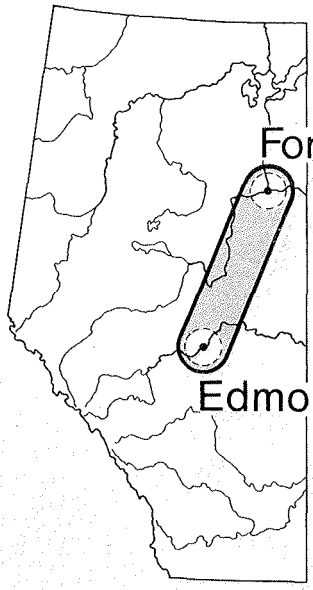
Transportation Corridor Study



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VOLUME 2 - APPENDIX

Extracts from Existing Literature Compiled for use of Study Group

prepared for

Alberta
ENVIRONMENT

by
stewart weir stewart watson & heinrichs
edmonton, alberta - june, 1973

TRANSPORTATION CORRIDOR STUDY

FORT McMURRAY TO EDMONTON

VOLUME 2

EXTRACTS FROM EXISTING LITERATURE

COMPILED FOR USE OF STUDY GROUP

Prepared for:

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By:
Stewart Weir Stewart
Watson & Heinrichs
Edmonton, Alberta - June, 1973

Note to members of the Study Group

With the large number of persons involved in this particular study it was decided that considerable time (money) could be saved by gathering into one volume extracts of available literature. Reports, studies by other groups, articles, information and literature in regard to environmental impact, transportation corridors, multi-use of rights-of-way, etc. have been reviewed and portions of some of these have been included. No attempt has been made to summarize, edit or abstract any of the material.

Generally only a portion of the report such as the introduction and/or conclusions have been included in this volume. If any members of the study group wish to study the whole report then they are available at the study headquarters (10551 - 123rd Street, Edmonton). These are being referred to during the course of the study thus cannot be taken away from headquarters.

Should members of the study group discover any further information which may be useful please forward to the Corridor Study Headquarters. If there is sufficient material then a supplementary issue will be made.

C.H. Weir, Project Manager
June, 1973

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THE TAR SANDS INDUSTRY

From Report by Intercontinental Engineering of Alberta Ltd., March/73

Alberta's tar sands industry is in its infancy when viewed in the light of its technology and growth potential. It is ideally suited, therefore, to a preventative program for environmental protection. The Alberta Government, as the custodian of the Province's natural resources, should guide the industrial and regional growth of the Area.

This new industry has many unique features. It requires massive production facilities and a large labour force. The recovery of the bitumen resource by conventional methods necessitates the disturbance of enormous quantities of earth. Huge volumes of water are consumed. Steam and electric power demands are supplied by large scale thermal generating plants. Processing facilities are needed to upgrade the bitumen to products.

The product which has stimulated the industry's growth to date is synthetic crude oil. The granting of a recent Government permit for a tar sands plant was predicated on a policy of preventing a decline in the life index of conventional crude oil below 12 to 13 years. This concept presupposes that products processed from bitumen will be used to supplement the supply of conventional crude.

Many projections have been published of the potential market demand for products from the tar sands. The conclusion from these estimates is that the demand for synthetic crude oil could amount to 1 million barrels per calendar day (BPCD) within 10 to 20 years. This projected industry level was used as the basis for quantifying future environmental impacts.

The unit ratios which interrelate tar sands, bitumen, and product have been compiled from the statistics published for the two

authorized plants. These have been modified by judgment factors and then utilized to compute the quantities of bitumen and tar sands which would correspond to 1 million BPCD of product.

There is devergence of opinion on the rate at which the tar sands industry should attain this range. Projections which are based primarily on the foreign demand for refinery feedstocks lead to the conclusion that the level of 1 million BPCD of synthetic crude should be attained within 10 years. This rapid rate of proliferation of new plants would jeopardize the technological improvements required to protect the environment. A more realistic rate of future tar sands development could be determined when commitments are made to the research recommendations in this report. Furthermore the future viability of the industry will be enhanced by the proposed research and planning.

House of Commons Issue No. 8 Tuesday, March 27, 1973
Chairman: Mr. Kieth R. Hymmen

EXTRACT FROM THE MINUTES OF PROCEEDINGS AND EVIDENCE OF THE STANDING COMMITTEE ON NATIONAL RESOURCES AND PUBLIC WORKS

Mr. Harold Page (President, Hydrocarb Consultants., Edmonton, Alberta): Thank you, Mr. Chairman, ladies and gentlemen. I sincerely appreciate this opportunity to speak to you. My remarks will be rather specific and addressed to the tar sands, more especially to the bitumen reserves that are contained in the Alberta tar sands.

The Alberta tar sands deposits contain vast reserves of bitumen, which is a naturally-occurring hydrocarbon. Let me allay any concerns you may have with regard to the map as we are only going to use it very briefly. It was a last-minute addition, really, but will give you a reference, if you wish to look at it more closely later.

If I may Mr. Chairman, I will just take a minute to point out on the map where the Alberta tar sands deposits occur, just so that you will have some concept.

The tar sands are geological deposits of sands which occur entirely within the Province of Alberta though, very recently, it was thought that one of these deposits may extend over into Saskatchewan, to a minor extent. This, just here on the map, is the largest of the deposits, designated by the geologists as the Athabasca deposit; this is the Peace River deposit and this, the Cold Lake deposit. There are some smaller deposits in this location. In total they represent approximately 8 million acres and they underly slightly less

than one twentieth of the Province of Alberta. That is the extent to which I will be using the map, but I thought it might be useful if you wanted to have a closer look at just where these sands are.

Now the bitumen occurs - impregnated in these sands - to an average content of approximately 12.5 per cent by weight. It is important to remember that bitumen is the natural resource in this case. The bitumen is a black viscous material; it is a hydrocarbon which is deficient in hydrogen, that is, it has a lower ratio of hydrogen to carbon than most hydrocarbons. Bitumen can be upgraded to marketable products by the relatively simple procedure of chemically adding hydrogen. There is only one tar sands plant currently operating and that is the one designated as the corporation, Great Canadian Oil Sands Limited. The second plant has been authorized, namely the Syncrude plant. Great Canadian Oil Sands is a corporation and 96.1 per cent of its equity is held by the Sun Oil Company, Philadelphia. Syncrude is a consortium of four of the major oil companies representing 30 per cent each: Imperial Oil, Cities Service, Atlantic Richfield; and the remaining 10 per cent Gulf.

Both of these plants are designed to upgrade the recovered bitumen to what is called synthetic crude oil, and as its name implies, this product is used as a supplement to conventional crude oil as a refinery feedstock. In actual fact the synthetic crude oil comprises three upgraded petroleum cuts, namely, naptha, kerosene and gas oil. The fact that these two plants are designed to upgrade the bitumen to synthetic crude oil has lead many people to think of the tar sands development as just another facet of the conventional oil industry, but in order to really understand the tar sands industry and its potential to Canadians, I submit that we must recognize it as a unique new industrial development.

The enormity of the bitumen reserves in the tar sands was first quantified by S.C. Ells, a federal geologist whose pioneering field

work was done for the most part by canoe and dog team between 1913 and 1931. In 1963 the Alberta Oil and Gas Conservation Board, as it was then designated, analysed the available test hole data and determined that the Alberta tar sands deposits contain 710 billion barrels of bitumen in place. I think it is important that we keep our semantics clearly in mind with this new industry. I am talking now about bitumen in place. How much of this is recoverable is another subject and we will go on to talk about that.

Of the 710 billion barrels of bitumen in place, 88 per cent of these bitumen reserves are found in the Athabasca deposit. That is the largest of the separate deposits, as I pointed out, in the northeast part of the province; and this is why the term "Athabasca" is used so frequently with regard to the tar sands, because it is the deposit that contains most of the reserves. It also happens to be the deposit in which the bitumen reserves are more readily accessible.

The value of these bitumen reserves is a function of their recoverability, which in turn depends upon the thickness of overburden covering the tar sands. Our only proven commercial technology for recovering bitumen involves the open-pit mining of the tar sands and the subsequent separation of the bitumen from the sands by the hot water extraction process. Both the existing GCOS plant and the contemplated Syncrude plant will use that proven conventional technology.

My own rule of thumb for current mining techniques would limit the permissible overburden for a viable open-pit mining operation to 120 feet. On this basis, 430,000 acres of tar sands are amenable to open-pit mining. This minable portion of the tar sands occurs within the Athabasca deposit and in the immediate vicinity of the Athabasca River.

You can arrive at different figures, naturally, this being substantially a judgment matter. One could say that within the next 10, and certainly 20, years, mining techniques and mining equipment will no doubt be improved, made even larger and more efficient, so that greater depths of overburden could be handled economically. This is quite true.

For purposes of my presentation this morning, I have taken an approach that is within the proven capability of the existing equipment; namely, 120 feet of overburden. It is on that basis that I say; there are 430,000 acres that are minable.

Now, that 430,000 acres of minable tar sands represents 40 billions of barrels of bitumen recoverable by open-pit mining. I recognize that the National Energy Board report uses a figure of 50 but have not had an opportunity to investigate the basis for their estimates. I presume this would be predicted on projections of the future capability, of handling deeper overburdens in an economically viable fashion.

It is interesting, in passing, to note that the 40 billions of barrels of recoverable bitumen by mining is approximately five times what is thought to be the proven Alberta conventional reserves.

As I mentioned at the outset, we are talking here about a unique new industry.

I personally like to avoid continual comparisons with the conventional crude, but for those of you to whom this is a necessary comparison, I would point out that Prudhoe Bay when first discovered was thought to contain 5 billion barrels of conventional oil, and therefore it was very exciting. Later it was found that it was actually 15 billion. But we are looking here at 40 billions of reserves that we know are actually there.

The technical feasibility of extracting and upgrading bitumen from mineable tar sands has been demonstrated now by four years of operating experience at the GCOS plant. Future plans, such as that conditionally authorized for Syncrude, could follow, probably at three-year intervals starting by 1978. Here again, you will hear many figures as to the frequency of these plants - how quickly they should or could be built. It is my judgment that subsequent to the Syncrude plant the most probable frequency would be three years. I think this could be reduced to two years as we get more experience in building these plants. But there are many factors which would determine the logical and permissible frequency with which the plants could be built, not the least of which is that it takes time to spend properly the amount of money that is involved.

The mineable bitumen reserves alone could support eight plants similar in capacity to that contemplated by Syncrude, for more than 60 years. The Syncrude plant is contemplated to have a capacity of 125,000 barrels per day. Eight plants of that size would have a combined capacity of one million barrels per day of upgraded products.

Mr. Woolliams: Would you say that again, please? I missed that part.

Mr. Page: Yes, sir. The mineable bitumen reserves alone, 40 barrels, could support eight plants similar to the Syncrude plant in capacity for more than 60 years. We will just run through these capacity figures a little more slowly. The authorized Syncrude plant would have a capacity of 125,000 barrels per day of upgraded produce; eight such plants would have a combined capacity of a million barrels per calender day.

Mr. Hamilton (Qu'Appelle-Moose Mountain): And that gives you a total of less than .4 billion a year - 365 million is less than .4 billion.

Mr. Page: Right

Mr. Hamilton: If .4 billion is divided into 40 billion, that is 100 years of operation.

Mr. Page: Except sir, that we are talking about bitumen . When the bitumen converts to upgraded product it gives you about three quarters of a barrel of upgraded product, so you cannot do the arithmetic directly. That arithmetic was done for illustration, to show that the 40 billion barrels of recoverable bitumen would support eight Syncrude-type plants for 60 years. I took the figure eight and the million barrels per day because there have been several reputable market projections that indicate that the demand for this upgraded product, the synthetic crude oil, could well reach a million barrels per day, some say within 10 years, from a purely market point of view. I do not feel that we could build the plants that fast and incorporate the technological improvements required. Incidentally those calculations make provision for the self-generation of energy and also an allowance for environmental exclusions.

I would like to point out that each of these new plants represents at least 1,200 permanent jobs, or that eight of them would represent 9,600 or, let us say, 10,000 permanent jobs. The construction-labour crew for each one of these plants would peak at about 2,500 men . Ideally, of course, if we could synchronize the projects, we would carry the same crew forward. So, you do not multiply that one by eight. The direct investment in one of these conventional tar sands plants will be in excess of $600 million each, or approximately six to one. In other words, there are six jobs created elsewhere for every direct job, and investment is in the order of three to one. That is, for every $100 million directly

invested in plant, there is $300 million somewhere in the supply and service industry to that basic plant.

However, we have only talked about the mineable portion of the tar sands. The mineable bitumen reserves only represent about 5.5 per cent of the total bitumen reserves in place. Most of the remaining 94.5 per cent will require different recovery techniques due to the depth of the overburden. One of the more promising possibilities involves in situ extraction using steam displacement or underground combu ion, or a combination of the two. Several field test units have demonstrated the technical feasibility of this technology and some of the bitumen processed has been upgraded in the existing plant. I estimate that a commercially viable in situ process will evolve within the next 5 to 10 years.

In 1963 the Alberta Oil and Gas Conservation Board estimated that 278 billion barrels of bitumen could be recovered by in situ methods. This vast quantity of hydrocarbon feedstock could supply another two million barrels a day of upgraded products for over 200 years.

Mr. Hamilton: It is 278 billion?

Mr. Page: It is 278 billion barrels of bitumen recoverable by in situ methods.

Mr. Hamilton: In addition to the...

Mr. Page: In addition. You can do the arithmetic on that in various ways. I chose to say that that represents an additional two million barrels a day of upgraded products over 200 years.

Over and above that there is the tar sand which underlies overburden that is too deep to mine and not quite deep enough for in situ, and it represents another 53 billion barrels of bitumen.

One of the unique features of the tar sands is that they are known to contain vast quantities of bitumen resource, and these hydrocarbon reserves should be incorporated into projections of Alberta's future production capabilities for hydrocarbons. In my opinion what is really needed to stimulate the tar sands industry is very sound industrial development planning, very comprehensive regional planning and a co-ordinated program of research and development. I sincerely believe that this represents one of the most unique opportunities for the participation by Canadians in many aspects of the evolution of this new industry; for example, in investment, in engineering design, in the career opportunities that should be available in construction, in the supply of extensive equipment and materials, in the research and development, and in the management of the operations.

Mr. Chairman, that concludes my presentation. Thank you very much.

EDMONTON REGIONAL PLANNING COMMISSION

PIPELINE STUDY COMMITTEE

WEDNESDAY, FEBRUARY 18TH, 1970 at 2 P.M.

Before considering the agenda, the Director outlined the past work of the Committee and stated that the Pipeline Study was begun in 1966 and the objective of the Study has been the accommodation of pipeline rights-of-way within the region and in particular the metropolitan area, with the minimum adverse effect upon the highest and best use of the land through which pipeline rights-of-way must go.

Although the Study initially was concerned with the major oil pipelines, it has been broadened to consider also gas lines and power lines. In considering the problem and evolving a general policy, the various interests have been carefully considered. These are:

a) the economy of land development and sound land use policies which are the concern of the Commission and its municipalities
b) the economy and technical requirements of the pipelines
c) the possible interests of users of other rights-of-way, rail, road and power, etc.
d) the interests of the land owners

The Pipeline Study Committee has met three times and a Technical Committee has met once. The progress has been as follows:

1) The Technical Committee examined the proposal for pipeline corridors on the basis of:
   a) Land acquisition
   b) Construction and maintenance
   c) Safety factors

d) River crossings
e) Type of substances to be transported
f) Distances between pipelines in corridors
g) Optimum size of corridor
h) Common carriers

2) Consideration was given to placing corridors along section and quarter section lines
3) The Provincial Subdivision and Transfer Regulations were examined regarding their stipulations on set backs from pipelines for development
4) Requirements for installation of pipelines under road allowances, etc.
5) Technical problems relating to placing pipelines adjacent to or in rail and power rights-of-way.

The Pipeline Study Committee then received the report of its Technical Committee and raised the following points:

1) Who is to have the responsibility for obtaining a corridor or corridors
2) What type of zoning will be used for pipelines in the metropolitan area
3) It was noted that under present legislation there is no way land can be acquired for a pipeline corridor and that information from the Provincial Government is that no change is contemplated
4) The uniqueness of our problem of pipelines and the infulence of the terminals in their established location in the metropolitan area upon this problem
5) The question of the future use of pipelines for other commodities than gas and oil

At the November 8th, 1967 meeting of the Committee, the following motion was put:

"Recommend to the Commission that they agree in principle to establishing corridors at certain definite locations in the metropolitan area"

The staff was instructed to prepare an outline plan showing ports of entry and possible pipeline corridors. Also it was requested that information be obtained from the Attorney General's Department regarding the limitation of present legislation in regard to obtaining pipeline corridor rights-of-way.

At a subsequent meeting held on May 2nd, 1968, the Committee considered the reply from the Attorney General's Department which stated in part:

"That under the Pipeline Act and the Expropriation Procedures Act, one pipeline owner cannot obtain a corridor to carry lines of other owners and that no changes in legislation are being contemplated at this time"

The letter also suggested that there was need for more study with particular emphasis upon:

a) determining the location of the corridor and the identities of the interest or authorities wishing to use the corridors as a common right-of-way
b) the use being made of the pipelines which will be placed together in each corridor
c) the most economical means of acquiring such corridors

The Committee then considered the staff proposals for routes for pipeline corridors in the metropolitan area. These routes were established on the factors of:

a) existing rights-of-way

b) the anticipated direction of pipeline routes entering the metropolitan area
c) the destination of the pipelines
d) anticipated direction of urban growth
e) the most direct routes out of the metroplitan area, based on Commission policy to locate pipelines on section or quarter section lines
f) concern for such obstacles as highway and river crossings

The Committee recommended to the Commission that these proposed routes be submitted to the affected municipalities for their comments and recommendations and to other interested bodies for their comments. The Commission agreed to this and to date we have received:

1) Official approval of the pipeline corridors from the County of Strathcona
2) A tabling recommendation from the City Planning Commission requesting more information on the route chosen in the southeast

The Director pointed out that according to the letter, means of obtaining a common right-of-way are not present in today's legislation. The Attorney General's Department suggests certain possible alternatives, but also emphasizes the need for more study before any proposals are made to amend the Acts.

A distinction is made between pipelines within urban limits and those beyond the limits. A suggestion is made that the Minister of Mines and Minerals could lay down a policy which would make the use of corridors mandatory outside of urban limits.

There is the suggestion that all municipalities may consider the possibility of allowing pipelines to locate in utility easements.

This would certainly require detailed consideration by the affected utilites as to the problems created.

Reference is made to the rights of expropriation which are allowed an individual under the Pipelines Act, and the limitation placed upon such rights.

The letter finally suggests that this Pipeline Study Committee should approach the various officials and boards concerned with pipelines in the Province for suggestions before proposing that the legislation be changed.

In the discussion that followed, Mr. Allman of the Department of Mines and Minerals, stated that at this particular stage, it is not the policy of the Deputy Minister to request a company to follow a particular route, rather the company proposes the route and then it is considered by the Department.

He also pointed out that new lines coming in are tending to follow other routes into the Metropolitan area, and that in building a pipeline, distances were important and that companies would try to follow the shortest route.

The City's Research Report on The Effect of Oil and Gas Transmission Pipelines on Expanding Urban Uses in Edmonton and its Environs, was distributed to the members, and on a motion by Messrs Wetter and Stapleton, was received as information.

The Director read an excerpt from a letter from Mr. Rutherford of the National Energy Board which stated:

"I believe that you could not do any better but to retain existing groups of pipelines in a corridor and continue in this fashion

not allowing any new pipeline groupings and ports of entry unless the existing corridors are completely filled. In addition, the writer is still of the opinion that you should give some further consideration to the use of median strips of twin carriage way highways as pipeline corridors. In suggesting this, the question of the safety aspects at crossings, particularly for natural gas, would have to be very stringently observed and this would be a matter for further study."

Mr. Allman further pointed out that if a company expropriates a fee simple, its title may be concelled if the pipeline is not used and this might cause complications as to ownership.

The Director summed up by stating that the action by the Commission to encourage corridors, seemed to be having a good effect.

Peace River Oil Pipe Line Co. Ltd.

The Director advised that a letter had been received from Allied Land Services Ltd. in connection with this proposed pipeline.

After discussion, it was agreed that the proposed pipeline was in accordance with Commission policy and the following motion was put:

Walker
Moyer "Recommend to the Commission that the proposed pipeline route be approved"

The Director then advised the above information brought the Committee up-to-date and called for discussion on the first item on the agenda:

1. Further consideration of the ways and means available to realize a corridor system for pipelines

He recalled the Attorney General's Department's comments which indicated that there is no means under present legislation for a third party to obtain an easement or right-of-way for use of a number of pipelines. He stated that this Commission has presently adopted the attitude that corridors should be established by policy. However, inherent in this approach is the problem of a high wastage of land because of the wide rights-of-way desired by each of the pipeline companies. This causes the corridor to become increasingly wider with a very low density of pipeline users.

Of course there are certain limitations to the closeness that one pipeline may come to another because of the need for working area for installing or repairing the pipeline. He stated that it would seem increasingly important that the Committee should discuss possible avenues for achieving these corridors with the best means available to limit the wastage of land.

The Committee examined the approved corridor routes as illustrated on the metropolitan base map. The members discussed in detail the problems presented by the present system of obtaining easements and rights-of-way. This system relies upon the desires of the pipeline company for the width of right-of-way needed and a successful agreement between the company and the land owner, subject of course to the rights of expropriation where agreement cannot be reached. There was general consensus that there was need for a central co-ordinating body if a corridor system was to work. Mention was made of the problem of the fragmentation of land at the points of entry into a corridor system.

The Committee generally agreed that further study was necessary in order to assess the feasibility of creating defined corridors

and it was recommended that the staff examine the problem further and solicit information from interested agencies and also from other regional areas.

2. Discussion of possible resolution of problems of pipelines and power line rights-of-way in the proposed areas for residential development and consideration of a letter from the City Planning Department regarding possible uses for pipeline and power line rights-of-way.

The Director read the following letter which had been received from the Planning Department of the City of Edmonton:

"The recent proposal for the development of land in southeast Edmonton for residential purposes raises the question of the use of pipeline rights-of-way. As you are aware the area is replete with pipelines and some difficulties will undoubtedly be encountered in planning aroud these lines. Previously where such lines have been encountered the right-of-way has been grassed and fenced thereby not contributing significantly to a properly designed residential environment. More recently, these rights-of-way have formed part of a walkway and park system.

I understand that there is a Pipelines Committee of the Edmonton Regional Planning Commission which has been meeting in the past to discuss the general problem of pipeline location and corridors. It would be appreciated if this Committee could be reconvened to review the problem of the use of pipeline rights-of-way and make appropriate recommendations.

