed against the

total benefits can the important development questions of 'where', 'what form' and 'when' be decided.

2. IMPLICATIONS OF TRANSMISSION LINES FOR THE FORM AND QUALITY OF SUBURBAN DEVELOPMENT

The most important observation is that, for good or ill, right of way location decisions made in early years have influenced and sometimes determined the present overall pattern of residential development. When these decisions were made, the areas though which the rights of way passed were either undeveloped or entirely rural, and no adverse effects seemed likely. The result has been, however, that past decisions made by one agency (or even one man) simply on the basis of technical determinants and economic criteria for the utility project have been responsible for the present form of urban areas.

The second important fact is that in the suburban residential areas near these lines, the conclusion is indisputable that overhead transmission lines which have ugly structures and unmaintained rights of way <u>do</u> have an adverse effect upon the quality of adjacent development. This effect is most marked in those areas which are striving for urban standards of residential density and neighbourhood amenity.

That even those transmission lines which are structurally attractive appear acceptable only in farming areas points immediately to the problem of right of way maintenance. In a broader and more useful sense, the problem is failure to integrate the lines with their surroundings. It is completely incongruous that whereas agricultural areas are not greatly disadvantaged by the presence of a well designed line, residential areas, on the other hand, suffer a great disadvantage. In point of public need, the opposite would be the tolerable condition.

In urban areas, no 'natural' economic forces exist which would obviate the adverse effects. In rural areas of pasture and tilled fields, modern transmission lines are attractive because what is best for the former is at the same time either the best for the utility agency, or at least acceptable to it. Neither party, in other words, is due any special credit for a desirable state of affairs.

There is no doubt that precise and scientific quantification of the effects of power lines upon residential development could be carried out. For example, studies of the effects upon property values should be made. In a real sense, however, demand for such financial proof is often quibbling. The critical issue may be stated interrogatively. What res-

ponsible citizen possessed of even a modicum of regard for the appearance of his home environment would not be disturbed by having one of the present suburban rights of way at his doorstep?

The suggestion of avoiding diagonal locations for rights of way, and similarly limiting their adverse effects upon property values is essentially negative. The problem is not how to screen and hide the lines, but how to adapt them, how to use them attractively, how to integrate them with residential areas.

The fact is that overhead transmission lines need not be unattractive. Competent architectural attention to total visual effect is completely lacking in British Columbia and possibly in North America. A positive approach could find multiple use for rights of way and so have them contribute to the suburban area pattern instead of splitting it as so often occurs at present. A landscaped right of way could safely allow some trees in selected positions, and thereby provide both park facilities and defining boundaries to residential neighbourhoods.

Almost equally important with the effects which power lines may have on the areas they pass through is the simple fact of the tremendous amount of land which they use, and thereby alienate for most urban uses. Rights of way of 450 feet wide

are now common in Surrey, and widths up to 600 feet are projected for the future. Practical dual use of this land is possible, and green strips which are neighbourhood divisions could be one of the most desirable. Governmental action and coordination are necessary for achieving these ends, however.

3. NEED FOR TRANSMISSION LINE DEVELOPMENT COORDINATION

Such a weighing of total costs and total benefits precedent to decisions for constructing transmission lines cannot be carried out effectively under the present system in British Columbia. The list of affected, or decision-making bodies outlined in the preceding section suggests that even coordination would not be ideal.

The realities of the governmental situation in Canada require that the provinces have essential control in all matters which have provincial areal scope. In all questions which have ramifications only within provincial boundaries, it would be desirable (perhaps essential) that the provincial government's role be an integrative one.

The two greatest shortcomings of the present arrangements are firstly, that local government, which is the body with the greatest concern in matters of adverse effect caused by transmission lines, is the one with the least amount of statutory power of control. The second is that provincial government

action is by practically independent departments, branches and boards.

The recently passed Bill 83 of the British Columbia Legislature could have provided some modicum of coordination of transmission line development matters if the Hydro and Power Authority had been given a place in the Technical Planning Committees of the Regional Boards.[1] The limited areal extent of each board makes the system somewhat inadequate for settling questions of location of long distance power lines.

It would seem that the only answer is an integrating Development Department at the provincial level. Truly regional-sized boards under such a department could well seat federal agency technical representatives, those actions could be co-ordinated with needs.

4. EVALUATION OF THE HYPOTHESIS AND THE SCOPE OF THE THESIS

The hypothesis upon which this study was based, and upon which analysis was carried out, has not proven to be valid in its entirety. It was phrased: "Because the location of overhead electric transmission lines has had considerable influence

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[1]British Columbia, Bill No. 83, being An Act to Amend the Municipal Act, as passed Third Reading on the 26th day of March, 1956 (Victoria: Queen's Printer).

(sometimes adverse) on the spatial pattern of residential development, there is need for coordinating the requirements of the utility agency and the appropriate planning agencies."

It has become evident during the study that many provincial level departments must take a large role in decisions. Regional planning agencies having effective jurisdiction over relatively large geographic regions would provide conditions which would satisfy most of the needs of local area residential development which is subject to utility agency development of long distance transmission lines. To this extent the hypothesis is valid. Federal and provincial departments should not be excluded from location and technical design decisions, however.

That the location of overhead transmission lines in Surrey has had considerable influence on the spatial pattern of residential development is established, though not with entire certainty. However, the discrete changes in assessment and population density which occur at the rights of way in many places in Surrey provide strong evidence. It must be pointed out that the presence of the right of way may be a concomitant variation with some other more fundamental cause, though the writer has not been able to identify any other which is as important as the presence of transmission lines. Topography and soil conditions must be ruled out as possible causes.

That the influence on the spatial pattern has been occationally adverse is rather more difficult to establish. It would appear, however, that a right of way pattern which has been determined as a result of pure engineering and cost considerations several decades ago is likely to be arbitrary in the light of present community needs for orderly residential development. It will be remembered that there was little development of any sort near most of the rights of way when they were located.

Establishing more definite and useful answers to the problems suggested by the hypothesis could well merit further study. Mention was made that little is known of the precise effects upon values of residential properties immediately adjacent to overhead transmission line rights of way. Architectural evaluation of alternative line designs could be a valuable contribution. The possibilities for multiple use of rights of way could well be explored also.

But, perhaps what is most urgently needed is a carefully worked out system of relative values and priorities. A system of objectives for transmission lines which weighs all the costs and all the benefits - not simply the economic - would be invaluable for both the future development of transmission lines and for taking steps to improve existing transmission lines and their rights of way where they lie within the rapidly developing

fringe areas of our cities. It is inequitable that fringe area communities must pay (in the form of disamenity) a disproportionate part of the costs for a service which benefits the whole of the metropolitan area.

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