Although the problem is regional in character, other communities may not yet be running into them; the City of Edmonton, however will be appointing planning consultants shortly to prepare an outline plan for the south-east area and there is some urgency in arriving at a list of some more imaginative uses of pipeline rights-of-way"

The Director advised that a question arose as to whether it is feasible for pipelines and power lines to be removed, which would be very costly or accommodated in the overall designs of subdivisions and he cited the problems created by the recent proposals for expansion of the City both northwest and southeasterly. The rights-of-way involved here are both pipelines and power lines.

The Department of Highway's representative suggested that pipelines and power lines need not necessarily have as derimental effect upon residential areas as was generally believed and cited high quality residential developments in the City which were near power lines, with no apparent adverse effect.

Other members of the Committee expressed varying opinions on the matter and the Committee agreed after much discussion that the Technical Committee should meet to consider the details of the problems and to recommend possible solutions.

The Committee then discussed proposed amendments to the Provincial Subdivision and Transfer Regulations as they affect pipelines and power lines.

Concern was expressed with the proposed amendments in that they had the effect of sterilizing more land than would seem necessary to provide adequate safety and separation.

It was agreed that the Director should seek more technical information regarding set backs and in the meantime the Provincial Planning Board should be contacted with a request to give further consideration of the proposed changes. Also, the Committee requested that the basis of the proposed set back regulations be elaborated upon in order to clarify their necessity.

The Committee then discussed the problems of pipelines within the region generally and the policy adopted by the Commission as to the

location of rights-of-way. Concern was expressed that the policy should apply equally in all parts of the region. The practicality of such a policy was questioned, particularly in regard to the concern for the economy of pipeline construction.

It was finally agreed to call a further Pipeline Study Committee meeting when the needed information and recommendations had been provided by the Technical Committee.

Meeting adjourned at 4 p.m.

Re: Pipelines Committee Meeting, February 4, 1970

The Director recommended that the Pipelines Study Committee should meet on February 18th to discuss the ways and means available to realize the "Corridor System" as proposed by the Committee previously, and to discuss the resolution of the problems of pipelines and power line rights-of-way in the proposed expansion area for General Urban in the Northwest and Southeast areas of the Metropolitan Plan as well as a letter from the City Planning Department regarding the use of pipeline and powerline rights-of-way.

It was agreed that the Pipelines Committee should meet on February 18th at 2 p.m. to discuss the above matters.

THE EFFECT OF FEDERAL REGULATIONS ON PIPELINES, April, 1970

New Pipeline Construction and Old Pipelines in Place

by William Wilson, Chief Engineer for Oklahoma Natural Gas Co.

The comments expressed are based on my own understanding and interpretation of proceedings and directives to date.

There are three regulations and one proposed guideline which will affect and control the design, construction, operation and maintenance of pipelines.

The proposed guideline is Federal Power Commission, Docket No. R-360 entitled "Selection, Clearing and Maintenance of Rights of Way Routes and Construction and Maintenance of Aboveground Facilities by Natural Gas Companies."

The Three regulations are: 1) Bureau of Public Roads, Policy and Procedure Memorandum, Accomondations of Utilities 30-4.1, 2) Pulbic Law 90-481 better known as the "Natural Gas Pipeline Safety Act of 1968," and 3) U.S. Department of Housing and Urban Development Circular, FHA 4540.2B.

The FPC "Proposed Guidelines for Interstate Gas Pipeline Construction and Maintenance to Assure Consideration of Aesthetic Values" were announced June 6, 1969, and interested parties had until July 21 1969 to offer written comments for the Commission's consideration before final action on the proposed amendments. I do not know whether or not final action has been taken to date.

The Commission pointed out that the construction of natural gas facilities "can affect scenic, historic and recreational values which are factors to be considered as part of the public interest by the Commission in determining whether facilities proposed to be constructed are required by public convenience and necessity." The FPC said it believes that rights of way should be selected to minimize conflict between the natural gas pipeline company rights of way and other present and foreseeable uses of the land on which they are to be located.

The Commission said it has come to its attention that some pipeline facilities built under FPC Certificate Authorization, "May not have been constructed with adequate consideration of the effect on aesthetic values." The FPC said its proposed guidelines are consistent with present practices of many companies.

The proposed policy statement provides that if guidelines are not followed, the FPC has the right to determine the appropriateness of any other guidelines adopted by individual companies.

The proposed amendments to the regulations would require companies to file two new exhibits with their pipeline construction applications. One would set forth the consideration given to the feasibility of using existing rather than additional rights of way and the effect of the proposed facilities upon scenic, historic, and recreational values. The other new exhibit would state whether the FPC's guidelines had been adopted, and if not, what guidelines were used.

The rule-making notice includes 25 guidelines relating to pipeline construction, 4 relating to maintenance, and 8 which would apply to construction of above ground facilities.

The guidlines would provide, among other things, that:

Rights of way should avoid scenic, recreational and historic areas; and if this is not practical, should be located in corridors least visible from public view;

Rights of way should avoid heavily timbered areas and steep slopes, and clearings should be kept to a minimum width to prevent interference with trees and other vegetation;

The time and method of clearing rights of way should take into account matters of soil stability, and protection of vegetation and adjacent resources;

Efforts should be made to prevent clearance of rights of way to the mineral soil except in the ditch itself. Where this does occur in scattered areas of rights of way, the top soil should be replaced and stabilized without undue delay by the planting of appropriate species of grass, shrubs and other vegetation which are properly fertilized;

Rights of way strips through forest areas should follow irregular patterns to prevent the appearance of tunnels cut through timber, with the oblique crossings of hills and mountains rather than straight up and down the sides;

Vegetation should be properly maintained upon existing rights of way;

Compressor stations and other aboveground facilities should be designed to comport with other buildings in the area;

Trees and shrubs should be planted in the area adjacent to above-ground facilities in order to both conceal and enhance their appearance.

Exhibits showing proposed location and statements explaining why the location of facilities shown in exhibits was selected are to be submitted. The statement shall inlcude the following:

Explanation of what consideration was given to using, enlarging or extending existing rights of way belonging either to applicant or to others such as pipelines, electric power lines, and railroads.

Explanation of what consideration was given to the effect of proposed facilities upon scenic, historic and recreational values. This explanation should indicate whether the proposed construction will have any effect on any of the districts, sites, buildings, structures,

or objects significant in American history, architecture, archeology, and culture, that are included in the National Register maintained by the Secretary of the Interior in accordance with Public Law 89-665 (1966), Sec. 101 (a) (1).

List of federal, state and local agencies which were consulted prior to the filing of the application with respect to matters of facility location and scenic, historic and recreational values.

An exhibit entitled Statement of Instructions To Employees Or Agents Of Applicant Concerning Right Of Way And Construction Activities indicating the guidelins set forth have been issued as instructions to construction personnel of applicant, contractors, sub-contractors, and Right of Way agents for all right of way acquisition activity and construction done for applicant. If applicant has not adopted these guidelines it shall file a copy of the instructions issued.

As you can readily see, the effect of this regulation will vary from company to company and it is doubtful that even the individual company can forecast the economic impact of design, construction and maintenance of pipeline rights of way and facilities to transport natural gas to market. In addition to the FPC rules, the Bureau of Public Roads is planning to control pipeline and other utility crossings to preserve the aesthetic values of adjacent countryside.

The Bureau of Public Roads, Policy and Procedure Memorandum, "Accomodation of Utilities," 30.41.1 dated November 29, 1968, prescribes policies and procedures for accommodating utility facilities on the rights of way of Federal and Federal-aid highway projects.

The provisions of this memorandum concern the location and manner

in which utility installations are to be made within the rights of way and the measures to be taken by highway authorities to preserve and protect the integrity of the highway, including aesthetic considerations and the safety of highway traffic.

The memorandum applies to new utility installations and to existing installations which are to be retained, relocated or adjusted within the rights of way of active highway projects.

I would now like to turn our attention to the second regulation I mentioned earlier, "Natural Gas Pipeline Safety Act of 1968."

An Act to authorize the Secretary of Transportation to prescribe safety standards for the transportation of natural and other gas by pipeline, and for other purposes was passed by Congress on August 12, 1968, and signed into Law August 13, 1968.

Interim minimum Federal Safety Standards became effective on August 12, 1968, and were published in the "Federal Register" Vol. 33, No. 221 on November 13, 1968. Essentially the interim code is B31.8 Code with such modifications as several of the states have made to that Code. Of the 52 jurisdictions covered by the Pipeline Safety Act, it was ascertained that 49 had safety standards of one form or another. Some states did not cover interstate facilities, some did not cover publicly owned facilities and some did not cover facilities under the jurisdiction of local authorities. In order to assure that no gaps exist in Federal Interim Standards it was decided that where a state had a safety code, regardless of its stated limitations, it would be considered to be the Federal Minimum Interim Standard for all gas facilities within the state. For those jurisdictions with no safety standards the USASI B31.8-1968 Code was declared to be the Federal Interim Standard.

Since the Office of Pipeline Safety is neither staffed nor financed to enforce the Federal Interim Standards, the states have been authorized to the extent that they have enforcement authority, under their own laws, to enforce the Federal Interim Standards on behalf of the Federal Government. It is expected that this authorization will be withdrawn with respect to interstate transmission facilities once the Office of Pipeline Safety is staffed sufficiently to perform this function.

In the event some of you have not had the opportunity or the need to follow the proceedings of the Natural Gas Safety Act, I would like to read to you from the testimony of Mr. William C. Jennings, Acting Director of the Department of Transporation, Office of Pipeline Safety. This testimony was given before the House Committee on Interstate and Foreign Commerce, Subcommittee on Communications and Power, on March 5, 1969. The following is a statement of policy which will govern the Office of Pipeline Safety in the administration of the Natural Gas Pipeline Safety Act of 1968.

"The Technical Pipeline Safety Standards Committee is a source of practical as well as technical advice, on policy as well as regulatory matters. The Act requires that the Committee be consulted on the technical feasibility, reasonableness, and practicability of proposed regulations. We shall seek the advice of the Committee on a wide range of subjects in addition to regulations. To the extent the Committee is willing to respond, we shall consult with it on all of our functions which affect the public.

"Our objective is safety. We shall issue regulations, of course, but they will not be an end in themselves. Regulation will be but one of many means of safety. We shall investigate system failures and research the causes of failures, defining safety problems and seeking solutions to those problems. We shall act as a clearing-

house for safety information, systematically distributing safety information acquired from government and industry research and development programs and from industry operating experience.

"Our regulations will establish minimum safety standards for all phases of the construction, maintenace and operation of gas pipeline facilities. They will apply to both privately owned and publicly owned systems.

"So far as practicable, we shall state the regulations in terms of performance standards rather than design and construction specifications. We shall prescribe what must be done to reach a minimum level of safety, leaving industry free to develop and use improved technological means of meeting the required level. To ensure that industry does meet the performance standards, we shall prescribe tests and analytical procedures to check the level of performance.

"Our performance standards will define the goal which must be met by those who design, build, and operate pipeline systems. Industry will have to work out the design and construction specifications in the future, as in the past, under the USAS B31.8 Code. The continued development and use of the Code will complement regulatory requirements, provided the Code meets the prescribed standards.

"Our safety regulations will be solutions to safety problems. Through analysis of system failures and other operating information, we shall identify and we shall seek a solution. The solution may, or may not, be a regulation, depending upon technical feasibility, reasonableness, and practicability. Reasonableness and practicability will depend in part on a cost/benefit analysis.

"The cost/benefit aspect of safety regulation is not a mathematical formula, weighing the cost of a regulation against the projected saving in life, injury, and property loss. The cost of complying

with a regulation can be computed in dollars, but human life and suffering cannot. The cost/benefit analysis is, perhaps, more a state of mind than a formula. But it is a critically important state of mind, one which consciously considers technology and economics along with the desire for safety, seeking to minimize the hazard to the public within the limits of technical feasibility and economic practicability.

"We shall conduct our regulatory proceedings in public. Industry, other governmental agencies, and the general public will have ample opportunity to participate - early and often - in the identification and definition of safety problems, the development of alternative solutions to the problem, and the choice of regulatory solutions (where regulation is appropriate).

"We shall seek the active participation of state agencies and their national organizations in a cooperative safety program. We appreciate their concern with local problems. We respect their experience in the promotion of safety in their state programs and hope to have the benefit of that experience in the development of a national program.

"Finally, we shall always recognize that we perform a governmental function. Therefore, while we may deal on a daily basis with representatives of the affected industry, we recognize that it is our duty to ensure that the interests of the unorganized general public are served. Thus, in every act, we shall seek to serve the over-all public welfare."

The regulatory procedures which will be followed in the developments of safety regulations have been outlined by Mr. Jennings. Initially the Office of Pipeline Safety will collect information which will serve as a basis for defining safety problems. As the problems

are defined, the staff will work out possible alternate solutions. A solution will be selected which appears best suited to resolving the problem and published as a notice of proposed rule making. The public and all interested parties will be given an opportunity to submit written comment on the proposal. The usual time period for such comment is 60 days, but may be longer depending on the complexity of the proposal.

In addition, there must be opportunity for oral testimony and argument. This may be by informal conference or public hearing.

Consideration is given to the record developed and the proposed regulation revised, if appropriate, to reflect the information submitted.

The next step is to submit the proposal to the Technical Committee which will review and submit a report, including minority reports if appropriate.

The Office of Pipeline Safety after giving consideration to the Technical Committee report will publish a regulation. In the event that the recommendations of the Committee are rejected by the Office of Pipeline Safety, the reasons for such rejection must be published.

The first step taken by the Office of Pipeline Safety in the orderly development of meaningful regulation was the letting of a contract to a research firm to initiate a study project on the types of information presently available which would serve as a basis for establishing a data collection system.

The study project has been completed and forms for reporting gas pipeline failures were proposed by the Department of Transportation

on July 8, 1969, and written comments to be submitted by September 8, 1969. The failure reports proposed included forms to be used for individual failures and annual summary reports for gas distribution systems and transmission/gathering systems. Also included was a form for reporting failures occurring during the proof testing of pipelines. A failure is defined as a detected leak or unintended escape of gas from a pipeline system.

Some of the information requested on the forms is available from company records and a portion of the information can be provided with a great deal of research and expense; some of the information is unobtainable.

The type and method of keeping records is continually changing for different reasons, such as accounting, taxes, and pipeline safety. Records which are required now are much more detailed and refined when compared to similar records required in 1900. Many companies have facilities which are 40 to 50 years old and are maintained and operated in a safe prudent manner. Some of the records of these facilities provide little more than the nominal pipe size and weight and the reporting forms today ask for the manufacturer, where pipe was manufactured, manufacturer's mill heat number and other pieces of information which are not available from most company records kept a number of years ago. This type of information is probably now being maintained by most companies.

It would be interesting to know why some of these bits of information are being requested.

Again the effect of this Regulation will vary with each company, depending on past procedures of keeping records on construction and maintenance of facilities. I am sure that gas companies which

have not started maintaining more detailed records in recent years will start now because all sizes and types of companies are responsible to the Department of Transportation Office of Pipeline Safety. Section 2 of the "Natural Gas Pipeline Safety Act" defines "Persons" as any individual, firm joint venture, partnership, corporation, association, state, municipality, cooperative associations, or joint stock association, and includes any trustee, receiver, assignee, or personal representative thereof. As you can see, this doesn't leave out anyone who is in the gas business.

In addition to the expense of more detailed record keeping and filing reports, there may be assessments on intra-state companies to help finance the Pipeline Safety program in that state.

There is such an assessment in the State of Oklahoma. The assessment is $100 per company or $1.50 per pipeline mile whichever is greater. This assessment was due and payable August 31, 1969. The pipeline miles are exclusive of gathering systems.

It is difficult to estimate the economic effect on the gas industry since to-date only the above-mentioned reporting forms have been proposed and I am sure as time goes on other portions of gas operations and maintenance will be similarly affected.

The F.H.A. Regulation, Circular FHA 4540.2B dated as of July 28, 1969, supersedes FHA Circular 4540.2A dated January 27, 1969, and establishes conditions under which residential construction may be permitted adjacent to high pressure gas transmission pipelines in new subdivisions processed and accepted by F.H.A. and V.A. after the date of this Circular. It is <u>not</u> applicable to liquid petroleum transportation systems. The following is quoted from Circular 4540.2B:

"When the gas transmission piping complies with stress levels prescribed for Type C or D construction as defined in Chapter Iv of USA Standard Code For Pressure Piping, Gas Transmission and Distribution Piping Systems, USAS B31.8-1968, or where such piping is qualified for operation in Class Locations III or IV by any of the methods provided in Chapter V, Paragraph 850.4, "Change in Class Location," of said Code, structures not exceeding three stories in height may be located not less than 10 feet from such piping, but in no case shall encroach on the pipeline easement.

"When piping complies with the stress prescribed for Type D construction or has been qualified for operation in Class Location IV under the provisions of Chapter V, Paragraph 850.4, "Changes in Class Location," of said Code, structures more than three stories in height also may be located as incated above.

"When piping does not comply with paraghaphs above, structures may be located as indicated therein provided evidence is obtainable that the pipeline operating company will comply with the requirements of USA Standard Code For Pressure Piping, Gas Transmission and Distribution Piping Systems, USAS B31.8-1968, as such requirements relate to changes in Class Location, or with other equivalent and pertinent regulations issued by the Department of Transportation.

"Evidence that the gas trnasmission piping is in compliance with the requirements of paragraphs above, or that it will be brought into compliance, shall be obtained by the subdivision sponsor from the pipeline operating company. The evidence shall consist of a certified statement signed by an authorized company executive. A copy of the statement shall be forwarded to the Architectural Division, Office of Technical Standards."

GOVERNMENT OF CANADA

EXPANDED GUIDELINES FOR NORTHERN PIPELINES

As Tabled in the House of Commons June 28, 1972

by the Honorable Jean Chretien

Pipelines "Corridor" Guidelines

Introduction

The 1970 Guidelines made provision for the establishment of a "Corridor" to enclose trunk oil and gas pipelines. The following comments and proposals relate to the application and implementation of this corridor concept.

Purpose and Use of "Corridor" Concept

Control of pipeline routes is required to minimize environmental and social disturbance, to ensure maximum benefits to northern residents and communities, and to channel resource development in accordance with governmental priorities. In approaching the concept of a pipeline "corridor", the Government of Canada recognizes the need for flexibility in the choice of pipeline routing in consideration of resource and market locations, economics, engineering and construction requirements, and the severity and sensitivity of Arctic terrain conditions.

The concept of "one trunk oil pipeline and one trunk gas pipeline" within a "corridor" was enunciated with the intention of confining environmental and social distrurbance resulting from trunk pipelines to a narrow zone, thus limiting inso far as possible the geographic area involved in these disturbances and leaving as much as possible of our northern lands in an undisturbed state. On the other hand, it is recognized that restriction of both oil and gas pipeline construction activities to a narrow "corridor"

would lead to increased intensity of land use and the possibility of unacceptable environmental and social disruption. The routing of oil and gas pipelines close to other transportation-communication systems (and the probability of subsequent development of such systems adjacent to pipelines) may add to problems of maintaining the environment. Even minor disturbances arising from adjacent developmental activities may reinforce on another to produce cumulative ecological disruptions. Moreover, local shortages of gravel or other granular materials may result from close spacing of construction projects. In addition, the differing terrain requirements of oil and gas pipelines may prevent adjacent routings under some circumstances. Thus, caution will be required in defining specific routes or "corridor" boundaries.

"Corridor" for Trunk Pipelines in Yukon Territory and Mackenzie Valley Region

Information is presented here concerning the general routing of pipeline "corridors" and applications for pipeline permits across the northern portion of the Yukon Territory and through the Mackenzie Valley region of the Northwest Territories, to carry oil and gas to southern market from sources in this part of Canada and/or from the Alaska north slope. The present comments apply only to trunk pipelines in the area outlined above, and do not apply to pipelines or "corridors" that may be proposed for other parts of the Yukon Territory and the Northwest Territories.

1. The Government of Canada is prepared to receive and review applications* to construct one trunk oil pipeline and/or one trunk gas pipeline within the following broad "corridors":

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* Applications are to be filed with the National Energy Board for a Certificate of Public Convenience and Necessity, and with the Department of Indian Affairs and Northern Development, under the Territorial Lands Act, for tenure of land comprising the pipeline right-of-way.

i) Along the Mackenzie Valley region (in a broad sense) from the Arctic coast to the provincial boundary;

ii) Across the northern part of the Yukon Territory either adjacent to the Arctic coast or through the northern interior region from the boundary of Alaska to the general vicinity of Fort MacPherson, and thus to join the Mackenzie "corridor" ;

2. To confine the environmental (and social) disturbance arising from pipelines and their construction to a limited area, trunk oil and gas pipelines within the corridors outlined in 1. above are to follow routes that are as close together as is consistent with the differing engineering constraints and environmental hazards of the two types of pipelines, but not so close together as to bring about undesirable environmental interaction between the two lines. The same principle is also to apply where the trunk pipeline route lies parallel and near to a present or proposed highway or other overland communication system.

3. In view of the influence of the first trunk pipeline in shaping the transportation corridor system and in moulding the environmental and social future of the region, any applicant to build a first trunk pipeline within any segment of the corridor system outlined in 1. above must provide with his application:

i) assessment of the suitability of the applicant's route for nearby routing of the other pipeline, in terms of the environmental-social and terrain-engineering consequences of the other pipeline and the combined effect of the two pipelines; (fully engineered proposals concerning the other pipeline are not necessarily required);

ii) assessment of the environmental-social impact of both pipelines on nearby settlements or nearby existing or proposed transportation systems; and

iii) comparison of the applicant's proposed route with alternative pipeline routes, in terms of environmental and social factors as well as technical and cost considerations; (fully engineered proposals concerning alternative routes are not necessarily required).

4. In relation to the pipeline corridors identified in 1. above, the Government will identify geographic areas of specific environmental and social concern or sensitivity, areas in which it will impose specific restrictions concerning route or pipeline activities, and possible areas excluded from pipeline construction. These concerns and restrictions will pertain to fishing, hunting, and trapping areas, potential recreation areas, ecologically sensitive areas, hazardous terrain conditions, construction material sources, and other similar matters. Statements announcing the above will be released through the office of the Director, Environmental-Social Program, Northern Pipelines.

5. If and when an applicant has received governmental authorizations to construct and operate any trunk pipeline, it is contemplated that Land Management Zones under the Territorial Lands Act and/or Development Areas under the Area Development Ordinances would be established to encompass the pipeline route and the additional lands required for ancillary facilities such as roads, staging areas, gravel and borrow pits, construction camps, etc.

Environmental Guidelines

Introduction

Guideline No. 6 of August 1970 required that any applicant "must document the research conducted and submit a comprehensive report assessing the expected effects of the project upon the environment". The amplification of this guideline presented below registers some current environmental concerns of government and is intended to indicate to potential applicants some of the major topics that should be included in such an environmental assessment with specific engineering design data and proposals that take into consideration the conditions encountered along their particular route. In responding to these concerns, applicants also are to provide documented evidence that they possess not only the necessary knowledge, but also the capability to carry out the specific proposals. As indicated in the 1970 guidelines, applicants will have available, and may be required to submit, all background data upon which the environmental assessment is based. However, the focus should be on specific responses to the concerns outlined below. In connection with these environmental concerns, government may impose restrictions or exclusion on pipeline activities in specific geographic areas that are environmentally sensitive, as outlined in Section 4 of the Pipeline "Corridor" Guidelines.

Guidelines: Some Current Environmental Concerns of Government

Any applicant for a Certificate of Public Convenience and Necessity and for right-of-way and other related land requirements, must submit a comprehensive assessment, based upon documented research, of the expected effects of the project upon the environment. Any certificate issued will be strictly conditioned with respect to applicable statutes providing for the protection of the environment and the following environmental concerns of government:

1. that a pipeline be constructed,* operated and abandoned in keeping with good engineering practice to ensure its safety and integrity, in the interests of good environmental management and the reduction of environmental damage;

2. that construction, operation and abandonment of a pipeline will be done so as to avoid or minimize adverse effects upon the surrounding terrain, including vegetation, and aesthetic damage to the landscape;

3. that rivers and other waterbodies will be approached and crossed, either overhead or underground, in a way that will minimize environmental disturbance to the waterbody itself, to its bed and banks, and to the adjacent land or vegetation during construction, operation, and abandonment of a pipeline;

4. that a pipeline will be constructed, operated and abandoned with a minimal disruption to river and lake regimes, water quality, and feeding, reproduction and migrating stages of fish and other aquatic organisms;

5. that a pipeline will be constructed, operated and abandoned with minimal interference to the lands and vegetation that serve as feeding, reproduction and migrating areas for mammals and wildfowl, and with maximum protection to rare or endangered species and their habitats;

6. that adequate provision be made for disposal of sewage, garbage and various gaseous, liquid and solid wastes and all toxic materials during construction, operation or abandonment phases of the project.

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* Where the words "construction" or constructed" are used they are meant to include preconstruction activities of a pipeline project.

7. that adequate provision be made for preservation or salvage-excavation of archaeological and historical sites, and that minimal damage to such sites will result from pipeline activities.

8. that effective plans be developed to deal with oil leaks, oil spills, pipeline rupture, fire and other hazards to terrestrial, lake and marine habitats, that such plans be designed to minimize environmental disturbances caused by containment, clean-up or other operations and to bring about adequate restoration of the environment, that they be designed to deal with minor and major incidents, whether they are single-event or occur over a period of time and that they include contingency plans to cope with major hazards or critical situations.

9. that an effective plan be developed for implementation of specific environmental safeguards through an educational program for field personnel prior to and during construction and operation of the pipeline;

10. that an effective pipeline performance monitoring system of inspection and instrumentation be established to ensure operational performance in keeping with the above-stated environmental concerns.

Suggested Topics for Response to Environmental Concerns

Examples of the kinds of topics that could be included in an applicant's environmental assessment in response to these environmental concerns of government are presented below. The items are numbered to coincide with the arrangement of the ten environmental concerns in the foregoing section. The listing of topics is not complete and the material is not intended for use as a formal checklist.

It is suggested that specific proposals or information be presented regarding the following:

1. Safety and integrity of the pipeline (items applicable to this concern are incorporated in concerns 2 - 10 immediately below).

2. Terrain and vegetation
   a) methods of handling potential problems in relation to earthquakes, landslides, avalanches, or terrain changes resulting from thawing of frozen ground;
   b) methods of minimizing removal of vegtation and the organic mat in permafrost areas with high ice content;
   c) methods of minimizing interference with the movement or quality of water on and in the ground with particular attention given to the expected boundary or limit of influence: where drainage disruptions are expected, the boundary of influence may be well beyond the actual area of construction;
   d) methods of minimizing the loss of strength and volume of soil as a result of melting of ground ice, particularly if the ice occurs in segregated masses; if such melting cannot be entirely prevented then there should be indications of how consequent instability and differential thaw-settlement is to be minimized;
   e) safeguards to be taken against potential dangers to a pipeline from differential vertical movement caused by uneven settlement from thawing of permafrost materials or from "growth" of permafrost; where soil collapse over ice masses and differential flotation and sinking over liquified soil could deform or rupture pipe, proposed safeguards should be identified;
   f) methods of maintaining slope stability in general;

g) methods of construction and location of permanent facilities in a way that will harmonize with their natural setting;

h) removal and/or appropriate disposal, of debris created by construction activities and plans for buffer strips of natural vegetation between public roads and pipeline facilities;

i) quantity and quality of aggregate or borrow materials required, details of the geographical distributions of the requirements and proposals as to sources of the required material, including proposed access routes from pit or quarry to point of use, and restoration of pits and quarries;

j) plans to carry out assisted revegetation or alternative methods of providing and insulating cover on which natural revegetation can occur;

3. River and lake crossings

a) for river or strean crossings to be installed beneath the watercourse, depth of maximum anticipated scour and depth of proposed placement of pipe, supported by bore-hole logs and other data indicating the scour depth;

b) design of approaches to river crossings so as to maintain stability of valley walls and river banks and to minimize changes that could lead to slope failures; gullying and related distrubances;

c) design of underground crossings of rivers and streams that could withstand the effects of run-off, bank erosion, meander cutoffs, lateral migration of stream channels, ice jams, and icings, the magnitudes of which should be calculated according to reasonably expected extremes for a particular stream crossing area;

d) design of approaches to and crossings of ponds or lakes, with particular reference to degradation or growth of ground ice, and shore or bank regression or collapse

through thermokarst or other processes;

4. River and lake regimes
   a) methods for construction of stream and river crossings in a way that will minimize interference with fish passage or degredation of aquatic habitats through erosion and sedimentation;
   b) alternative fish passage structures in cases where the proposed project requires stream channel modification that would obstruct migrating fish;
   c) schedules of construction activities and evidence that the project contains the flexibility to allow pipeline, road, or other construction to cease for periods of time when important areas critical to fish, wildlife, or waterfowl are temporarily threatened;
   d) methods of minimizing the addition of sediment and introduction of oils and greases into water bodies as a result of preconstruction or construction activities, particularly in respect to access roads and ice-bridges;
   e) proposed location, volume, composition and disposal of pipeline test fluids;
   f) plans to restore fish and wildlife habits that are damaged by pipeline activities;
   g) dates and propsed methods of construction within 300 feet of any water body frequented by fish;

5. Wildlife
   a) methods of minimizing the restriction of movement of wild animals such as caribou;
   b) methods of protection of wetland areas used as feeding, breeding, or staging areas by migratory waterfowl or as habitat for fur-bearers;
   c) methods of minimizing harassment and other impact upon wildlife populations from greatly increased human intrusions

and the operation of boats, ground vehicles, aircraft, and compressor or pumping stations;

d) safeguards proposed and alternatives that were considered for the habitats of rare or endangered species;

e) control of possession of firearms in construction camps and on construction operations;

6. Waste and toxic material

a) methods of waste disposal to avoid health hazard to humans and animals as well as aesthetic pollution; information should be provided on use of water from streams, springs or lakes for domestic, camp or construction purposes and on location of camps and sewage disposal systems relative to local drainage patterns;

b) how ice fog accumulation and air pollution will be minimized;

c) the nature, transportation and use of any pesticides, herbicides, pipe coating materials, anti-corrosion materials, flushing agents, or other toxic substances, proposed for the project, and information on their expected persistence and mobility in surrounding ecological systems;

7. Archaeological sites

a) archaeological surveys to identify prehistoric sites prior to and during construction phases of a pipeline project;

b) procedures to promote recognition, reporting, and assessment of archaeological materials encountered in pipeline activities including orientation of construction personnel;

c) arrangements for preservation or salvage-excavation of sites judged to be of archaeological significance;

8. Contingency plans

a) how the possible loss of oil or gas through pipeline leaks would be routinely detected and stopped quickly (the maximum

potential undetected loss from the pipeline should be specified and evidence provided. This value is to be as low as is technologically feasible);

b) how oil which has escaped into the terrestrial, lake or marine environment would be detected, how it would be disposed of and how the elements of the environment affected by the oil would be rehabilitated;

c) methods to prevent burning of vegetation and proposals for a general contingency plan for fire prevention and suppression on the right-of-way, on the immediately surrounding land, and on lands involved in ancillary activities during preconstruction, construction, operation, and abandonment phases of the project;

9. Environmental briefings

how the applicant intends to carry out environmental briefings to ensure that personnel are fully aware of all environmental restrictions for each construction section and each construction and operational phase of the project, and the reasons for such restrictions;

10. Monitoring

a) continuous surveillance and maintenance programs along the pipeline right-of-way;

b) plans to monitor the environmental side effects during and after construction, including downstream sampling of sediment and potentially toxic materials.

Social Guidelines

Introduction

Guideline No. 6 of August 1970 reads in part as follows: "Any certificate issued will be strictly conditioned in respect of ...

the protection of the rights of northern resident,...". Government recognizes the concerns of the Indian people of the Territories with regard to the construction and operation of northern pipelines. Government is prepared to discuss with the Indian people their land claims and Treaty rights whenever they express their willingness to meet on the matter, and any decisions made concerning northern pipelines will be without prejudice to Indian land claims and Treaty rights. Guideline No. 7 of August 1970 requires the applicant to undertake specific training programs, to employ residents of the North during the construction and operational phases of the pipelines and to provide adequate housing and counselling service. The following social guidelines are an elaboration of those issued in 1970. They are consistent with Canada's policy on northern development. They give priority to a higher standard of living and equality of opportunity for northerners by means compatible with their own preferences and aspirations. In addition, they seek to minimize the adverse social and economic consequences associated with rapid large-scale development, where these adverse affects can be predicted with some degree of certainty.

Guidelines:

1. The Applicant must undertake specific programs leading to the employment, at all occupational levels, of residents of the territories - and in particular native people, during the construction and operation of the pipeline. Such programs or projects shall include but not be limited to: advance information on all jobs in a manner that ensures that the information reaches potential workers; skills required for various occupations and anticipated duration of employment; upgrading and skill training; other forms of integrated training that include on-the-job work experience; and counselling for those unfamiliar with industrial jobs or wage style living. All training, orientation and counselling courses will be planned

and carried out in co-operation with the various agencies of government responsible for these matters. The pipeline companies shall have particular responsibility for on-the-job work experience.

2. Priority placement in jobs shall be accorded native people of the territories in keeping with the tenor of Article 5 of the International Labour Organization Convention 111, 1958, ratified by Canada, and the government's intent to increase employment opportunities for members of disadvantaged minority groups. During the consultation between government, unions and employers as outlined in the Convention, ways and means will be found to ensure access for these employees into the appropriate union locals and hiring halls where there is a requirement. In addition, in accordance with the principle of employment of local workers which is accepted by organized labour, the Applicant will employ labour from the locality where work is being executed to the extent it is available. The Applicant shall comply with the above Convention and employment principles, and cooperate with government's effort to operate an effective recruitment, placement and counselling service.

3. The collective agreements signed by the Applicant and organized labour shall not distinguish between residents of the territories and others respecting special benefits and allowances, including housing for operational staff, and the nature of these benefits shall be in no way inferior for employees from the territories. In addition, in situations where special measures are required to ensure the employment of native people as outlined in the International Labour Convention 111, the Applicant shall negotiate special agreements related to the employment of native people, in consultation with the native people and government. Related to the above matters but not restricted thereto is the requirement for the Applicant to set up special orientation and consultation machinery to familiarize its staff and employees with

the culture and aspirations of native people and of territorial residents generally. Conversely, this orientation and consultation will acquaint employees from the territories with the pipeline industry and the work habits and life style of non-territorial employees. The orientation and consultation activity shall be planned and operated with the participation of native people, other northern residents, organized labour, the Applicant and the appropriate governmental agency that will coordinate and monitor the various functions performed.

4. Contracts and sub-contracts shall be so designed and publicized as to invite and encourage bids from native organizations, settlement councils and local contractors. In addition, the businessess and commercial organizations of the territories shall be invited and encouraged to supply goods and services required for the pipeline development and operation.

5. A substantial number of native people depend on trapping and hunting as a principal means of livelihood, and many derive a real satisfaction from being on the land and being master of a familiar environment. Therefore, the pipeline will be constructed, operated and abandoned with minimal interference to traditional trapping, hunting and fishing areas. In addition, where the pipeline construction is planned to be located in proximity to a settlement--particularly a native settlement or localized area subject to intensive use, then the location of construction camps, associated activities and the detailed siting of the pipeline will be decided by government after consultation with the Applicant, and the settlement council, or local government body, or the native organization.

6. Where the construction, operation or abondonment of a pipeline results in loss or damage to the undertakings or property of territorial residents - and native people in particular - then the Applicant shall deal promptly and equitably with all reasonable claims.

7. In order to ensure that the social and economic benefits outweigh the costs, the Applicant shall make a conscious effort to contribute to the social and economic development of the territories. This objective shall have particular relevance regarding; locating permanent infrastructure and maintenance facilities so that their presence will be to the benefit of communities; preserving scarce resources such as aggregate and forest products required by communities - both present and future demands; assuring residents reasonable access to transportation and communication facilities associated with the pipeline system; making gas energy available to selected territorial communities at places and costs to be negotiated between the Applicant and the appropriate governmental agency; and the Applicant shall give prior consideration to the territorial governments - concerning the disposal of all surplus facilities, equipment, or infrastructure, at a place to be negotiated between the Applicant and the respective government.

8. The pipeline construction activity shall be self-sufficient with respect to certain services such as sewer and water, power, roads, fire prevention, recreation services and emergency health services unless there is a prior agreement to the contrary. With respect to other public services that by their nature must remain under public control such as police protection, base hospitals and like services, there will be early consultation with the appropriate level of government to ensure adequate preparation and continuing liaison during the construction and operation phases to ensure maximum coordination and cooperation.

Full Comment From Public Will Follow Definition of North Pipeline Guidelines, Oilweek, December 18/72

Dr. James Riddick, Manager of Arctic Land Use Research Program, University of Calgary

Public comment and criticism will be invited when the federal guidelines for northern pipelines come out in definitive form late in

1972 or early in 1973, Dr. James Riddick, manager of the Arctic land use research program, said at a University of Calgary open meeting.

The existing program is being evaluated in an effort to identify any gaps which should be plugged and to assess all current environmental research for an ultimate report. Approximately 10 assessment teams will be set up, staffed by researchers, to deal with the major topics such as archeology and historic sites, vegetation, terrain and slope stability, waste disposal and river crossings.

Federal spending on research will run to about $5 million in the current 1972-73 fiscal year. This amount will be duplicated in 1973-74 and the program will taper off in 1974-75 with cumulative expenditures of $15 to $20 million. Private industry expenditures will probably be somewhat higher, making a total of $40 to $50 million, but this is expected to cover full required research on both an oil and gas pipeline.

Tentatively a routing for the pipeline corridor along the east side of the Mackenzie River appears most likely, Riddick said. Estimating a total distance of 1,500 miles for the initial project, the lateral area of incluence will be about 100 miles, so upwards of 150,000 to possible 200,000 square miles will be under federal control.

At present 34 separate research programs are in progress, under three federal government departments and the Northwest Territories government. There are 15 under energy, mines and resources, nine under environment and nine under Indian affairs. The N.W.T. project is a development plan for the projected pipeline corridor. Environment studies are the most costly, amount to about half the total funding.

Among the subjects being dealt with are evaluation of line pipe and

steel, aerial photography, vegetation and terrain classification, identification of granular materials, and topographical mapping. A series of studies is also being carried out be Geological Survey of Canada, including surficial geology, mapping, unconsolidated materials, rock, land forms, muskeg, ground ice and permafrost.

The program is aiming to develop some measure of terrain sensitivity with reference to different materials under different conditions. This includes potential man-made disturbance due to pipeline construction. Among the other factors are erosion in permafrost, slope stability, engineering geology, geophysical techniques to determine occurrence of permafrost, and earthquake hazards along the pipeline route.

A major socio-economic study is being made of the impact of big-inch pipeline construction, to analyze benefits and costs to the N.W.T. and its residents. The objective is to maximize benefits and minimize detrimental effects. It will assess the impact of pipeline development and renewable and non-renewable resources.

Experiments have been conducted with land-based oil spills. This is a relevant topic, Riddick explained, because the pipeline route is so close to the river that any land spill would not take long to reach the water. Small test plots have been used to determine preventive containment and cleanup methods.

There have been indications that after an oil spill there is an increase in soil micro-organisms and sometimes in total respiratory rate. These seem closely related to temperature and soil moisture content. A larger program will be needed, to cover the boreal forest area which will contain more of the total pipeline mileage than will be laid in the tundra. This program has been set up in the Normal Wells area which is considered most representative of

conditions in the whole area of interest and contains several seepage sites comparable to oil spill areas.

Each series of test plots will be programmed for three different seasonal conditions, summer, mid-winter and spring runoff. Among the objectives for determination are physical-chemical reactions, rate of oil flow, extent of dispersal, absorption in snow or ice, adsorption into soil, concentration of dissolved and emulsified oil in nearby water bodies and weathering effect. Desk studies will be made of probable spill size, fire hazard and cleanup techniques.

Biological studies are to be made on short and long range effects of oil spills on vegetation, rate of recovery and effect on soil fertility. Similar studies will be made on water bodies, seepage into them, direct spills into water and containment methods. Examination of contaminated sites is expected to produce information on long-term effects, such as from seepage. Microbiological research will deal with ability of indigenous soil micro-organisms to degrade oil and with toxicity of crude oil so degraded.

A special problem is the varying effect of the nature of oil used. Norman Wells crude has been used exclusively because of availability, but its qualities are very different from Prudhoe Bay, Atkinson Point and the Arctic Islands. A substantial program of lab studies has been set up, using all four oil types.

Finally research on oil leak detection techniques, especially fluorescence, is being done by Prof. Gordon W. Hodgson of U. of C. This includes practical problems such as sampling the middle of the Mackenzie River, Riddick concluded.

Rational Approach to Conservation is Urged by Panarctic's Bob Currie - Oilweek, February 26, 1973

Bob Currie's fed up with irresponsible environmentalists and their industry-slowing machinations.

He's so upset, in fact, that he thinks it's time pollution "and related fashionably social concerns such as ecological upset are put in their place" and, unlike many industry officials, the vice-president, land and administration, for Panarctic Oils Ltd. is saying so publicly.

"Society today has enough real, identifiable stresses corroding it without the added worry of unsubstantiated ecological doomsday statements," he told the Vancouver Board of Trade recently. "I have grown weary and genuinely angry at the unfounded accusations that continue to roll in (to Panarctic) through the mails, by telephone, in the press on radio and television.

"There has been little attempt at rational communication. The environmentalists have attacked rather than communicated, and industry has been seriously remiss in remaining largely silent, standing aloof, weathering the storm in the hope that if it waits long enough the attackers will grow weary, will grow old and go home."

But Currie's not one of those who can be called remiss on the question. He accepts that ecological protection would rate high on anybody's list of priorities and quite readily admits the environmentalists have some responsible people and a lot of good going for them.

It's just that priorities should not be established from an emotional half-informed base; that somehow intelligent exchange between experts from both industry and conservation has to take place bereft of emotion and semi-religious zeal.

One thing that should be recognized, says Currie, is that nature herself is a much more grievous polluter than man. Volcanic eruptions have put more dust, ash and combined gases into the atmosphere than all of man's industrial activities; springs feed huge quantities of salt into some North American rivers, other waterways are more acidic than the worst acid leached streams in coal-mining districts, various major rivers carry tons of silt into the sea -- and even the Athabasca river, since geologic time established them, has carried billions of barrels of oil from the tar sands to the Arctic Ocean.

Currie isn't buying the argument that what nature does is natural, what man does unnatural.

"The idea that mankind, for some reason, is not to be considered a part of nature, amuses me. There is an implied arrogance here which is not justified in view of our attitudes toward each other during recorded history. Man is not an outsider -- he is part and parcel of nature and the very study of ecology is a study of the inter-relationsip of plants and animals, including man."

There has to be a middle course for environmentalists, Currie opined, pointing out that many victories they appear to have won in the past haven't been victories at all, but instead caused more damage than the original 'sin'.

Examples quoted in support of that theory included cases of insecticides being banned as dangerous to humans only to result in serious infestations in areas where insects were formerly controlled.

In fact, said the voluble Panarctic vice-president, the environmental crisis is the result of success, not failure -- success in curbing infant mortality rates which in turn brought about the population

explosion; success in raising farm output to prevent mass famines, which in turn brought about contamination by pesticides and chemical fertilizers; success in getting people out of urban tenements and into the "greenery and privacy of the single-family home in the suburbs" which led to urban sprawl and traffic jams.

If someone wonders whether industrial development in an area such as the Arctic is right or beneficial, the best thing to do would be to look at life in the area without development.

Visit a Pond Inlet Eskimo, Currie recommended. Compare his cold, dard, hard life, with the continuing threat of starvation if his tenuous source of food disappears, with the relatively secure life industrial development is bringing for the native of the north. Don't think for a minute he'd choose the old way.

And don't give Currie the argument that the new ways may not be right for the Eskimo -- that they'll make him forget the art of survival in the far north. Because if you do, then Currie's going to ask in return what, in exchange for a halt to northern exploration, the knocker is going to do in the foreseeable future when oil and gas supplies run out.

"Will he be prepared, in the dead of a Prairie winter, after the furniture and surplus combustibles in this neighborhood have been consumed, to build an igloo, light a feeble lamp and try to survive until spring?"

Oil and gas development in the far north are going to disturb the environment, the ecosystem, the atmosphere, the tundra, the waterways and the human communities, Currie bluntly warned his listeners.

"But the key word is disturb, not destroy. Disturbance is the price we must pay to develop an urgently-needed energy resource."

Reminding his audience that much of the current U.S. energy crisis was caused by environmentally-related action and legislation (he used the California offshore as an example), Currie broadcast an indirect warning against letting disturbance to the northern environment keep Canada and her neighbor from the needed resources of the Arctic.

In terms of effort to check pollution and safeguard the environment we are precisely at the right time in history, he added. Most people are aware of the dangers, are seeking solutions and are striving to put the solutions to work before the next plateau of resource and industrial development is reached.

Industry and govenment have invested a great deal of effort and money in studying the northern environment so it will be possible to avoid or control any crisis that might occur. This effort, which far exceeds the record of detractors to date, leaves Currie convinced the resources can be located, developed and channeled to the homes and factories of the south without damaging the environment.

But the industry and conservationists are going to have to work together toward a common cause. Pollution and ecological upset are moral issues, but they are business issues as well.

"If we want energy, if we want jobs, if we want a better way of life for ourselves and our children, if we want beauty and satisfaction in our lives, communication and understanding are basic requirements now."

PROS' AND CONS' OF REGULATORY CONTROL

Paper at 19th Annual International Right-of-Way Educational Seminar May 18, 1973, Mr. Carl von Einsiedel , Chief, Right-of-Way Division, Pipeline Divisions, National Energy Board

Regulatory control of utility companies and the like is often found to be irritating, because it imposes restrictions on us as organizations and as members of the general public; we try to reject it -- to argue it away.

However, we cannot completely 'argue away' the validity of its function. There is no doubt that the interests of the public must not be overridden by private considerations of economic gain; and that we must monitor the use of natural resources.

We are aware that regulatory agencies have been subjected to sharp criticisms. Let us examine some of the complaints regarding regulatory control. The most frequent are that these agencies cause loss of time; they require a lot of seemingly unnecessary information; they add to the costs of the products;

I think we must acknowledge, first of all, that our countries the United States of America and Canada, as compared to others of this world, are subject to only limited regulatory control. As citizens of participatory democracies, who acknowledge certain merits of regulatory control, we must direct our efforts to improving and updating our methods. The improving and updating are the responsibility of both the regulator and the regulated.

One of the most important prerequisites in respect of regulatory authorities is that not only the policy and decision makers but also the staff of such authorities, be full conversant with and knowledgeable about the specific field and the resultant problems which may arise from the controls to be imposed. At the same time,

it is imperative that those empowered to regulate by administrative action allow for and are willing to listen to the claims of rights of individuals and groups affected by the business of regulatory control. Agencies must not only be increasingly responsive to such demands but also realize that they are not umpires or mediators and must at times be prepared, difficult at it may be, to make clear choices on the basis of fullest available information and must be willing to defend such choices in the name of justice.

We all have in recent years experienced that individuals and groups who seemed to have been silent for so long are raising their voices loud and clear to express concerns over objections to the construction of, for example, pipelines, power transmission lines and other facilities, which may be required for the general well being of our nations. Were it that no regulatory control existed, most of such construction proposals may be tied up in the courts for years. So, while advocats of industry have proclaimed that in many areas such an "overregulation" exists which stifles industrial progress, they could perhaps through litigation have experienced greater time loss and expense.

Let us examine the work most of us are doing. The acquisition of right-of-way, other rights, and determination and payment of compensation and reasonable damages. During that performance of our duties do we not quite often find that, because no particular regulation exists, shortcuts are being made, which, since they are not forbidden are called justifiable, but are they?

Or do we often find when two major interests negotiate for rights, that the grantor may try to restrict or superimpose demands on the grantee, which are wholly unreasonable, but can not be refuted because no regulatory control authority exists which could rule on such matters.

Industry could benefit to a considerable extent from regulatory

control, save time and expenses by being fully conversant with the requisite regulatory requirements, by gearing its planning for accurate submissions to regulatory authorities, which would gain more rapid consideration and if in the public interest consequent approval.

By co-operation much is to be gained. As a staff member of the National Energy Board of Canada during its past 13 years of oepration, I have observed and participated in many public hearings held and decisions made by the Board within the triangle of industry-general public - regulatory control. The National Energy Board has decided on cases respecting energy transmission between Canadian Provinces and those which required the crossing of the international boundary, be it by pipeline or hydroelectric facilities as well as on important export matters and additionally on price and rate cases.

However at the same time the Board has held hearings on land matters, drainage and the crossings of highways and utiliites which were brought about by objections voiced from groups other than the respective industry.

From my observations of the functioning of the National Energy Board, I am quite convinced that industry, regulatory agency and the public can accomplish much. With a concentrated effort, improved communication and co-operation by all parties involved, regulatory control could have 'REWARDS' and 'BENEFITS' for all.

THANK YOU

City of Edmonton Planning Department Research Division
WORKING PAPER No. 2, Research by A.E. Gordichuk, Fall, 1967
THE EFFECT OF OIL AND GAS TRANSMISSION PIPELINES ON EXPANDING URBAN USES IN EDMONTON AND ITS ENVIRONS

Champter 4 Recommendations and Provisions for Pipeline Developments

The previous discussion of costs detailed thos situations which best outlined Edmonton's expenses incurred in accomodating pipelines.

In short, it indicated how the potential value of land is, in part, influenced by the pipeline being able to enter or pass through any part of it. However, merely relating the state of affairs or expected costs due to metropolitan growth is not satisfactory in formulating any beneficial future pipeline policy. Therefore, it is the intent of this chapter to suggest means to provide for the present and future occurance of pipelines in an efficient planned pattern in full recognition of urban growth and the influence pipelines have on such growth. The remaining discussion will propose recommendations providing for pipelines to pass through the Edmonton area in a least detrimental manner as possible.

RECOMMENDATION 1

It is important that the Edmonton Regional Planning Commission and the City of Edmonton continue to receive an adequate opportunity to discuss with the pipeline developer the location of the proposed line in advance of land purchases of expropriation by the pipeline company.

In the past it has been found that the City often does not get an opportunity to comment on the proposed pipeline route until the location of the line is quite firm and changing the route would creat numerous problems. With the implementation of this recommendation the company intending to construct a line would directly contact the City and Regional Planning Commission thus giving them a chance to discuss, at an early stage, the location of the proposed pipeline. The City and Regional Planning Commission should receive a report outlining in detail the proposed route together with large scale maps indicating the course of the pipeline.

RECOMMENDATION 2

The City of Edmonton should provide the Provincial Department of Mines and Minerals and the National Energy Board with its expansion plans indicating future roadway development and utility alignments. Thus when a pipeline company wishes to construct a

new pipeline the government agency can inform them as to what construction procedure should be followed so that future municipal expenses in accommodating pipelines will be minimized.

A reliable land use plan, indicating the location, character, and magnitude of development stages, presented to the government agencies would be of considerable value since it would solve any conflicts arising over "who was there first" or "who knew of each other's development policies first". The Department of Mines and Minerals considers this idea of "primary permanence" essential in deciding the outcome of a conflict of prior development rights and thus who pays succeeding development costs. For example, when future pipelines are constructed where roadways are anticipated, they should be laid at such a depth so as not to require casings. If casings were found to be necessary, their expense would be absorbed by the pipeline company if the roadway existed previous to the building of the pipeline or if the roadway's proposed route was indicated in a long-range expansion plan presented to the provincial and federal agencies in charge of pipeline development.

RECOMMENATION 3

It is recommended that major oil and gas pipelines do not locate in the path of land to be developed for purposes of residential land use. Particularly the route of high pressure pipelines should avoid all residential communities of potential growth.

There would have to be exceptions to gas utility lines of at least .400 inch wall thickness at low pressure which service residential areas and to already existing pipelines within this path.

The basic reason supporting recommendation 3 is the high cost factor. Although the costs were quite tentative and, in some cases, only estimates, Chapter 3 showed how the costs of casings, pipe shutdowns, utility crossings, landscaping, subdividing and insurance were mainly applicable to the residential areas. Some of the more significant costs, like development, would apply to residential areas only. In addition, pipelines passing through residential areas sterilize large tracts of valuable land. For

example, the Trans Mountain pipeline in Petrolia occupies approximately six acres of potential residential land.

RECOMMENDATION 4

The Subdivision and Transfer Regulation should be ammended so that the required fifty feet restriction against residential and commercial development is reduced.

For most pipelines, the fifty foot development restriction has little purpose, especially in terms of safety. The technology of pipe manufacturing and laying procedure is basically concerned with the safety features of fluid transmissions. In fact, so much confidence is placed on pipe strength that both company and government officials feel road casings are not required. It is interesting to note that large diameter pipelines operate within the residential and industrial areas of Houston, Texas, within a twenty feet right-of-way. Here, residential and commercial development occur within ten feet of the easement center line. With an advanced knowledge of pipeline activities, it is felt this is adequate operating room and hence this makes the subdivision and Transfer Regulation somewhat inconsistent with experience. The pipeline easement provides ample room for the maintenance, repair , and replacement of pipes.

RECOMMENDATION 5

The present Subdivision and Transfer Regulation should be changed to eliminate the stipulation necessitating the construction of a roadway parallel to a right-of-way in residential and commercial areas.

As far as can be determined, this regulation serves no recognizable purpose, and is one of the major expenses in accomodating pipelines. It simply adds to the cost of extra roadways and their complementary facilities ($56,806 in the southwest residential area discussed in Chapter 3); it causes additional design problems and it contributes to a large amount of wasted residential land. The pipeline easement itself allows the company full access for any necessary work to be done to the pipe.

RECOMMENDATION 6

Where new pipelines are necessary, they should enter the Edmonton area only from the eastern metropolitan outskirts in the industrial areas as shown by Drawing 4 and, in doing so, they should, wherever possible, locate on existing rights-of-way. Before contacting the existing right-of-way in the eastern outskirts and upon approaching this route from, perhaps, the western metropolitan area, they should follow adjacent to section and quarter section lines keeping away at least six miles from existing City boundaries.

This would prevent the fragmentation of land and certainly preserve potential urban land and especially industrial development in the east.

Based on estimates of employment in manufacturing and related industrial areas, it is expected by 1981 that 5,200 additional acres of industrial land will be required within the City boundaries and 2,100 acres beyond City limits.[1] The industrial land required beyond City limits consists mostly of that area east of Edmonton containing the heaviest concentration of pipelines. In this area, as well up to this point in time, pipelines have restricted the availability and development of adjacent land to the industrial user. It is evident, as displayed by Drawing 3, that the pipelines while conveying into one large area on route to their respective tank farms, refinery, processing plant, etc., simply cut diagonally across sections, roads, farms, and municipalities. If this continues, industrial sites requiring adequate size, conducive to economic development, and properly situated will not be available; large capacity utility services and transportation facilities will be costly to provide and eventually a balanced and advantageous environment needed to draw in selective industries other than oil and gas types would, in part, be destroyed.

RECOMMENDATION 7

It it becomes necessary to locate additional lines in the general area of the existing concentration of pipelines in Edmonton's eastern outskirts, it is recommended that large pipeline corridors

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1 General Plan estimates.

be implemented. The probability that Edmonton will expand into this area gives weight especially to this corridor recommendation in eliminating many of the expected costs.

A corridor system, or as it may be called, an extension of exiting rights-of-way widths should be considered in a further study.

The following questions were considered by the Technical Committee of the Pipeline Study Committee and were summarized in a report by them:[2]

a) What type (locations and dimensions) of corridor?

b) Are there any alternatives to the pipeline problems other than a corridor?

c) At what period in time should corridors be formed?

d) What type of financing is involved in constructing or maintaining a corridor?

e) Who would administer the corridor?

f) Will there be enough new pipelines involved to merit the success of a corridor system?

RECOMMENDATION 8

A formal presentation should be made to Provincial and Federal authorities (Mines and Minerals Department and the National Energy Board) regarding the City's need for a more equitable distribution of responsibilities. It is suggested that these agencies give more study to the problems of locating lines in and adjacent to urban areas. Both technical and financial aspects, as those outlined in this report, should be examined.

The National Energy Board and the Provincial Department of Mines and Minerals must be convinced that their attention to pipeline impacts upon urban areas should be increased. Perhaps these authorities might and a "Municipal Clause" in their respective regulations documents, following their examination of metropolitan growth and pipeline locations.

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[2]See Edmonton Regional Planning Commission, Pipeline Study Committee, Technical Committee, Report of Meeting, September 1, 1967.

The construction of pipelines to date has taken place mainly in rural areas. The various regulations governing pipelines are best applied to rural areas. A brief look at Drawing 2 clearly places Edmonton on the natural geographic hub of almost two-thirds of the major oil fields in Alberta. Edmonton is the logical center for supply terminals, manufacturers and distributors of oil field equipment servicing companies, and oil and gas products. Hence the complimentary increase of numerous pipelines in the Edmonton region is most surely apt to choose the City as a destination. Edmonton should then be included in a "Municipal Clasue" allowing for the abbreviation of many costs. Such elements, as the necessity of casings in terms of pipe strength under City roadways, the participation of pipeline companies in taking longer routes, giving the City some means of expressing its opinion prior to the granting of expropriation rights, and changing various stipulations such as in the subdivisions and transfer regulations, should be examined.

ECONOMIC EFFECT OF HIGH VOLTAGE - TRANSMISSION LINE CONSTRUCTION

On Adjoing Properties by Richard M. Rhodes, M.A.I., SR/WA
President - Rhodes, Brennan & Clark Inc. , Right-of-Way, December, 1970

Who needs Econimc Studies:

1. Staff appraisers; as a guide to appraisal practice.
2. Management; for route planning, budgeting, cost analysis, and environmental consideration.
3. Property owners; to understand the true effect of towerlines.
4. Right of Way agents; as a tool for negotiations.
5. Condemnation Attorneys; as a form of evidence.
6. Independent appraisers; as background for analysis of severance damages.

I shall review some of the history of economic studies on powerlines, then we will cover two broad subjects; first, a discussion of how economic studies are made; secondly, a discussion of the results of

these studies and methods to illustrate these results to get the most benefit from the studies.

In the early days of land economic studies, the Department of Water and Power of the City of Los Angeles, compiled a study which consisted of a book containing nearly 600 pages. It was a compilation of opinions and factual data running a span of years from 1936 to 1944. The study was made by some of the top appraisers of that time: George Schmutz, Charles B. Shattuck, Tom Mason, George S. Coffin, and Cloyce D. Carll, all of them members of the American Institute of Real Estate Appraisers.

The study also contains the results of radio interference tests conducted by an eminent scientist.

The land economic study covered eight major transmission lines in the vicinity of Los Angeles. It documented sales of 4,143 lots, improved and unimproved, contained intereviews of 644 property owners, 83 real estate brokers, and 50 bankers and savings and loan officials.

In 1955 at the first annual National Seminar of The American Right of Way Association, Cloyce D. Carrll, M.A.I. was a panelist on the subject of power line rights of way. He emphasized "that serious consideration often coupled by a work load that is often extensive and exhaustive, is required of the appraiser to distinguish between what is factual valuation data and propaganda which can be exceedingly misleading when rendering opinions of damages to remainder lands of a right of way to be improved with a transmission line on steel towers."

In 1958, Cloyce Carll, by then considered one of the leading experts on transmission lines, wrote an article in the Appraisal Journal entitled, "Valuation of Electric Transmission Lines Rights of Way." This, in my opinion, was a classic article showing the step by step methods for properly appraising such rights of way and the effects on remainder lands. He stated the familiar problem

that it is difficult to form an opinion of value based on consideration of easement rights because such rights are not freely traded in the open market. And in his opinion, felt the proper method of determining the value of the easement was first to render a valuation on the property rights remaining in the fee ownership, the balance being the value of the easement. A further extension of this theory, of course, is that the value of the rights remaining outside the easement is the basis for determination of the economic effects on the remainder by the imposition of the easement and the construction of the powerlines. He stated, "that after personal interviews with more than 1,500 buyers and sellers of property adjoining or traversed by an electric transmission line right of way, the mere presence or close proximity of the right of way did not adversely affect the market value of such properties."

In 1959, Francis E. Manley, Vice-President of the Orange and Rockland Utilities Company, Nyack, New York, wrote "The Community Aspect of a Utility Right of Way." This was a pilot study of land economics urging Right of Way Association chapters to conduct factual economic studies and in particular, showing the advantage of the use of color photographs and other demonstrative evidence of the land uses available and desirable adjacent and abutting electrical transmission lines.

In the January, 1960 issue of the Appraisal Journal, reference is made to a "Tennessee Valley Authority case in which a steel tower line was constructed across an acreage in which a portion, highly suitable for residential purposes, overlooked the area traversed by the line. All of the land owners witnessess took into consideration the fact that "the towers and the powerlines which were in line of vision from the portion of the property adaptable to residential use, were undesirable."

The United States Court of Appeals of the Sixth Circuit, in holding that the evidence of reduction of value should be considered, took

notice of the fact that four qualified witnesses testified that the 113 acres had been substantially reduced in value by the presence of the four steel towers, 84 feet high, and twin power lines each carrying 154,000 volts. The court concluded that there could be damages to esthetic values and stated "the apprehension of injuries to persons and property by the presence of power lines on the property is founded on practical experience and may be taken into consideration in so far as the lines and towers affect the market value of the land." The court held that this apprehension was reasonable, and noted, "A TVA witness of 19 years experience testified that the towers might attract lightning better than trees."

In approximately 1960, Charles W. Leighton of Detroit Edison Company, wrote a pamphelet together with photographs of a residential subdivision on which a north-south easement for steel towers paralleled the boundary of the property and an east-west steel tower line bisected the property. The results were that no losses were experienced and the homes adjacent to the right of way were sold very quickly. Furthermore, "property across the stree from Rosalie subdivision with no tower line, also sold at the time for the same price." The study showed basically that there was no effect on the sales either in price or time for the properties adjoining the property line and the lack of abutting neighbors backed up to them.

In 1963, Peter F. Brennan of Southern California Edison, (who subsequently became my partner), conducted "A Study of the Effects of Transmission Lines Rights of Way on Adjacent Residential Properties." The study covered four tracts in the Metropolitan Los Angeles area, three in Orange County, and one in Los Angeles County. It was a random sampling of a total of 255 lots, both adjacent to transmission line rights of way and located some distance away as a control. In each instance he found that there was no adverse effect on the properties influenced by the transmission lines in sale price, time necessary to complete sale, or loan value.

In the same year, Southern California Edison Company hired Robert E. Lamb, an independent appraiser to make a similar study in a different area. His conclusions were; (1) that transmission lines are not an adverse determinant factor in the purchase of homes located adjacent thereto; (2) transmission lines were not considered as a detracting factor by most residential developers; (3) transmission lines are not a devaluating factor in the type homes being constructed; (4) transmission line rights of way are a determining factor in planning and zoning where land may appreciate or depreciate in use by rezoning as a direct result of the transmission lines; and (5) devaluating and detrimental conditions may accrue resulting from reduction in size, small remainders, odd shaped parcels, smaller yields, etc.

In 1964, the Institute of Urban Research of the University of Connecticut published "Transmission Rights of Way and Residential Values." This is one of the finest land economic studies that I have seen and has the advantage of being prepared independently of power line companies. This study under the overall supervision of William N. Kinnard, Jr., should serve as a reference and guide to the study of the impact of transmission lines on residential properties to anyone interested in the subject.

In 1965, Electric Light and Power published an article entitled, "Property Values Don't Go Down When Transmssion Lines Go UP." This article is based on research conducted over an eight year period by Herbert H. Smith Associates, in which they concluded that there is no clear evidence that transmission lines adversely affect residential property values.

Various bibliographies are available, probably the best concerning transmission lines is the Edison Electric Institute's "Library of Land Economic Studies," published in 1968. This is available through the Edison Electric Institute, 750 3rd Avenue, New York, New York 10017. It is suggested that any of you needing information on economic studies, obtain a copy of this excellent bibliography.

The University of Connecticut study referred to above also has an excellent bibliography, as does the Real Estate Appraisal Bibliography, published by the American Institute of Real Estate Appraisers.

Fifteen years ago, Pacific Gas and Electric Company was ignoring severance damages in their condemnation of tower lines and getting clobbered. They were relying on the legal fact that the burden of proof for the value of the take and damages was on the owner. Well, the owners were claiming large severance damages due to the construction of tower lines and P.G. & E. had no positive information to contradict this.

I am using P.G. & E. as an example because they operate in our area. A man by the name of Steve Goin is in the land Department of P.G. & E. and is assigned to the Law Department. He has been a pioneer in conducting research and studies on the effects of tower lines on adjacent properties and has been instrumental in getting the company to retain outside consultants to make studies.

They first started by interviewing buyers of properties along tower lines and asking them if the tower line made any difference. This information was spotty and it was not useable for direct application to other properties, and was not admissible in court. Then the company, with its own staff and with outside consultants, went to "before and after" studies on properties with tower lines and on control properties without tower lines.

They found it then necessary to have economic studies made from the standpoint of the agricultural productivity of the property in farming areas. Therefore, the next step was to go into interviews with farmers on the details of the operations and the equipment used. Next, it was found necessary to interview equipment manufacturers to get the specification on all sorts of equipment that would be used in the agricultural operations in the area. This included the height, width, turning radius, etc.,

of every known type of equipment. Most of this study was done by Mr. Goin in his spare time or between other jobs as it is sometimes difficult to get management to assign someone to a permanent or semi-permanent role in economic studies.

The study of aircraft operations around power lines was the next objective. Steve interviewed 50 crop dusters throughout the great Centra Valley of California and also independent appraisers were adked to interview crop dusters in areas in which they would be appraising power line rights of way; our firm interviewed all the dusters in our area. With the 500 DV line coming into play, it was necessary to work to solve the crop dusters problems around these lines rather than to find reasons why the crop dusters should not object. The crop dusters were not friendly, and said they would not fly around these lines.

Movies taken of crop dusters flying under conductors that were less than 30 feet above the ground and further tests and interviews with crop dusters indicated that if the low point of the conductors was 50 feet above the ground, the seeding, fertilizing, dusting, and spraying operations could be performed without great interference.

Here is some advice on movie making: When you are taking movies of crop dusters, be sure to get the identification number on the aircraft and note the time of day and the location. Also, obtain the name of the crop dusting company if possible. You will need all of this data later in order to be able to have your movies admissible in court.

It will be of interest to you that are utility men, that the P.G. & E. keeps ownership maps in all the counties in which they operate and they have microfilm of the entire county assessment map, assessment rolls, and all the parcels. They can then make

studies in their office of the transfers of lands in areas affected by the tower lines and then go out into the field to actually verify these sales and pick up other information.

It is strongly suggested that you have someone in your own organization keep track of all developments around your tower line rights of way and to keep a running account of sales activities that occur in these areas. You could hire an independent consultant to make initial studies and set up your procedures. Then the staff can take it from there.

The following three hypotheses may be used as a basis for studying the effects of tower lines on agricultural properties:

A. It is the basic curbstone opinion of the public that tower lines per se, are detrimental to adjoining property value.

B. It is most commonly stated by crop dusters, that they either won't fly around the lines or they will charge more for it.

C. Most farmers state that tower lines are damaging to crops, productivity, and land value and are very dangerous.

Our studies, and those of many learned researchers throughout the country, show the following conclusions to the above hypotheses:

A. Tower lines are not ordinarily detrimental to adjoining property values except in specific cases where they create changes in land use. Some of these are:
   1. Odd-shaped remainers on farms, or subdivisions.
   2. Physical interference with operations of the property, affecting its highest and best use.
   3. Increased costs of development such as running water lines, roads, etc., across a nonuseable easement area.
   4. Interference with Duck Clubs.

B. There is no evidence that crop dusters either refuse to fly near the lines or that they charge more for this type of work.

C. Farm productivity is affected only at the towers and, for some crops, under the lines. Some examples are:

1. Row crops may be difficult to irrigate and harvest within the towers.
2. Rice crops may get less fertilizer, seed and spray under the lines and towers.
3. Orchards may not be allowed under the lines or may be difficult to spray from the air.
4. In all other cases, unless there are other physical influences, we find no changes in productivity or value for land adjacent to the utility easement. We also do not find any scientific or market evidence of physical danger to occupants of the property.

How to make an economic study:

There are two basic methods in which to make economic studies of the effects of steel tower transmission lines. The first type is a market data study, the second is a land use study.

A market data study in its simple form is a survey of direct comparable sales with and without the effects of tower line easements. The method used for any type of property be it agricultural, residential, commercial, or industrial is to go into the market and research sales of similar properties that are adjacent and affected by tower lines and compare them to property sales that are not influenced by tower lines in any way.

Basic data are obtainable through county records or other sources of sales information and can ordinarily be done on a clerical level in which the researcher merely goes in and obtains the recorded information on other sales in specified areas not affected by these rights.

Our method has been to obtain the locations of the various lines and plot them on County maps or city maps and then outline areas

for our record-searchers to pick up ever sale in the area and not apply any judgement to these sales at this time.

The appraiser in charge of this operation must take special care in picking control properties away from the power lines that are truly similar to the properties being studied adjacent to the power lines. Also, in making the sales comparison, all of the other variables that are possible in comparing properties one to another, must be taken into account so that the power line is not given more weight than it actually deserves. For instance, in residential areas, great care should be taken to note the differences between the homes such as built-in appliances, extra yard improvements, and other factors that might have gone into the sale that would show a difference in price, but something outside the scope of the effect of the power line.

Likewise, for agricultural properties, this includes soil type, productivity, irrigation practices, access to markets, and any other factors that can have a greater effect on the value of the land than the power lines ever could. Other factors such as price created by urban encroachment are extremely important to take into consideration in making these studies.

The appraiser then tabulates the results of the sales after interviewing buyers and sellers and doing a thorough job of testing the comparability of these sales. The next step is to make comparisons to see if there are actually any price differentials between properties adjacent to or crossed by the power lines and those that are not.

The other form of study is what we call a land use study and this can take two forms; one is to study and record the types of uses that have been placed voluntarily adjacent to power lines.

The Second is actual studies of the particular use of the property within a tower line easement such as farming practices in areas affected by tower lines. In the first type of land use study, the appraiser makes a broad survey of the areas adjacent to tower lines noting the types of residences, industries, businesses, etc. that are constructed there. Often the appraiser takes aerial photographs or ground photographs showing these installations. This type of survey has been used very effectively to show the results of freeway interchanges and can also be used to the same extent to show the response of the public to tower lines. The thought here is that if people are willing to invest their money voluntarily in projects adjacent to tower lines, the effect of the tower line, on that type of use at least, must be negligible.

The second form of land use study is to make a detailed study of the actual useability of the land adjacent to, and within the easement area. We participated in extensive studies of the possible effects of the 500 K.V. Pacific Intertie system that was constructed by the Pacific Gas and Electric Company through the rice fields of Butte, Sutter, and Sacramento Counties. Some of the objections that had been raised were the hazards to aircraft and the inability to be able to use aerial applications on the rice fields, the possibility of crop losses within the easement areas, and the inability to operate equipment in and around the towers.

P.G. & E. hired various consultants to investigate all aspects of these matters; however, we did not have a 500 D.V. line in operation, so most of the studies were made on the lower voltage lines. An agricultural organization was retained and the Chief Consultant was Dr. Richard Bahme. A professional crop duster was hired to make actual tests. Also, arrangements were made so that a tower to be used on the project was constructed in advance and all types of agricultural equipment that were to be

used in the area affected were operated around the tower to note whether the tower would accommodate these operations. Our firm was retained to investigate the real estate aspects of the tower lines and we made a comprehensive survey of the effects of tower lines through rice lands and irrigated pasture land throughout the area.

Dr. Bahme made studies under the tower lines and outside the tower lines on existing lines of the Bureau of Reclamation and P.G. & E. These included single lines of towers and twin lines of towers. The crops were hand harvested and machine harvested and the results of the study were that in the rice fields, the loss of production directly under the lines was from 0 to 16.5 per cent, and in most examples ranged about 6 per cent, to 13 per cent reduced production of rice. There was no loss outside the lines.

In some other fields containing milo, sugar beets, and alfalfa which were applied from the ground, there was actually a slight gain in production from 2.1 per cent to 5.9 per cent. We do not have a logical explanation for this increase, although the increase certainly is not as a direct result of the tower lines. Indirectly, it is probable that the grower made sure to take a couple of extra turns around the towers and probably just planted more seed in these areas.

All of the rice fields were planted by aerial application and everything else is applied by air in the rice fields, such as pesticides and fertilizer. The effect upon farming operations was the interference with aerial application. Also, the towers are constructed in such fashion that the cultural and harvesting equipment can drive directly beneath them so there is much less wasted space.

I personally conducted interviews with numerous crop dusters throughout the area, several of whom had appeared at Public Utility Commission hearings objecting to the construction of the

500 DV line. In the interviews, it was typical for the crop dusters to complain about tower lines, yet in nearly all cases they admitted that they flew around these lines daily, they fly under the lines, over the lines and although they would like to charge more to the farmer who has lines across his property, the competition is such that there is actually no extra charge.

We have motion pictures of crop dusters flying under very low transmission lines even though some of these same individuals have claimed they will not fly under these lines.

The following are some methods used to illustrate these studies:

1. Testimony in court concerning sales and land uses.
2. Charts and graphs and tables showing the results of these studies.
3. Aerial photographs and ground photographs showing land uses.
4. Movies and slides of properties so affected.
5. Prepare a brief, attractive brochure to hand out to the public.

The point is that data must be intelligible to a jury or to a Planning Commission or to the property owner whom you are trying to convince. It must be able to present the information in an interesting, informative fashion in which the message is extremely clear.

I would like to quote from a talk by Robert E. Alleman, M.A.I., of Southern California Edison Company. "Land economic studies as we see them, should present only facts. No opinions should be included; it is therefore extremely important that the data be presented clearly, concisely, and as briefly as possible so that the reader doesn't have to struggle to form his own opinion. You might say that some knowledge of the advertising business is required to prepare a study that will be effective. The type of study to be handed to a property owner should cover no more than two or three carefully selected properties. And finally, the answer should stand out like a sore thumb."

THE EFFECTS ON UNDERGROUND PIPELINES OF EARTH CURRENTS CREATED BY HIGH VOLTAGE DIRECT CURRENT POWER TRANSMISSION SYSTEMS

Prepared for: The Managing Committee - Operating Division of the Canadian Gas Association by their Corrosion Control Committee

Canadian Gas Association, 55 Scarsdale Road, Don Mills, Ontario
October, 1972

The Effects on Underground Pipelines of Earth Currents Created By High Voltage Direct Current Power Transmission Systems

Summary

There are over a dozen HVDC power transmission systems in all parts of the world and because of economic and operating advantages, the number is likely to increase.

Most systems discharge large electric currents into the earth and this is a great hazard to pipelines as, under the proper circumstances, it will cause rapid and severe corrosion of the pipe.

Many experiments and field tests have shown that such a hazard does exist with most of the larger existing HVDC systems.

The discharge of large electric currents into the earth is a form of pollution and should be treated as such. It can be eliminated completely by requiring that all HVDC transmission systems have a separate metallic conductor to carry all unbalanced or return currents instead of utilizing the earth as a conductor.

Devices can be installed on pipelines to reduce the effect of HVDC but these may not be sufficiently effective and would be difficult to maintain. Also the expense would fall on the pipeline owner whereas it should fall on the originator of the electrical pollution.

INTRODUCTION

About 20 years ago in Sweden work began on the first High Voltage Direct Current (HVDC) system for commercial use in transmitting electric power and, since that time, installations have been made in a number of countries.

HVDC is an alternative to the common three-phase High Voltage Alternating Current transmission system. It has economic advantages over AC for situations where underwater or underground cables, or very long overland transmission lines are necessary. Also, it has advantages of improved electrical stability and reliability.

At present there are over a dozen HVDC systems in the world and, with increasing demands for electric power, it appears certain that many more will be built. There are four such systems in Canada and the U.S.A. but only one of these is in operation at present.

Pipeline owners are concerned about the use of HVDC because most HVDC systems put direct electric current into the earth and, if this current flows onto a pipeline, it will cause corrosion unless corrective steps, which may be expensive, are taken. Because these currents may be extremely large, such corrosion could be rapid and severe with resulting pollution, hazards to safety, interruption of service and loss of product. Other industries which may be affected by HVDC interference are railway signalling systems, telephone and radio communication and navigational aids.

Characteristics of HVDC Systems

An HVDC system takes high voltage alternating current power and, by means of a system of rectifiers, changes it to high voltage direct current. In this form it is transmitted by a wire or cable

system to the receiving terminal where inverters change it back into alternating current power for distribution to consumers.

Three principal types of HVDC systems are in use as illustrated in Figure 1, Page 73 and described below. Figure 1 shows voltages of 100,000 between neutral points but this is merely illustrative, as systems now planned go as high as 750,000 volts.

1. Bipolar-Metallic Neutral System - Figure 1A

This is a two-pole (conductor) system which has a third or neutral conductor connecting the mid-points of the two terminals of the system. This neutral conductor carries any unbalanced current that may arise because of unequal distribution of load between the two halves of the system.

No current is discharged to the earth, therefore, this type of system has no effect on underground metallic structures.

2. Bipolar-Earth Neutral System - Figure 1B

This is similar to the above system except that the mid-points are grounded to the earth and the earth is used as the third or neutral conductor. Normal system unblanced current (said to be up to 5% of the load) flows through the grounding points to travel through the earth and so can affect underground metallic structures such as pipelines.

It should be noted that with this system, if either conductor or its related rectifiers, inverters, transformers, etc. should fail, then ALL of the load current would travel through the earth and the effect on underground metallic structures would be extreme. Also, the ground current would flow in either direction depending on the location of the failure. Because of this variable and reversible nature of the ground current, protection against its

effects would be difficult and expensive. Protective devices must be large enough for the maximum ground current and sophisticated and sensitive enough to counteract ground current in either direction.

Under circumstances of failure described, the power transmitted by the balance of the system would be half of normal. However, in current relevant literature (36), this availability of the earth circuit for half power is cited as a reason for using this type of system because the possibility of forced outage for more than 50% of capacity is much reduced. In other words, it would be intended to operate the system at full ground current and half power, aslong as the circumstances require it, and this would be a reason for using the system.

3. Monopolar System - Figure 1C

This is a single-pole (conductor) system in which all of the load current it returned through the earth all of the time. Because the ground current is always large and is continuous, it would have the worst effect on underground metallic structures. However, because it is constant in direction, protection against its effects is less complex than for the bipolar type described previously.

Research On The Effects of HVDC

About ten years ago in the United States work was begun to collect information on possible HVDC effects. A formal organization was set up in 1967 to carry out extensive research to determine the nature and extent of the problem and to devise means of protecting pipelines from the effects. The Canadian Gas Association made contributions towards the cost of this work and had representatives on some committees.

The research projects were of a mathematical, laboratory and field nature and are described in more detail in Appendix A, Page 17.

It was confirmed that HVDC effects could create serious corrosion problems. The seriousness of these problems depends on a number of factors as pipe size, coating, length, distance from the HVDC electrode, etc. However, the most significant factor and one whose influence cannot be determined easily in a specific case, is the effect of geology and the related resistivity of the earth.

It was determined from a hypothetical case of a large coated pipeline passing 20 miles from an HVDC electrode (Fifth Project, Appendix A) that it could be protected from the effects but that the cost would be over $200,000.

In the field widespread organized readings were taken during part scale and full scale current tests of a U.S.A. Bipolar system and of a Monopolar system in Canada. This work and some of the results are described in Appendix A, Projects 9 and 10.

Because proponents of HVDC theorize that their ground currents will have less effect than natural earth currents, elaborate field tests on this aspect were carried out. As outlined in Appendix A, Fourth Project, conclusions were drawn that the opposite is true. Some recent field observations in Canada that bear this out are described in Appendix B.

Effects of Electric Earth Currents on Buried Pipelines

Corrosion of a metal submerged in water or buried in moist earth will occur if an electric current leaves the metal (in the conventional sense) and enters the surroundings. Such currents on a very small

scale may be set up by natural differences in an undisturbed piece of steel in water or moist soil. That briefly, is the natural corrosion process of most metals.

Corrosion can become very rapid if some outside source of potential increases the current flow and thus the corrosion rate. An example of corrosion rate is that one ampere of current flowing continuously for a year will remove 20 lbs. of steel. This is equal to about one foot of an 8" steel pipe being removed. Under actual conditions with concentrated current flow, it would not be exceptional for a leak to occur in a few weeks.

The natural corrosion process can be controlled by setting up, by some means, a small potential in the reverse direction so as to cause a current to flow from the surroundings onto the metal. This is called cathodic protection and is the principal means of controlling corrosion of buried and submerged pipelines. Cathodic protection and its principles can be used within limits to control corrosion caused or intensified by outside sources of potential.

The potential maintained on a cathodically protected and coated pipeline is small by many standards. As conventionally measured to control corrosion, the potential difference between the pipe and the soil is usually maintained (37) such that the pipe is measured to be at least 0.85 volts negative to the soil. In some circumstances a greater voltage may be tolerated for operating reasons but this is not desirable as it may damage the coating on the pipe.

An small change of potential will cause difficulties in corrosion control. For example, if the applied potential decreases from 0.85 volts corrosion usually can begin and becomes more rapid the greater the decrease.

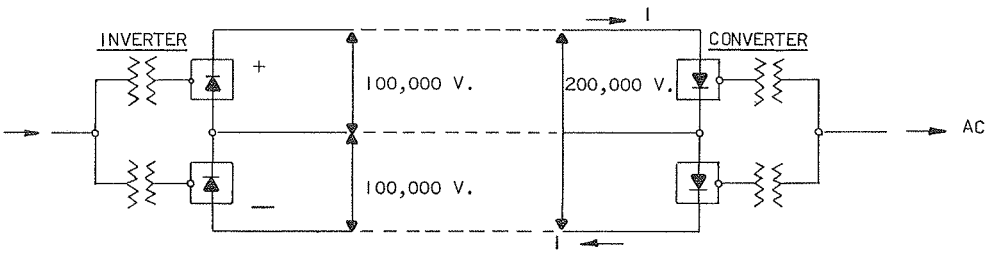
A large external source of potential such as an HVDC system can change the potential of the earth many miles from its electrodes

depending on the ground current and the resistivity of the earth. For example, at 1 mile from an electrode the normal soil potential relative to a very remote point may be changed by 25 to 50 volts. At 10 miles this may be 2 to 10 volts and at 20 miles 1 to 5 volts. This change gradually decreases with distance and is much affected by the resistivity of the earth.

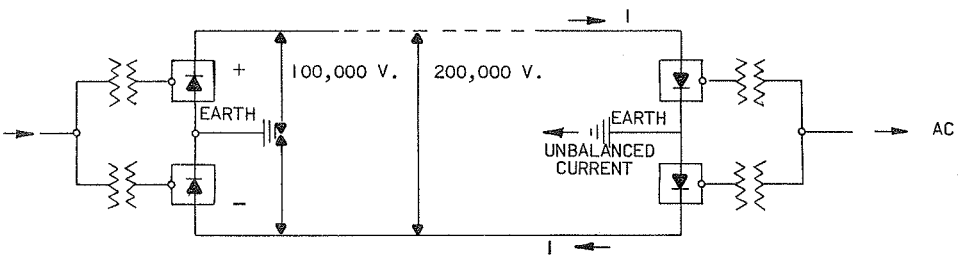
It is apparent from the above that if a long pipeline passed within a distance from an HVDC electrode, such that the normal potential on part of its length were changed appreciably, then proper corrosion control would be difficult or impossible without the installation of special arrangements of counteractive devices and necessarily associated monitoring equipment. At points of greater potential change, corrosion control would not be possible so serious corrosion would be inevitable.

It also follows from the fact that the HVDC potential change or gradient per mile is not large at say 20 miles or more from the electrode that there should be little effect on electrically isolated short lengths of pipe located there, if it were normally cathodically protected. This means that gas distribution piping that is normally insulated and cathodically protected may not be affected at such distances.

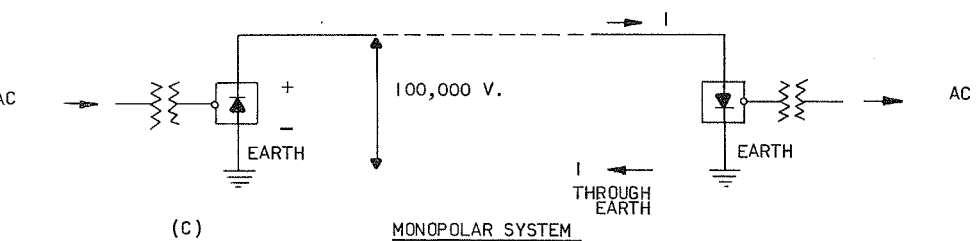
It should be noted that with Bipolar-Earth Neutral systems, the HVDC ground current and therefore the earth potential change can vary from one direction to the other. In one direction the soil potential may be increased so that the pipe coating is damaged. In the other direction decreased potential cancause corrosion and because of damaged coating this can be more extensive than it would have been otherwise. With the variable nature of its ground current, any counteractive system is difficult and expensive to arrange.



(A) BIPOLAR METALLIC NEUTRAL SYSTEM



(B) BIPOLAR EARTH NEUTRAL SYSTEM



(C) MONOPOLAR SYSTEM

I = LOAD CURRENT

FIGURE 1

SITING TRANSMISSION LINES

By Clyde O. Fisher, Jr., Chief of Environmental Planning Coordination Northeast Utilities of Hartford, Connecticut , A.S.P.O., February 22/73

Those who call the National Environmental Policy Act of 1969 the "lawyers relief act" may yet have little idea how many planning jobs will be necessary in both the public and private sectors to meet the planning requirement of NEPA and the state-level SEPAs it is spawning.

The scale on which new generating and transmission facilities appear necessary, the limitations of traditional public planning and regulatory mechanisms for guiding this development, as well as the opposition sometimes engendered by individual facilities, have led to recent proposals for state siting councils with broad regulatory jurisdiction over the location and design of these facilities.

Several siting bills introduced in recent sessions of the Congress, especially the one proposed by the President, would require that each state establish such a council or lose jurisdiction over major generating and transmission facilities to the federal government. The state councils would have a one-stop jurisdiction that would be exclusive of any local and almost any other state-level regulation over zoning. The utility companies would have to secure council approval for individual facilities and to publish 10- or 20- year development programs annually. Companies would also be expected to acquire plant sites and transmission routes many years in advance of construction.

Similarly, public planning agencies would be expected to make adequate allocations for plan sites and transmission routes in their own work, an element that public-agency plans have seldom included in the past. This requirement for long-range public planning for major utility facilities is also found in the recent national land-use policy bills.

Connecticut Siting Law

Connecticut adopted a siting law in 1971, called the Public Utility Environmental Standards Act, that is basically a SEPA for all future generating plants and transmission lines. Except for development in wetlands, these utility facilities are the only public or private development yet subject to such environmental scrutiny under Connecticut law. The act creates a Power Facility Evaluation Council from which a certificate of public need and environmental compatibility must be obtained for every new plant or line that "may have a substantial adverse environmental effect." Each utility company must also publish annual 10-year and 20-year forecasts.

Transmission lines will account for almost all the applications filed with the council each year. There may be 15 to 20 applications for transmission lines annually, whereas there may be applications for major new generating plants only once every two or three years. Transmission lines have not previously received extensive environmental examination under state or federal law in Connecticut. Thus, the transmission line planning has taken on new significance for both the utility companies and the state, regional, and local planning agencies.

The Connecticut act requires that an application for approval of a transmission line describe the effect of the line "on the environment, ecology, and scenic, historic, and recreational values." The act also specifies that the approval of a line must be accompanied by a determination of "the nature of (its) probable environmental impact, including a specification of every adverse effect on, and conflict with the policies of the state concerning, the natural environment, ecological balance, public health and safety, scenic, historic, and recreational values, forests and parks, air and water purity, and fish and wildlife."

Northeast Utilities of Hartford, which supplies about three-quarters of the electricity used in Connecticut and western Massachusetts, has evolved a planning process for the selection of transmission

routes that involves an analytical framework for identifying related environmental issues, a careful selection process, and a procedure for informal review of proposed routes with municipal, regional, and state agencies prior to the filing of an application with the Connecticut council.

For analytical purposes, the issues that may properly be termed environmental in the planning of transmission facilities can be categorized as follows:

- visual or aesthetic concerns relating to the changed appearance of the immediate area after introduction of a transmission line into it;
- land-use conflict concerns relating to the amount of land needed for transmission lines, to the extent that the same land cannot also be used for other purposes.
- land-use conflict concerns that may, in a few cases, require an extra degree of separation between the transmission line and other uses or activities; and
- ecological concerns relating to the impact of transmission construction and right-of-way maintenance upon the soil, water, flora, and fauna in or near the line.

Of these four categories, it is the visual concerns that generally constitute the principal category of environmental questions raised in transmission route planning. Visual concerns are given particular attention in the Federal Power Commission's guidelines, to which conformity is required. The other three categories of environmental issues are relatively minor by comparison.

Route Selection

Route selection studies are basically environmental in nature, with a major emphasis upon visual and land-use analyses. They are documented in considerable detail to assure a full weighing of environmental values and tofacilitate public comprehension and review of route proposals.

The route selection process begins with a preliminary reconnaissance and includes both field surveys and some initial gathering and mapping of land-use information. Opportunities are examined for using corridors already established by transportation and utility facilities, and in addition a thorough search is made for new routes that might be environmentally and economically preferable.

The inventory step consists of the collection of significant land-use and other environmental data. The data are obtained primarily from town plans and reports, regional and state planning agencies, U.S. Geological Survey maps, and aerial photographs, and are verified and supplemented by field work.

For study areas that are relatively small in size and homogeneous in land use, the analysis step involves mapping the data on a single set of inventory and analysis maps that identify "constraint" areas through which a transmission line should either be avoided or else built with special care. In more complex cases, it may be necessary to prepare a set of inventory maps and then a separate set of analysis maps, often as overlays upon the inventory maps. A separate set of analysis maps can show, for example, gradations among constraint areas in terms of high, medium, and low degrees of constraint.

The third phase, that of identification and evaluation of possible routes, involves a careful reading of inventory and analysis data, together with further field work to find routes that involve the least possible environmental constraint. These preliminary routes or route segments are then evaluated with respect to feasibility on engineering and real estate grounds, after which they are reviewed with a series of public agencies prior to the selection of the route to be proposed. As a final step, the routes to be proposed are submitted to affected public agencies for further review.

Review Process

The act does not require such reviews; they are undertaken as part

of the company's own planning process. The act does require that an application describe what route reviews may have occurred in each case.

At the beginning of the route selection process, a meeting is generally held with the chief executive officer of each affected municipality, and they are requested to provide available data on existing and proposed land use and other relevant matters.

Toward the end of the route studies, the preliminary routes are discussed with interested town agencies, and their comments are solicited. Other aspects of the prospective application are also discussed, and every effort is made to incorporate their comments.

While the municipal review process is underway, the preliminary routes are also reviewed with affected regional planning agencies, state planning office, and planners from other state agencies. Comments from these sources are similarly weighed in the selection of proposed and alternative routes for the application. As time goes one, it is hoped that these agencies will be able to comment on the basis of their own advance planning studies, rather than just in reaction to utility company proposals. One day their planning studies may even be available as advance guidance in the preparation of utility company proposals.

In conclusion, three points bear reemphasis. First, planners have plenty of new work to do because of the environmental impact statement requirements of new federal and state laws. Second, much of this work relates to the many new electric utility facilities required by the energy demands of our society. Third, this utility planning must be shared by planners working for utility companies and public planning agencies.

A final point must also be stressed. The environmental scrutiny now being applied to electric utility facilities will increasingly

be applied to other categories of development of critical public interest. The experience being acquired in the environmental planning of utility facilties, as well as the resource inventories and analytical techniques being developed in this work, will be of great value in the years ahead.

ELECTRIC POWER TRANSMISSION AND THE ENVIRONMENT

Federal Power Commission - Guidelines for the protection of natural, historic, scenic and recreational values in the design and location of rights-of-way and transmission facilities. November, 1969

It is intended that these guidelines provide an indication of the basic principles and elements of good practice which, if applied in a reasonable manner to planning and design of particular facilities, will provide the most acceptable answers from an environmental standpoint taking account also of such factors as safety, reliability of service, land use planning, economics and technical feasibility.

Introduction

The Federal Power Commission on November 27, 1970 adopted new regulations (Docket No. R-368, Order No. 414) implementing procedures for the protection and enhancement of aesthetic and related values in the design location, construction and operation of licensed hydroelectric power project works.

The Commission concurrently issued the guidlines designed to provide an indication of the basic principles to be applied in the planning and design of electric power transmission facilities. The guidelines, reprinted in this pamphlet, seek to provide the most acceptable answers from an environmental standpoint taking into account safety, service reliability, land us planning, economics and technical feasibility.

The guidelines were published as an appendix to the November 1970 rulemaking order. These guidelines cover selection and clearing of rights-of-way routes; the location of transmission towers and overhead lines; the design of transmission towers; the maintenance of transmission line rights-of-way; possible secondary uses of rights-of-way; and the location of appurtenant above-ground facilities. In addition to the written guidelines, the report includes drawings showing the "preferred" method for planning and designing the facilities and in selecting and clearing rights-of-way.

The Selection and Clearing of Rights-of-Way Routes

1. To the extent permitted by the property interest involved, rights-of-way should be selected with the purpose of minimizing conflict between the rights-of-way and present and prospective uses of the land on which they are to be located. To this end, existing rights-of-way should be given priority as the locations for additions to existing transmission facilities, and the joint use of existing rights-of-way by different kinds of utility services should be considered.

2. Where practical, rights-of-way should avoid the national historic places listed in the National Register of Historic Places and natural landmarks listed in the National Register of Natural Landmarks maintained by the Secretary of the Interior, and parks, scenic, wildlife and recreational lands, officially designated by duly constituted public authorities. If rights-of-way must be routed through such historic places, parks, wildlife or scenic areas, they should be located in areas or placed in a manner so as to be least visible from areas of public view and so far as possible in a manner designed to preserve the character of the area.

3. Rights-of-way should avoid prime or scenic timbered areas, steep slopes and proximity to main highways where practical.

In some situations scenic values would emphasize locating rights-of way remote from highways while in others where scenic values are less important rights-of-way along highways in timbered areas would achieve desirable conservation of existing forest lands.

4. Where the transmission rights-of-way cross areas of land managed by Government agencies, State agencies or private organizations, these agencies should be contacted early in the planning of the transmission project to coordinate the line location with their land-use planning and with other existing or proposed rights-of-way.

5. In scenic and residential areas clearing of natural vegetation should be limited to that material which poses a hazard to the transmission lines. Determination of a hazard in critical areas such as park and forest lands should be a joint endeavor of the utility company and the land manager in keeping with the National Electric Safety Code, state or other electric safety and reliability requirements.

6. Long tunnel view of transmission lines crossing highways in wooded areas, down canyons and valleys or up ridges and hills should be avoided. This can be accomplished by having the lines change alignment in making the crossing, or in other situations by concealment of terrain or by judicious use of screen planting.

7. Rights-of-way clearings should be kept to the minimum width necessary to prevent interference of trees and other vegetation with the proposed transmission facilities. In scenic or urban areas trees which would interfere with the proposed transmission facilities and those which could cause damage if fallen should be selectively cut and removed.

8. The time and method of clearing rights-of-way should take into account matters of soil stability, the protection of natural vegetation and the protection of adjacent resources.

9. The use of helicopters for the construction and maintenance of rights-of-way should be considered in mountainous and scenic areas where consistent with reliability of service. This would permit rights-of-way to be located in more remote areas and would reduce disturbance of the ground and the number of access roads.

10. Trees and other vegetation cleared from rights-of-way in areas of public view should be disposed of without undue delay. If trees and other vegetation are burned, local fire and air pollution regulations should be observed. Unsightly tree stumps which are adjacent to roads and other areas of public view should be cut close to the ground or removed.

11. Trees, shrubs, grass and top soil which are not cleared should be protected from damage during construction.

12. Rights-of-way should not be cleared to the mineral soil where possible. Where this does occur in scattered areas of the rights-of-way, the top soil should be replaced and stabilized without undue delay by the planting of appropriate species of grass, shrubs and other vegetation which are properly fertilized.

13. Soil which has been excavated during construction and not used should be evenly filled back onto the cleared area or removed from the site. The soil should be graded to comport with the terrain and the adjacent land, and the top soil should then be replaced and appropriate vegetation should be planted and fertilized.

14. Scars on the surface of the ground should be repaired with top soil and replanted with appropriate vegetation or otherwise conformed to local, natural conditions. Grading generally should not be done on slopes where the scars cannot be repaired without creating an erosion problem.

15. Terraces and other erosion control devices should be constructed where necessary to prevent soil erosion on slopes on which rights-of-way are located.

16. Where rights-of-way cross streams or other bodies of water, the banks should be stabilized to prevent erosion. Construction on rights-of-way should not damage shorelines, recreational areas or fish and wildlife habitats.

17. When necessary, cofferdam techniques to lay pipe or cable across streams should be used in order to permit full flow in one part of the stream while construction work is being performed in another part.

18. Care should be taken to avoid oil spills and other types of pollution while work is performed in streams.

19. In scenic areas visible to the public, rights-of-way strips through forest and timber areas should be deflected occasionally and should follow irregular patterns or be suitably screened to prevent the rights-of-way from appearing as tunnels cut through the timber.

20. At road crossings or other special locations of high visibility rights-of-way strips through forest and timber areas should be cleared with varying alignment to comport with the topography of the terrain. In such locations also where rights-of-way enter dense timber from a meadow or other clearing, trees should be feathered in at the entrance of the timber for a distance of 150-200 yards. Small trees and plants should be used for transition from natural ground cover to larger areas.

21. If underground transmission lines must be located near the crests of hills or other high points, trenching should be done with small equipment in order to minimize the width of the rights-of-way clearings.

22. Roads used during construction should be stabilized without undue delay by erosion control measures and the planting of appropriate grass and other vegetation. These roads should be designed for proper drainage, and water bars to control soil erosion should be installed.

23. Access roads should not be constructed on unstable slopes. Where feasible, service and access roads should be used jointly.

The Location of Transmission Towers and Overhead Lines

24. If an overhead line must be routed across uniquely scenic, recreational or historic areas or rivers, the feasibility of placing the lower voltage line underground should be considered. If the line must be placed overhead, it should be located on a right-of-way least visible from areas of public view.

25. Transmission facilities should be located with a background of topography and natural cover where possible. Vegetation and terrain should be used to screen these facilities from highways and other areas of public view.

26. Where transmission facilities must be placed on slopes which parallel highways or other areas of public view, they should be located approximately two-thirds the distance up the slopes where feasible. With the slopes as background, the presence of the facilities would be less noticeable.

27. Transmission line rights-of-way should not cross hills and other high points at the crests and when possible should avoid placing a transmission tower at the crest of a ridge or hill. Towers should be spaced below the crest to carry the line over the ridge or hill, and the profile of the facilities should present a minimum silhouette against the sky.

28. Transmission lines should not cross highways at the crest of a road.

29. Long views of transmission lines parallel to highways should be avoided where possible. This may be accomplished by overhead lines being placed beyond ridges or timber areas.

30. Transmission lines should cross canyons up slope from roads which traverse the canyon basins if the terrain permits.

31. When crossing canyons in a forest, high long-span towers should be used to keep the power lines above the trees and to eliminate the need to clear all vegetation from below the lines. Only as much vegetation as is necessary to string the line should be cut.

32. Where ridges or timber areas are adjacent to highways or other areas of public view, overhead lines should be placed beyond the ridges or timber areas.

33. In forest or timber areas, high long-span towers should be used to cross highways in order to retain much of the natural growth along the highways.

34. Native shrubs and trees should be left in place or planted at random, with the necessary allowance for safety, near the edges of rights-of-way adjacent to roads.

35. Transmission lines hould not be located or cross at road intersections or interchanges where possible.

36. The Federal Highway Administration and the State Highway Department should be consulted with respect to any applicable guidelines or regulations that they might have to govern transmission lines which cross highways.

The Design of Transmission Towers

37. The size of transmission towers should be kept to the minimum feasible.

38. Simple, but functional, designs of towers and poles should be used. Illustrations of these kinds of structures can be found in the book ELECTRIC TRANSMISSION STRUCTURES, sponsored by the Electric Research Council.

39. The use of poles designed without cross-arms for electric transmission lines of 138 kv and below and communications cables should be considered.

40. The materials used to construct transmission towers and the colors of the components of the towers should comport with the natural surroundings.

41. In addition to steel and aluminum transmission towers, the use of towers constructed of fiberglass, reinforced plastic, laminated wood, concrete, and other materials should be considered.

42. The use of treated single or double wood poles should be considered in forest or timber areas.

43. The use of weathered galvanized steel structures should be considered when transmission towers are to be silhouetted against the sky.

44. The design and color of the insulators should be compatible with the design of the tower.

45. Where two or more circuits are required at high crossings, the use of multiple circuit towers should be considered where it is consistent with adequate reliability.

The Maintenance of Transmission Line Rights-of-Way

46. Once a cover of vegetation has been established on a right-of-way, it should be properly maintained.

47. Chemicals, when used, should be carefully selected to have a minimum effect on desirable indigenous plant life. Selective application should be used wherever appropriate to preserve the natural environment. In scenic areas, the impact of temporary discoloration of foliage should be considered; and where this factor is critical, either mechanical means of vegetative control should be used, or the work should be scheduled in early spring or late fall. It is essential that chemicals be applied in a manner fully consistent with the protection of the entire environment, particularly of the health of humans and wildlife.

48. Access roads and service roads should be maintained with suitable natural cover, water bars, and the proper slope in order to prevent soil erosion.

49. Aerial and ground maintenance inspection activities of the transmission line facility should include observations of soil erosion problems, fallen timber and conditions of the vegetation which require attention. The use of aircraft to inspect and maintain transmission facilities should be encouraged.

Possible Secondary Uses of Rights-of-Way

50. One of the potential benefits of transmission line routes is that clearings at safe distances adjacent to transmission facilities may be used for secondary purposes. Consistent with general safety factors the following should be considered as possible secondary uses of rights-of-way to the extent permitted by the property interest involved:

Cultivation of Christmas trees,
elderberry and huckleberry bushes,
and other nursery stock.
Parks,
Golf courses
Equestrian or bicycle paths
Picnic areas
Game refuges
Hiking trail routes
General agriculture
Winter sports
Orchards

The Location of Appurtenant Aboveground Facilities

51. The proposed designs and locations of electric substations, and other aboveground facilities, including communication towers, should be made available to local agencies with jurisdiction over these matters sufficiently in advance of construction deadlines to permit adequate review.

52. Unobtrusive sites should be selected where possible for the location of substations and like facilities.

54. The size of substations and like facilities should be kept to the minimum feasible.

55. The designs of the exteriors of substations and like facilities should comport with surroundings and other buildings in the area all in keeping with local control and applicable local zoning ordinance. For example, if a substation is to be located in a residential area, its design should comport with the designs of nearby residences.

56. If substations are located in residential and/or scenic areas, the appurtenant transmission conductors and distribution conductors adjacent to the substations should be placed underground where economically and technically feasible.

57. Trees and other landscaping appropriate to the site should be placed around substations to present a pleasing view to the public.

58. Storage tanks in scenic areas should be placed below ground where feasible. If storage tanks must be placed above ground, they should be concealed in part by appropriate plantings of trees and shrubs.

59. The materials used to construct substations, storage tanks and like facilities and the colors of these materials should comport with the surroundings.

Report to: CENTRAL MORTGAGE & HOUSING CORPORATION on
TRANSPORTATION CORRIDORS N.D. Leas & Assoc. Ltd.
December, 1969

Chapter 9: Conclusions and Recommendations

1. The size and population of most large Canadian cities may be expected to more than double by the turn of the century. The sub-urban fringe area into which the city must necessarily expand is now sparsely developed and relatively inexpensive. It is certainly desirable to acquire transportation corridors before the local development pattern is fixed.

2. Some trend forecasts have indicated higher speeds and more automation for new transportation modes. The restraint put on any vehicle system for moving people is the acceleration acceptable to the human body. It is possible to fix corridor alignment requirements without knowing what mode will be developed once the speed of travel, and hence the acceleration, is decided.

3. The design speed for preliminary design of urban corridors has been selected as 80 mph, but this should be subjected to further study.

4. The provisional design standards for an 80 mph urban corridor, taking into account the restraints of the human body and the possible modes to be accommodated, are as follows:

minimum radius of curvature		2,150 ft.
absolute minimum width		800 ft.
desirable minimum width		1,300 ft.
intersection area	4,000 ft. x	4,000 ft.
normal maximum grade		3%

5. It may be desirable to acquire a wider corridor and more land near access points to give the public the benefit of the price increase that will follow the introduction of public transportation facilities. This question should be the subject of further economic analysis.

6. Through preliminary study of a theoretical city it has been determined that corridors can be planned in advance of construction in such a way as to accommodate main transportation facilities, while at the same time allowing adequate flexibility for any conceivable land-use development. It is recommended that corridor planning techniques be developed through detailed studies of at least two real life cases. In general it is considered that urban corridors should be in a grid pattern with spacings of three to six miles, but this too should be investigated further in the case studies.

7. Initially urban corridors would accommodate conventional freeways which would be built as needed. The proposed corridor standards are of sufficient width to include mass transit and automatic vehicle systems which may be developed. Pipelines and transmission lines may also be included.

8. With increasing urbanization and the emergence of major population centres close to each other, there will be an increasing demand for high speed inter-city ground transportation systems.

9. Since inter-city transportation must penetrate into the city, it is essential to reserve some of the corridors in urban regions at sufficiently high design standards to accommodate high speed inter-city ground transportation.

10. The following preliminary design standards are proposed for inter-city corridors that include high speed ground transportation:

Minimum radius of curvature	5 miles
Minimum width	800 feet
Normal maximum grade	3%

11. Inter-city corridor design requirements, and their coordination with airport location, both require further study. This might best be done by a case study.

12. The economics of transportation corridors, particularly from the point of view of determining the time horizon to be used in acquisition, needs further study. It is likely that corridors should be reserved 15 to 20 years in advance of construction, but more thorough investigation is required to develop criteria that can be applied selectively by corridor link.

COMBINED TRANSPORTATION CORRIDORS
PART II: THE SPADINA EXPRESSWAY - THE ABANDONED CORRIDOR

by John R. Crosby Director Transportation and Planning Division
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Summary and Conclusions

The past ten years have seen changes in the public acceptance of many transportation projects. This undoubtedly has been influenced by the writings and opinion expressed by both experts and laymen on the subject of transportation systems as they exist and have

been proposed for the future. Some of these proposals are spurious or so far into the future that any suggestion as to their application within our normal planning and design periods, can only be considered irresponsible. Unfortunately, the general public frequently does not possess the background knowledge to discriminate between what might be called transportation facts and fantasy.

Both the popular press and officials or individuals responsibe for the release of untimely or exaggerated information must assume considerable responsibility for the doubts and uncertainty which are now expressed by the public. This has lead to delay in project implementation, millions of dollars of public expenditure for review, restudy, hearings, etc., and increased cost for delayed implementation due to the insidious effect of inflation.

The current democratic process seems to require the total involvement of citizens in the decision-making role irrespective of the question or issues involved. This appears to be a direct attack upon the mandate given to an elected representative and implicit in his success at the polls. Is he representing all the people in his ward or riding, or only those that oppose a particular issue? There still remains a number of individuals who believe that our local elected representatives must continue as decision-makers in their own right.

Ralph Tabor, Director of Federal Affairs for the National Association of Countries, states;

> "We have to talk in terms of politics, we have to talk in terms of who is going to finally make those decisions, and it is not going to be citizens themselves, it is going to be elected governing board members that are going to make those decisions."

Milton Pikarsky, Chicago's Commissioner of Public Works, makes an even stronger case for keeping citizen participation in the design and decision-making process within the established legal government

of the community:

> "The question is, who represents the community? The militant who tries to organize a block club? The person who quietly tries to persuade the community that school systems are fine and that we should continue? Basically the decision makers are the elected representatives... To assume anything else again is sheer folly. Who are the community leaders today? Who will be tomorrow? A project may take a year or two years. You may find that you have received community support from local groups, block clubs, and others only to find when the project is under construction that there are different presidents, different leaders, different advocacies. The only people you can depend on to represent the community are their elected representatives."

A stratification of governmental responsibility, at each level, is essential to the entire process. Without definite definition of authority and responsibility, the electorate cannot evaluate or even identify the demonstrated performance in terms of his expectations. Public apathy is a legitimate reaction to this situation as confusion is a certainty when individuals cannot properly identify the responsible agencies of government which relate to particular areas of their needs and desires. Is it any wonder that a large sector of the public do not exercise their franchise? This, of course, is only one aspect of the current situation, but is of sufficient importance to warrant concern and possibly correction.

Those charged with the formulation of transport policy and implementation must also assume a considerable share of responsibility for the state of things today. Granted, many of the issues are dynamic and it becomes increasingly difficult to produce a plan for a positive course of action to deal with such issues. Nevertheless, it is incumbent upon us to apply forceful action in addition to the lip service normally given to the following items:

L. An official plan and zoning by-law is one of the most important development controls available to an urban area. Without such a plan, and the assurances it provides, transportation

planning is little more than an academic exercise. Thus, urban transportation planning must be carried out as a part of the overall development plan and become a part of the official plan.

2. Transportation planning must be comprehensive and requires that consideration be given to all existing modes that currently exist within the study area or may become applicable within the planning period due to the current growth rate of the area.

3. The transportation plan, as an important component of an official plan, must be given official status as the approved policy and intent of the municipality. The gossamer cloak of "approval in-principal" is inadequate assurance of its acceptability.

4. The up-dating of a transportation plan is essential at such time that major departures can be discerned from the official plan. Sound planning suggests that both be updated and approved with adequate protection and assurance that they demonstrate the agreed development policy.

5. Based upon the acceptance of the preceding proposals, the functional planning and design of specific projects must be accepted as the authorized pre-implementation stage which is no longer open to a question of need and/or desirability. These questions cannot be answered at this stage, as they are completely unrelated to specific projects. They must be considered a direct attack upon the official plan and the related transportation plan and can therefore only be properly viewed within this overall context.

Other conclusions have been drawn that appear to be beyond our collective control, but are of great importance to our society and must be recognized by all responsible individuals:

1. Professionals, governmental officials and the members of the press have a public responsibility to refrain from extravagant claims or proposals that may mislead or will certainly be misinterpreted by the public. There is no excuse for sensationalism on the part of such parties at the public expense.

2. Press reporters, editors and publishers must exercise reasonable value judgement in the presentation of public-related information. This is not a proposal for censorship or the elimination of constructive dissent: rather, it is a proposal to restrain sensationalism which is intended to produce useless controversy or to focus attention upon special groups or individuals.

3. Decision-making bodies must exercise greater care in dealing with public related issues to determine the true alternatives available witin the appropriate time frame. Having determined these and the related consequences, the public needs should be given at least equal weight to those of individuals or private groups, without exception.

4. Both businessmen and special interest groups should accept responsibility for the public good in planning and development matters. This may appear to be an almost impossible altruistic cause. The author has observed cases where the owners of various developments which depended solely upon good transportation have opposed local transportation improvements to the detriment of the public.

5. There is also significant and growing concern within professional ranks that those employed by governmental organization, and who may be required to appear before judicial or similar type bodies in the support of various public works proposals which have attracted an adverse private or public reaction, are immediately suspect. This is not an idle claim, but the subject of discussion with others and recent personal experience. The normal reaction

to this, is for the more knowledgeable and experienced individuals to avoid these conformations and this directly weakens the case that should have been made in the public's interest.

6. The public is little better prepared today to deal with complex urban development issues than it has been historically. Although the levels of knowledge and interest has increased, the complexity of the decisions and challenges has also increased. Local citizen power blocks may be influenced in the decision-making areas but give little if any assurance that the broader aspects of the public interest is really best served by their demands. In a recent "citizens revolt" the only alternative proposed by the objectors would have placed the proposed facility just outside their area and within industrially zoned but otherwise undeveloped land. The normal extension of the facility to interconnect with existing or proposed future routes, would have imposed almost identical problems within other neighborhoods. A most interesting sidelight is that a parkway-type land reserve existed within their area and was unacceptable to them for freeway development. No similar reserve existed within the area where they proposed to locate the facility.

Experience of this type casts grave doubt upon both the willingness and ability of local organized groups to deal fairly and impartially with the real issues at stake. Are they truly acting as responsible citizens and in the public interest? Or rather, are they really saying we want the service and convenience, but don't place it within our area - move it over there?

Since it is apparent that public involvement in transportation related issues is a commitment for the present, we must use our efforts to provide assurance that the public-at-large will make the decisions - not the private dictates of special interest groups. This is a real danger and cannot be over emphasized!

The referendum procedure provided for in many democratic societies seems appropriate. The issues are the area transportation and development plans, and every means available to modern man should be applied to disseminate the alternatives and their respective costs. With the application of all media sources, including radio, television and the press, every citizen becomes a knowledgeable decision-maker. Our elected representatives, having received a mandate, can then proceed with the related issues of timing and individual project financing.

This proposal should satisfy the Nowlan's who have stated"... ...if planners will not involve the citizens, citizens will involve themselves". The major question however is: does it satisfy you? Are your prepared to vacate the ivory tower and hit-the-road? if you are, the job is yours; only you are qualified to place the question and alternatives before the public. And by the way,... good luck!

COMBINED TRANSPORTATION CORRIDORS

by Joseph D. George, Chief Design Engineer, Metropolitan Toronto Department of Roads and Traffic, September, 1971

Abstract

A "Combined Transportation Corridor" may be defined as a right-of-way designed to carry more than one service. Initially, a road allowance was considered mainly for one sole purpose, that of carrying traffic. This conception is changing because of the growth of urban areas, incidence of many different forms of transportation, need for utilities, concentrations of population, and high costs of land.

Combined corridors may be used both within urban areas and outside urban areas, connecting two or more communities.

The quality and economy of living in any community are largely dependent on the proper provision of its many services. In fact, the very existence of a community is dependent on the services, for without the services there would not be much advantage in living in a city.

One of the most important factors in supplying services for a community and keeping their costs down is provision for their proper location. It is, therefore, the purpose of this paper to promote the idea of "Combined Transportation Corridors" and to illustrate the subject by using examples of typical applications in Metropolitan Toronto.

Defintion and Concept

"Combined transportation corridors", simply defined are road allowances used for two or more forms of transportation. You are all familiar with the modern surface transportation systems such as automobile, train, public transit, go-trains, and mono-rail, but there is another form of transportation that most of us miss, and that is the utilities, such as water, sewers, telephone, gas and electricity. I shudder to think what would happen to the traffic situation if all of these services were delivered by surface transportation instead of by pipes and wires. Therefore, in dealing with "combined transportation corridors" we must not forget to consider utilities.

"Combined transportation corridors" apply both to urban and inter-urban transportation systems. The main difference between the two is that in the first case population growth occurs from a central point out in all possible directions, while in the second case growth takes the form known as "strip-development" adjacent to the transportation corridor.

Street road allowances are good examples of "Combined Transportation Corridors". While they were originally laid out for vehicular and

pedestrian traffic only (in most of the old cities), the road engineer has become reconciled to the fact that these road allowances must accommodate utilities and other public services as well. As a result new road allowances in most modern cities are now designed to accommodate all services, resulting in greater widths such as 100 and 120 feet instead of the old 66 foot standard.

On the other hand, expressway road allowances, generally, are designed for vehicular traffic only. We are gradually beginning to realize, however, that they too should be used for more than one purpose. In appropriate areas, expressways may be combined with rapid transit, go-trains, bus routes and other commuter transportation menas. What about the utilities? In the dense urban areas it is becoming more difficult to prevent the utilites from entering the expressway rights-of-way. The main argument is that if the express-way uses an existing street road allowance it should make room for utilities.

Anyway, the community will be better served if, wherever possible, the expressway corridor were initially designed with extra strips of land along each side that could be used by the utilities without interfering with the traffic on the expressway. Probably the same areas could also be used as service roads and/or as maintenance roads for the expressway itself. Such strips would also help in noise abatement by keeping the traffic farther away from adjacent establishments. Furthermore, economically and politically it will be much easier in the future to acquire a transportation right-of way if it is intended for several purposes, and not just for a road. This applies to inter-urban expressways also. There are some typical cross-sections of urban and inter-urban expressways that may be used as "Combined Transportation Corridors".

General Pattern of Urban Expressway Systems and how they fit into the Idea of "Confined Transportation Corridors"

One can be shown some typical examples of patterns of express-

ways used in some of the large cities. You will note that there is one common pattern or layout that becomes evident: the expressway corridors are in the form of rings and radials around the centre of the core area of the city. This is mainly due to the natural growth of a community - everything emanating from the centre out.

The main reason for such a pattern of growth is the services. People establish their home or business or their industry where services are economically available.

This means that settlement takes place around the starting point.

Therefore, it is not a surprise that the high speed facilities should form around the focal point. They may be circles, squares, rectangles or irregularly shaped. But they do, of necessity, focus to the core area.

Population density also follows the same pattern. As the community gets larger, the interior becomes denser. When this takes place all services such as roads, sidewalks, water, sewers, electricity etc. must revolve around this dense core to keep it supplied. You will notice then that this natural growth from the centre out, is common not only to population, but also to all services and utilities that the community needs. This, basically, is the reason for "Combined Transportation Corridors".

It can be easily seen that this is not artificial or even a planned growth, but it is a natural growth as mentioned above. One can visualize shows a graphical representation of this phenomenon. You will note more of the streets are used for transportation as one approaches the core. This necessitates more side or tangential movements. Then tangential movements become heavy enough a high capacity "ring road" becomes necessary. This is the first indication that a ring expressway may be needed.

Another way of looking at the formation of ring roads is by considering that, at different stages in the growth of a community, a high capacity road is necessary around the area to distribute the incoming and the outgoing traffic without excessive and circuitous use of local streets. Similarly, if the streets leading into the core become too congested then radial roads must be improved. If the concentration becomes heavy enough this leads to radial expressways or high capacity roads to relieve the pressure on the streets.

Analysed in this manner it becomes clear why capacity transportation corridors generally take the "ring" and "radial" shape.

At this point you may ask: what has all this got to do with "Combined Transportation Corridors"? The answer is that practically all the other services such as water, sewers, telephones, gas, and electricity follow the same pattern and focus to the core area, similar to roads. As a proof of this point, one need only look at a network of watermains, or one of gas mains. Telephone and power cables follow the pattern of streets. It can be seen that it is quite possible and logical to design the transportation corridors for all of the services. Such coordination will not only be more economical, and more efficient but it will help road authorities to justify acquisition of the necessary land and its acceptance by the general public.

Are Expressways Really Necessary?

No city can do without traffic trunk lines (expressways) any more than it can do without water and sewer trunk lines, if zoning has allowed concentration to go beyond a certain point. The old saying applies: "you can't have your cake and eat it". In other words if a city wants lots of skyscrapers densely situated it must have expressways and the other trunk line services to keep

itself alive, otherwise it will gradually die.

Assuming that most of the existing cities in the world have grown from the centre out, with very high densities at the core, they must have expressways. When the density of any area of a city passes the transportation capacity of its streets it must have a system of trunk roads (expressways) to relieve the streets. At this point, generally speaking, a combination of mass transit and expressways becomes necessary. Mass transit alone is not sufficient because it carries people only, not goods. Also the service is not flexible enough - it is impossible for transit to carry people from door to door. This lack of flexibility results in too much waste of time. Modern society will not put up with it.

Arbitrarily eliminating expressways is like eliminating trunk lines of other services, such as water, sewers, electricity etc., and expecting the smaller lines to do the job. This can only result in bad service, poor efficiency and high costs. When you want to supply a dense area with water, you don't use 57 four-inch diameter pipes! You use one 30-inch diameter pipe (which is equivalent). Why not do the same with traffic? Cutting down the mobility of an industrial community is like knocking the props from under its prosperity. Eventually, slowly but surely, the area will deteriorate.

Some great cities have already started dying at the heart because they lack mobility. Others will die as the people can afford to leave them in spite of their highly developed mass transit facilities. There is only one way of eliminating expressways - reduce the number of cars.

There are different ways of doing this:

- controls on the number of cars per family.
- high gasoline tax
- tax on parking fees at the areas where cars are to be reduced

- banning all cars (not trucks) from an area.
- issuing stickers for cars that would be allowed in the area.

But remember I am not recommending any of the above measures.
I am recommending only one measure:
Control density and design maximum mobility compatible with the needs of the area involved.

Conclusion

1. A community's supply of roads and other services must be commensurate with its needs. This means the community must be kept mobile and well supplied.

2. These needs depend on the density of population. For example, it is not right to allow a concentration of skyscrapers and, in the meantime, rule that no more expressways be constructed, as one often hears nowadays.

3. Streets alone will not carry all the traffic generated in core areas where rezoning has allowed heavy concentrations. Expressways are needed and should be brought in, close enough, to the core to relieve the streets from through-traffic, as much as possible.

4. Such expressways generally take the shape of loops (rings) and radials due to the natural growth of a city.

5. Since other services and utilities follow a similar pattern in layout, road allowances and expressway corridors should be designed for combined purposes.

6. Inter-city expressways, also may require "Combined Transportation Corridors" unless "strip-development" is not expected.

7. Rapid transit systems and other forms of mass transportation may also be needed in a city, but they can never completely replace all the functions of automobile traffic. Flexible mobility is essential in a modern community.

8. Excessive concentration at cores of cities creates more ecological and operational problems than are apparent.

9. More and wider transportation corridors are assurance for the future mobility of a community. If not used for automobiles they will be needed for other forms of transportation, that may be developed in the future.

10. Transportation corridors and parks may be the only open spaces left in the future industrial cities! Let us acquire and protect them.

PANEL: MULTIPLE USE OF TRANSPORTATION CORRIDORS

D.A. Crosbie, Director, Legal Branch, DTC Ontario, September, 1971

I have been asked to review the major legal considerations related to the multiple use of transportation corridors. In these comments I am assuming that "transportation corridor" means an enlarged right-of-way designed to accommodate transportation facilities, utilities, and various other linear land uses. Such a review must of necessity be very general in nature, as time does not permit reference to specific Acts and regulations. To merely list the legislation in the various federal and provincial jurisdictions covering the subject matter would require more time than has been allowed to me. That fact in itself is one of the main legal problems facing transportation authorities who hope to develop a reasonable multiple-use policy.

Division of Legislative Powers

One of the major legal problems arises out of the distribution of legislative powers under the British North America Act. The division of jurisdiction between federal and provincial authorities creates varying degrees of difficulty depending not only on the particular use of the corridor that is being considered, but also depending on which province you are in. For example, inter-provincial gas pipelines are regulated by the Federal Energy Board, whereas intra-provincial gas pipelines are regulated by provincial authorities. Such a division of responsibility may result in a uniform federal policy applying to one group of gas pipelines and a different provincial policy applying in each of the provinces to another group of gas pipelines. Jurisdiction over telephone companies illustrates a different problem. In some provinces, such as Alberta, Saskatchewan and Manitoba, the telephone service is provincially controlled and operated. In other provinces, such as Ontario and Quebec, much of the telephone service is provided by Bell Canada and is federally controlled and regulated. To illustrate how confusing this can become, I need only refer to the situation that exists in northeastern Ontario. The Ontario Northland Telecommunication Commission is a provincially-owned and controlled telecommunication company. Its wholly-owned subsidiary, Nipissing Central Railways Company, has telephone lines running from Ontario to Quebec and, therefore, comes under federal jurisdiction. The chief competitor of the Nipissing Central telephone service is the Ontario Telephone Company. This company comes under provincial jurisdiction even though it is a wholly-owned subsidiary of Bell Canada, which is previously noted comes under Federal jurisdiction

Effect of Division of Legislative Powers

The significance of this division of jurisdiction over undertakings that might logically make use of common rights-of-way becomes apparent when you attempt to develop uniform policies to apply

to such multiple use. It has been our experience in Ontario that provincial and federal goals do not always coincide and that provincial and federal regulatory provisions and practices, aimed at implementing these goals, are frequently quite different. Therefore, before multiple-use arrangements can be negotiated, it will be necessary to determine the rights and interest that the parties now enjoy and the extent to which such rights and interests will have to be varied to accommodate a multiple-use concept. For example, to what extent may a utility now demand or obtain a right to use a transportation corridor? And in either case, upon which terms and conditions is such use exercised? If it is determined that utilities should all be located in a particular corridor, to what extent may or should the planning authority be able to compel the various authorities to use the corridor? If a province can only control certain of the utilities, what are the ramifications of dealing in one manner with provincially-controlled utilities and in another way with federally-controlled companies? To what extent, if at all, should the various users be entitled to legally demand compensation for any additional costs arising out of the use of a common corridor?

Users' Interest in Right-of-Way

In the course of establishing a transportation corridor for multiple use, it will be necessary to determine the nature of the interest in the right-of-way enjoyed by each of the several users. Will the users each have separate but adjoing parts of the right-of-way? On What basis will relocation costs be borne in the event one user disturbs another? What effect will the concept of transportation corridor use have on the acquisition of the right-of-way and on expropriation proceedings? In Ontario we have a hearing of necessity procedure under which the expropriation authority may be required to justify its proposed expropriation. What difficulties will be encountered if a road authority acquires the common right-of-way, not only for highway purposes but also for use by utilities

and others? To what extent will it be necessary to enlarge the powers of expropriation to overcome this problem or to involve the various users of the corridor in the inquiry procedures? On What basis will the cost of acquiring the right-of-way be distributed amongst the users?

Abolition of Highway Designation

If as has been suggested in some quarters we abandon the historical designation of "highways" where multiple-use corridors are created, it will be necessary to replace a considerable body of common law and statutory provisions with new statutory provisions that clearly spell out the rights of the various parties and of the public that may be using the corridor.

Summary

In short, the main legal problems will involve an identification and redefinition of the rights and interests of various users of the transportation corridor, and of the procedures for the establishment, acquisition and use of the corridor.

J.V. Hassel, Assistant Chief Engineer, Bell Canada, September, 1971

To give perspective to our multiple use discussions to-day, I believe it is important to keep in mind that the common use of right-of-way concept, as such, is not new.

ThroughoutOntario and Quebec for example, Bell Canada, in conjunction with provincial and municipal power commissions, jointly uses almost one million poles and shares many miles of joint trenching for buried facilities. Much of this aerial and sub-surface plant is located on provincial highways and municipal roads and streets. Third

parties, including cable television and oil pipeline distribution companies, are also entering into these joint arrangements with growing frequency.

In the past, these arrangements were largely established on a voluntary basis in cases where overall mutual economies could be affected. However, while skyrocketing urban land costs will add significant weight to the financial considerations, other factors have been added which may necessitate the multiple use of rights-of-way on an unprecedented scale.

These other factors include:

- the public's growing concern for aesthetic and environmental values and the effectiveness with which its views are being made known and acted upon.
- the objections of private property owners to numerous and individual facility easements criss-crossing their property, with the impact that such rights-of-way have on their means of livelihood and property values.

Coupled with these external influences, growing congestion in and around the major urban centres is making it necessary for service and utility organizations to rethink their long-standing approach to right-of-way acquisition.

Most of us have some legitimate reservations concerning the practicability of the multiple use concept on the scale envisioned in our discussions to-day. The concept will entail loss of independence in route selection and much greater effort towards inter-organizational advance planning and project co-ordination. There will be technological and safety problems to be resolved and legal, regulatory and jurisdictional matters to be re-examined and restructured.

But these problem areas will not prove to be insurmountable if we can bring ourselves to accept the inevitability of multiple use on a more extensive basis.

In the brief time available, I would like to suggest for your consideration just three aspects of the multiple use concept which

are going to require additional, co-operative effort.

Advance Co-ordinated Planning

New and more sophisticated bodies to exchange planning and design information will have to be established between appropriate levels of government and all public and private service and utility organizations.

We have had considerable success through involvement in utility co-ordinating committees in the large towns and cities, but there will have to be a major shift in committee emphasis from job-by-job cooperation immediately prior to and during the construction interval, to an exchange of information during the initial planning and early design stages.

We also see a significant need to extend the establishment of such committees with successive levels of government, from cities and towns to townships and counties and on through to regional and provincial government levels.

The need for appropriate planning bodies is paramount and such bodies are essential to the multiple use concept in the full meaning of the term.

Co-operative Effort in Corridor Design

If the multiple use concept is widely accepted and utility occupancy of public rights of way significantly increases, then transportation routes for surface transport will emerge as service corridors for which an entirely new set of design criteria must be developed.

The fact that utilities have been accommodated over the years on routes designed primarily to carry vehicular traffic has led to some of the mutual problems of occupancy which we face to-day. Service

corridors are neither an adaptation of, or an appendage to, a vehicular transportation route. They are an entirely new concept and must be treated as such.

On an interdisciplinary basis, it should be possible to integrate the corridor design requirements of all the potential users into a mutually acceptable set of standards.

On major provincial highways, for example, it may prove desirable to restrict utility usage to trunk and transmission type facilities Feeder and distrubution plant could continue to be accommodated on municipal rights of way. However, in all cases of multiple occupancy, the assignment of standard, technically feasible locations, closely adhered to by the users of such corridors, would be an essential design consideration.

Facility Design as Related to User Compatibility

At the present stage of the art, technology imposes certain limitations on the proximity with which various utilities can be installed on a shared right-of-way.

With low voltage power systems, for example, we can install our telecommunication plant with random to zero separation in a common trench. With high voltage transmission lines, we may require separations of up to 2000 feet. Close proximity to railway lines can result in physical vibraions which cause faulty relay operation at repeater installations, thereby introducing transmission distortion and errors. Electrolysis problems on shared rights-of-way are another design consideration.

These examples are mentioned simply to emphasize the need for co-ordinated action in terms of planning, route selection and corridor facility design. User compatibility considerations, as such, do not represent insurmountable obstacles to multiple use.

In Conclusion

As a utility representative, I have been much encouraged during the last few years by the leadership that is being provided by both Canadian and American road authorities in the development of multiple use concepts as related to trasportation routes. A more all-embracing interest is being shown in various methods and forms of transportation. In the broader meaning of the word, "transportation" would include the plant and facilities of service and utility organizations. Some road authorities are therefore tentatively talking in terms of integrated "service corridors", rather than transportation routes.

We can foresee some significant loss of corporate independence in terms of route selection that will be appropriate to the combined needs and timing of all the parties involved. Present and potential user compatability limitations will necessitate considerable technological innovation to make service corridor usage practicable Co-ordinated advance planning and project scheduling will be required on a much earlier and more intensive basis.

But we recognize that the multiple use concept will enable us all to meet the needs of the users of our services in a manner more in harmony with the public's concerns and wishes.

Bell Canada is therefore interested in this enlightened approach to right-of-way acquisition and usage.

M.G. Elston, Senior Planning Engineer, Department of Highways, B.C.
September, 1971

Sharing of rights-of-way in British Columbia is at this time largely confined to utilities. Power, phone, gas, sewer, water, T.V., district steam and similar utilities are accommodated in conventional

highway and street rights-of-way above and below ground. Utilites are not accommodated in freeway rights-of-way, except for crossings, because of interference with freeway operation. All highway and street rights-of-way except in the City of Vancouver are owned by the Crown Provincial and no charge is levied against utilities for their use. Some rentals are however paid by utilities accommodated on bridges. The usual rules of clearance between utilities apply. Uses other than utilites at this time are few and are generally confined to automobile parking and material storage beneath bridge approach structures. Leases at commercial rental are entered into.

One notable exception to the utilities-only use is the C.P.R.'s imaginative project 200 in Vancouver. This is a large redevelopment scheme utilizing in part the air space over the C.P.R. tracks in downtown Vancouver. The whole project consists of four office buildings, one hotel, three apartment buildings, a group of townhouses and one department store. Total parking is to be of the order of 7,000 stalls - indicating the scope and size of the development. A significant part of the development is over the C.P.R. tracks and the first buildings may be seen under construction at this time at the north end of Granville Street.

At the last session, the Legislature enacted an Air Space Titles Act - among the first in North America. Our system follows the Torrens system of Crown guaranteed titles. Under the common law a property owner owns the air space above his property, subject of course to the rights of navigation, and this Act allows him to register a title for his air space separate from his title for his ground. This air space title can be freely sold and, more importantly, mortgaged and the Act will thus facilitate air space development.

The joint corridor concept is being studied by the Province at this time. The proposal is to locate rural major highways, power trans-

mission lines and pipelines in one corridor several hundred feet wide. The chief objective is to reduce severance and minimize total area of land cost to other uses such as agriculture. There are however problems particularly with solids pipelines and with location in difficult topography.

Thus, it can be seen that the Province of British Columbia believes in the multiple use of rights-of-way. That there has been little past use in our opinion, due to land values but land values have risen greatly in the last few years and the trend appears to be a continuation, so we anticipate more and more diverse multiple use of rights-of-way in the future.

E.G. Sheasby, Assistant General Counsel, Interprovincial Pipe Line Co.
September, 1971

In speaking to this topic, I would like to make two general observations which I feel should be kept in mind.

Firstly, the "public interest". We all recognize in our public or corporate capacities as citizens that the continuing growth in population and urbanization with the consequent expansion of industry has given rise to a growing public concern to optimize land use, and to minimize any disturbance of other land users, aesthetic values and our environment. These considerations may very well support the concept of a transportation corridor in one set of circumstances, but in another they may not. For instance, the growing congestion around our large metro centres may, by itself, appear to justify the multiple use of a transportation corridor. On the other hand, however, we all recognize that almost daily, facilities are being added to or work being done on one or more of the present transportation facilities or essential services entering such metropolitan areas. Thus, from the point of view of safety and security alone, is it perhaps unwise in the public interest to

compress all or a substantial part of all our essential transportation and communication links, and energy sources, into one corridor, where due to their proximity to each other the possibility of a complete breakdown of all such services is increased by reason of continuous contruction activity, maintenance or some other happening.

Secondly, there are certain basic considerations which influence the selection of a right-of-way route for a certain facility, which are not factors of concern in route selection by others. For instance cross-country trunk pipelines, such as Interprovincial, normally take the most direct and economic route to processing centres by by-passing as much as possible built-up areas. On the other hand, I believe it fair to say that the rights-of-way of highways, railways, and utilities such as hydro and telephone, are generally designed with a view to servicing communities en route. Grade is also an important consideration in the selection of rights-of-way for both railways and highways, but normally does not influence to the same extent the determination of a pipeline route. Another factor to keep in mind is that the installation of pipelines, as compared to the presence of highways, railways, and certain above ground utilites generally has a relatively minor impact on future land use. That is, by constructing a pipeline you do not sterilize land from some other use.

In making these observations I do not wish to indicate a position against the concept of the multiple-use corridor from either a pipeline or any other point of view, but merely wish to point out that one must consider many factors in weighing the pros and cons of its application in any specific proposal, as the very considerations which are popularly bandied about in support of this concept, such as "the public interest" and "economic land use" may also be used as arguments against its application in a particular set of circumstances.

Dealing more specifically with the material considerations to be resolved in establishing a multiple-use corridor, I refer to certain descriptive words and phrases which appeared in the terms of reference I was given for this panel, such as "service corridors", "utility use of public rights-of-way", and "sharing road and highway rights-of-way". These expressions have different connotations - at least to me - and I feel it most important at the outset to distinguish between the multiple use of an existing right-of-way, and establishing a transportation corridor where no other right-of-way exists. In my experience, making an additional use of an existing right-of-way invariably results in a senior and junior user with corresponding rights and obligations; whereas establishing a right-of-way corridor suggests to me either the use of an area in common with others, or the use of separate rights-of-way within a corridor, with all occupiers in both cases granted equal rights and assuming equal responsibilities.

The sharing of an existing right-of-way most commonly occurs at specific locations due to local conditions or particular circumstances, such as the physical restriction of mountain passes, or the extensive development in an area which makes the physical or economic acquisition of other right-of-way impractical or perhaps impossible. Opposition to a proposed route and cost considerations have also required sharing an existing right-of-way. In other words, there may be no practical alternative. However, when a practical alternative does exist, one has to weigh the obvious engineering, safety, and legal considerations involved in sharing the right-of-way of another. Apart from the technical and safety considerations involved, the senior right-of-way user is generally in a position to impose some pretty stiff terms, which are in addition to the compensation and covenants which the landowner will demand if the right-of-way is not owned in fee. One provision I have seen

and consider particularly objectionable is a clause making the grantee responsible for all damage to its facility when caused by the negligence of the senior party, its agents or contractors - this is a standard clause insisted on by some public bodies and companies. Another condition quite often insisted upon by the senior user is one requiring the future relocation of the junior facility at the descretion of the senior party - which very often is unacceptable for obvious reasons, both practical and legal, and can give rise to jurisdictional problems. Thus the fact that one is senior and one is junior adds a particular barrier to establishing a transportation corridor in an existing right-of-way where another practical alternative exists.

Assuming, however, that at the initial planning stage an unfettered transportation corridor is proposed, that it has been determined to be in the public interest, and that it is suitable to potential users from a servicee point of view, then the advantages to the user are pretty obvious. A transportation corridor would minimize delay and possible public opposition to route selection; it would hopefully reduce the acquisition cost of right-of-way; and for other services it would provide ready access from highways or railways, if such are included, to facilitate construction, operation and maintenance.

Some of the negative factors are also obvious from a technical, safety, and legal point of view, as I am sure we all prefer the uncomplicated operation which our own unrestricted right-of-way affords. However, once having determined that the establishment of such a corridor is in the public interest, and that the route is suitable for the potential users' purposes, then I cannot - at least from the point of view of a federal pipeline such as Interprovincial - comprehend any technical, safety, legal, jurisdictional or other reservation which could not be resolved to make such a concept acceptable.

Richard A. Toner, Manager, Distribution, New Brunswick Electric Power Commission, September, 1971

It would seem appropriate that your association be host to this seminar on sharing rights-of-way. You have been doing just that for water, sewage, telephone and power since the inception of these services. In particular, for the latter two services, streets and highways have been utility distribution corridors.

In the early years of this century, the electric power utilities and their sister utilities in the communication field invariably travelled their separate ways and managed to populate both sides of city streets and provincial highways with a forest of wood poles. Co-operation between the utilities couples with technological improvements in materials, construction and operating practices eliminated many of the undesirable effects of power lines on communication facilities. For several years now, we have been using the same pole line or cable trench in a joint effort to reduce the pole population and right-of-way requirements. The joint facilities accommodate telephone, television cable, and power circuits where the latter operate at voltages below 15,000 volts. In low-cost underground systems, where direct burial of facilites takes place, the power and telephone cables are either plowed in or placed with random separation further reducing right-of-way needs.

The latest agreement between NBTel and NBPower is keyed to joint planning of small jobs by the field forces, as well as of long-range projects in our Engineering Departments. By sharing of the savings realized by our joint efforts, we have the stimulus that produces results all the way down the line in both organizations.

That's the situation for local services to residential, commercial, and small industrial customers. What of the high voltage transmission network for the power system and large industrial customers? Other than for inter-city telephone trunk cables and a few scattered cases of paralleling railroads and highways, the

power transmission network has a point-to-point pattern with a minimum of right-of-way sharing mainly because other utilities do not choose to follow the same route, possible for technical and financial reasons.

Current Situation

The combined efforts of the Department of Highways, Municipal and Provincial Planning Boards, City Engineering Departments, NBTel, and Provincail and Municipal Electric Utilities have resulted in some worthy accomplishments:

- Utility planning committees in Saint John, Moncton and Fredericton. The committee meetings provide a forum for "show and tell" communication.
- In Saint John, a bylaw regulates location and type of all utilities. The regulations will be issued shortly for use by developers.
- The new Saint John Harbour Bridge and many other bridges, overpasses and major interchanges in the province have duct work provided for power and communication circuits.
- Subdividers incorporate utility easements in all property deeds.
- A Department of Highways' Utilities Agreement, which is a statement of policy to be followed by N.B. Department of Highways, NBTel and NBPower in matters related to joint use of right-of-way.

The railways, CN and CP, have co-operated in sharing their right-of-way with power lines provided the necessary clearances from their communication circuits are maintained. In turn, they share our right of-way where communication circuits connect their microwave tower system to urban terminals. As a rule, the power lines intercept railways rather than parallel them. Right-of-way is covered by a license with a 30-day removal clause, and our utility, in all but exceptional cases, prefers to obtain right-of-way that offers more security. Present regulations governing clearances from railway communication circuits and relating to inductive interference problems are restrictive to right-of-way sharing or even to the electric lines being on adjacent property. It would appear that the electric

utility and railway communication engineers would have to make transmission line and/or communication system modifications if more "togetherness" is to be realized in the future.

Our transmission lines, particularly in provincial and federal parks, provide trails for the fast-growing sport of snowmobiling. Hunters and fishermen have long made use of them to reach their favorite game stand or trout pool. The access road on the right-of-way is used to fight forest fires.

Another use for right-of-way has been for Christmas tree plantations. The largest grower has some 76 acres under cultivation in the south western section of the Province.

Granted, there have been some accomplishments, but sharing of right-of-way is minimal in New Brunswick. The blockages are many, such as:

- One city tapped a distant lake for its water supply. An access road, pipeline and a power line were required. Everyone agreed to a joint right-of-way for all three facilities. To parallel the pipeline and the road meant added cost to the electric utility because of the greater distance. There was also some concern that electric induction would cause corrosion of the water pipe. The work schedule did not permit research into protective systems to offset the probable corrosion. In this isolated area, the Planning Board was not active; so two swaths were cleared through the timber which is a prime resource in our province.

- Many comprehensive community plans are in existince, but no utility corridors are defined. With pressure on the power supplier to meet ever-increasing demands, right-of-way is purchased in locations to satisfy basic engineering needs.

- Railway rights-of-way offer point-to-point and urban access routes. However, these are jealously guarded by railways. We hardly blame them as their future needs are uncertain. There are good examples in Chicago of power lines in a confined space on a railway right-of-way. We will continue to work closely with the railways and co-operate where possible.

- Modern highways could be utility corridors. We have examples where our transmission lines closely parallel the highway in full view. The motorist objects to the radio interference on his car radio; the planner to the ribbon of steel unscreened by vegetation or terrain.

Future Prospects

With 28,000 square miles in our province and roughly 80 percent forested land, one would hardly dare speak of a tight right-of-way situation. The exceptions would be the Chignecto Isthmus near the Nova Scotia border and areas in and around cities and towns. We made a brief survey of land occupied by various rights-of-way, and the results are approximately:

Type	Area (Sq. Miles)
Highways (excluding cities & towns)	200
Railways	31
Airports	15
Cities & Towns	300
Power transmission lines	45
Rivers and lakes	800
Parks, reserves and military areas	865
Total	2,256

Future power transmission land requirements are about two square miles per year. Our right-of-way needs have been drastically reduced because higher system voltages are now used to increase load capabilities, and we plan multiple circuit structures in urban areas.

With community planners progressively developing comprehensive plans and establishing planning districts, and with the Department of Highways establishing, through legislation, control lines along Trans-Canada and arterial highways, we foresee a trend towards sharing of right-of-way.

We, the electric utility, feel that we have a social responsibility. However, electric power is an integral part of the energy and transportation systems. We must go where the action is; i.e. to the core of the city, to the industrial plant, to the home. Until we can obtain a co-ordinated definition of the socially-acceptable route, the utility will follow the path of least resistance.
Our objectives would be:

- To work with the Provincial Planning Board and planning groups at all levels to help establish transportation corridors primarily in the urban areas.
- To promote the establishment of a central co-ordinating board to help promote the multiple use of right-of-way. We have an example of this in Montreal, where the Electrical Commission installs the duct system and leases it at various utilities.
- To work towards developing environmental criteria for electric transmission lines that will make us more acceptable to other tenants on the right-of-way.

We fully realize the there are steep engineering, environmental conrol and economic hurdles to overcome if comprehensive sharing of right-of-way is to be realized. As one author put it, "Sharing of rights-of-way seems logical to everyone except those who must give a little and share a little so that all could benefit." We see long-range planning as being the key to bring about the multiple us concept of transportation corridors.

Denne Bosworth, Commissioner of Engineering, Regional Municipality of York

September 1971

Purpose of the Panel

My interpretation of the purpose of this panel is to examine and

to discuss the use of public and private right-of-ways by the various utilities, particularly with a view to attaining the most economical use of lands in and abutting the right-of-way.

My Position on the Panel

Since my total engineering experience has been with town and county levels of government, I shall confine my remarks to the establishment of utilities upon secondary and local highways. In this light therefore, I shall assume the attitude of the representative of the owner of lands upon which the various owners of utilities wish to become tenants.

Relationship of the Parties Involved

If this concept of landlord and tenant is accepted, it must be noted that our case is not the normal one wherein the landlord sets the terms of rental of his property and the tenant may accept these terms, or reject them and look elsewhere for suitable premises.

In our case, we as landlords, are required by various statutes and regulations, to provide the space for the tenant to install his plant in conjunction with not only our own works, but also, in most cases, with one or more other utility agency.

We as owners have the authority to regulate the location and methods of installation of these services upon the right-of-ways, but the fact remains that we have to provide the space.

It is therefore most evident, that successful and economical use of right-of-way can only be attained by total co-operation of the utilityand road authorities from the initial planning to completion of construction and further through the life-time of operation.

How Necessary is this Co-ordination

The necessity for co-ordination of services generally varies with the development of the area and the subsequent increase in population density. That is, to say, that co-ordinated utility locations on a city street require much more thought, planning and control than those on a rural concession road. However, this does not mean that rural roads should be disregarded, for I believe almost everyone has experienced the growth of a rural road or part of it, into an urban arterial, during the expansion of our town and cities in the past twenty-five years. Planned utility locations will promote sound development of this rural road to its future functions.

It is necessary, therefore, to regard the location of any utility on every road with a view to establishing the service in a location wherein it can operate without disturbance for as long a time as it is possible to foresee. It is granted that it is impossible to forecast every development to its ultimate, but by intelligent planning and co-operation, I believe we can considerably reduce the amount of disturbance occasioned by haphazard and unrelated service installation, and thereby correspondingly reduce the overall costs.

In urban areas the necessity to co-ordinate services into the minimal width of right-of-way is particularly necessary, in order that the substantial costs of acquiring additional right-of-way be kept to a minimum. For example, in the southern part of our region adjacent to Metropolitan Toronto, widening can cost as much as $50,000 per acre. An eight-foot strip required for a pole line amounts to almost one acre per mile. It is evident from this example that costs can be materially reduced, if all services can be tightened up and planned within the road allowance. We agreed that land values decrease further from the city's influence, but the same principles of economics prevail.

In addition to the economic aspect, a great deal of poor public opinion can be avoided if services are planned and constructed in such a way that the road can be developed with as little disruption of the environment as possible.

How can Co-ordination be Accomplished

I have stressed the need for planning and co-ordination of services. The point is now "How can this be acomplished".

The basic necessity is for all utility agencies and road authorities to know what the others are planning to do.

On method by which this can be done is by the formation of a Technical Co-ordinating Committee composed of representatives of each agency. Such a committee can accomplish the following:

Firstly, for underdeveloped roads, devise standard utility locations which set out the place upon the road allowances where each service will be installed as it is required.

Sencondly, set up standard procedures for application for approval of service installations.

Thirdly, on developed roads, produce plans showing location of existing services and keep amendments to date, so that a complete picture is available of all services in the area.

Fourthly, and perhaps most important, such a committee presents the opportunity for the planners and engineers of all services to know their counterparts and become acquainted with each others problems, and thereby, build a relationship conductive to co-operative planning.

There are many other aspects of multiple use of right-of-ways requiring

consideration, but I feel the basic requirement for establishing sound principles, is the desire of all agencies to recognize the problems, discuss them, and try to evolve a spirit of mutual regard and co-operation.

Discussion

Moderator: Could I then ask a member of the panel if he has a question for another member of the panel.
Unknown: Perhaps I could suggest another area that we should be thinking about since we have these two members on the panel directly involved in the question. I put it to them. In this consideration involving the use of corridors where we are dealing with public assets, rights-of-way, do you have the same set of rules for privately owned companies and publicly owned companies? How do we deal with this problem?

Moderator: Well, perhaps if you asked Mr. Sheasby who is a pipeline man and Mr. Hassell of Bell Canada, they will comment on it.

Sheasby: Well, I don't know whether they ask the leg and arm from everyone else, but they do of us.

Moderator: Mr. Hassell, do you have any comment?

Hassell: I guess I don't really feel that the differentiation is really that significant and that may be evading the question Don, but we all have services to provide. We happen to be providing the telephone. I don't really see that there should be any significant difference. For instance, I do believe that I concur with Mr. Sheasby's comment here that there should be some sort of jurisdiction, the right to force particular services to use the right-of-way. I think that if the corridor is attractive enough perhaps, we would

all want to join in any case. I think of a case now where in the Toronto Centred Region, a design development plan is being produced by the provincial government and it is an excellent one. They have a parkway belt, or as you can refer to it perhaps now as a combined urban separation and services corridor and I guess we would like to think we could make use of this. I am not sure whether we are potential users or not. One of the major problems would be in terms of timing. This corridor might not be built for some time. So I would be concerned about saying today that we would be willing and able perhaps to utilize a corridor in every case. I would be somewhat concerned about the use of that on a voluntary basis. Perhaps we couldn't change our minds.

Mr. George: This point has been discussed an awful lot in our committee. You have to look at it from the view of the community. The community needs all the services. Just because one of them is privately managed, it really doesn't matter. Their costs are high, you have to pay them anyway. The taxpayer pays, the users pay and thus the community. Another point that should be raised, is you take the case of Bell Telephone. It's not exactly private, the prices are not privately fixed, they have limits and the federal government controls them. So that you might say its a semi-public utility. What is really important is, can you bring total costs down? Another point I would like to suggest is that this is something we give an awful lot of thought for I certainly suggest the corridors should remain the property of the road authority because the extra width that is needed initially won't cost too much, because you are going to put the corridor through there anyway and making it a little wider doesn't cost that much. In the second place, somebody has to manage that corridor and that must be one authority. Logically to me, it should be the owner, the road authority. Then when you do put the extra strips on the sides, they benefit from the road authority maintenance of the right-of-way. So that it's gain to all parties involved, and the costs can be allocated if necessary just the way we do it for the streets. I think there is a schedule agreement on how much each utility shall pay for each foot of cable,

whatever it is. Butthese are not insurmountable difficulties. I think the main thing is that we must plan efficiently.

Moderator: Perhaps some of the other members of the panel could comment on who they think is the proper level of government and it seems there is some agreement that some level of government has to initiate these and probably has ownership of the land in question. Perhaps I could just go right down the list and see if there is any consensus. Do you want to try Mr. Sheasby?

Sheasby: Well, I think what I said. In don't know what you would call it whether you would call it a multiple-use corridor, but I still think some independent agency should be chosen. I think in that way you solve an awful lot of problems, financial, legal, jurisdictional and the whole bit.

Moderator: Under a provincial charter?

Sheasby: That would be fine.

Moderator: How about you Mr. Hassell?

Hassell: I would hesitate to suggest the province take over control of municipal roads.

Moderator: No, we are talking about major corridors.

Hassell: If we are talking about major corridors, yes, once it crosses municipal boundaries, and in the true corridors concept, I would prefer it be the province.

Moderator: Mr. Bosworth?

Bosworth: I would concur on the major corridor being at provincial level, but any minor service corridor I think would have to be made with some flexibility.

Moderator: Mr. Toner?

Toner: Well, I think I would prefer to see the body independent of the highway department, because they have too much at stake, I think it's better to have a provincial body, but I can see this provincial planning as separate.

Moderator: Mr. Crosbie, what do you say?

Crosbie: I think Mr. Toner has touched on a very essential point and that is a service corridor controlled by highway or transportation departments. To come around this problem, it's the logical place in terms of structure with the authority acquisition of the corridor. I would hesitate to suggest another agency in government for the sole purpose of controlling transporation corridors. So I think I balanced it out for the transporation authority to have control of these corridors.

Moderator: Is it fair, for a member of the department of highways, in asking that?

Mr. Crosbie: Of course it's fair. Mind you the real question is not who can look after the corridors but who is going to pay for it. If you want the highway department to pay for it, the highway department will want to look after it. If you want someone else to look after it then let someone else pay for it.

Moderator: Well, gentlemen, I take this opportunity to close this panel, I personally have learned a good deal this afternoon. I am sort of like Mr. George, academically interested. I belive that that we do have de facto corridors within metropolitan areas now.

They have been built up by a long history of use. I believe that our metropolitan areas are spread out , we have an opportunity to designate the kind of corridor that has been talked here, a parkway, a utility corridor or in fact following your transportation routes. I do believe that somebody has to take the initiative. This is the kind of thing that can fall between far too many stools. Mr. Hassell has suggested to us that there are full series of questions of standards, and how things are brought together. Perhaps the Roads and Transportation Association committee might be the type of an organization that can take on some of the questions of standards and compatibility of various roads and so that they can be investigated and brought to the attention of the various levels of government that are concerned. It is very true that if the proliferation of services continue, I really hadn't thought of snowmobiles when I started talking about this, although I had thought of such things as cablevision and so on, we can see that the multiplicity of these things is probably going to continue with the population growth projected in Canada over the next thirty years. It is imperative that we engage in some kind of planning for these transportation corridors. I would like to thank on behalf of those people present, the members of the panel for their very thoughtful presentations, and for the thought they have put in this.

MULTIPLE USE OF TRANSPORTATION CORRIDORS IN CANADA July, 1969
By V.S. Pendakur

PREFACE

This study: "Multiple Use of Transportation Corridors in Canada", was initiated by the principle author in 1968. The focus of the study is upon Canada, with particular reference to several large-scale urban development projects involving use of air space over railways and highways.

Part I of this study dealt with "Conceptual and Legal Aspects" and Part II deals with "Socio-Economic Impact and Transport Consequences". Project 200 development in Vancouver, British Columbia is examined in detail within the framework of planning policy implications at the local, provincial and national levels. This project involves a multi-purpose urban development over railway trackage and the adjoing harbour waterfront. The concept and its implementation affect civic national policies towards railways and waterfront land use in the context of emerging demand for use of air space over transportation corridors.

The entire study was supported by a research grant by the Canada Department of Transport, Policy and Research Branch. Assistance throughout the study by Mr. A.R. Conboy, Mr. E.L. Hewson, Mr. A.L. Peel and Dr. Derek Scrafton is gratefully acknowledged.

Publication of the study was partially supported by the Greater Vancouver Real Estate Board. Assistance by Mr. Alf Buttress and Mr. Peter Watkinson, and the interest of the Board of Urban Transportation Research are appreciated.

The very nature of the study demanded that the research team seek the cooperation of several agencies and individuals concerned with the subject. Special thanks are due to Mr. J.C.Bolduc, Mr. H.P. Bonner, Mr. D.G. Bream, Mr. L. Carlyle, Mr. R.H. David, Mr. W.E. Graham, Mr. J. Hutchinson, Capt. B.D.L. Johnson, Mr. J.D. Mooney, Mr. R.T. Riley, Prof. P.O. Roer, Mr. J.D. Scott and Mr. J.M.D. Tootill.

Research was carried out under the direction of the principle author who assumes complete responsibility for opinions and conclusions, and consequently for errors and omissions. The conclusions drawn are the authors' own and do not necessarily reflect the policies

of research sponsors.

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III. Conclusions and Further Study - Conceptual and Legal Aspects

The air rights projects examined in Chapter I indicate a wide range of projects where the air rights concept is applicable. These examples also illustrate that sufficient precedent has been set in air rights development and that a meaningful study of the associated problems can be made. The air rights concept has been used with greatest success in large Metropolitan Centres where land values and building densities are high. However, this may not necessarily always be the case and in subsequent chapters this issue will be examined.

The most notable air rights projects have been built or are being contemplated above railway trackage located in central cities, or in multi-level, multi-purpose downtown development schemes. The third type of air rights development, that is widely recognized and practised in the United States and as yet untried in Canada, is the use of space above or below freeways and city streets. In Vancouver the Pacific Centre project under construction in 1969 will make substantial use of sub-surface city streets for parking and walkways and retailing.

The concept of air rights development has particular relevenace to the Province of British Columbia. Here the rugged topography and varied climate has resulted in a concentration of the population in the Lower Fraser Valley with the highest concentration being in Metropolitan Vancouver,and with one of the fastest population growth rates in Canada. Air space development is but one response to this increased demand for urban land. In addition it would appear to be desirable to incorporate other air rights projects with future transportation and land use planning. Project 200 is perhaps the

beginning of many future air space developments.

There is no doubt that the demand for air space will increase commensurate with the strong and growing urban trends in Canada. Fundamental to the development created by this impending demand is a sound legal basis in which ownership may be established and security of title safeguarded. While such a basis has existed in the development of the nation, it is based upon singular ownership of the surface and the space above and below, and does not anticipate separation of ownership of horizontal strata as are currently proposed. To deal with such diversity of use through a separate ownership or leasehold does not impose any insuperable difficulty, although there appears to be some hesitation on the part of land registration officials to approve of conveyances for air rights. In the Province of Quebec, several ninety-nine year leases have been initiated relevant to the air space development in downtown Montreal. In Ontario, where air space utilization has advanced beyond the western provinces several titles for ownership in fee simple of air space have been issued. In Western Canada where developments are only beginning, a precedent has been created in Alberta for the disposition of air rights, upon which further titles may be based. In the Province of British Columbia development to date, other than the Strata Titles Act, has been restricted to Metropolitan Vancouver, where all air rights have been issued through leases over roads or streets.

In view of the large increase in traffic and mounting pressures on the central business districts, and the tendency towards large projects involving multi-block development, the role of the provincial governments is particularly crucial, inasmuch as ownership of major arterial streets is vested with them. It is particularly appropriate for these governments to formulate policy and guidelines covering their relationships with the municipalities and the disposition of air space over streets.

Further Study

Part I of the study presented here is an examination of the Conceptual and Legal Aspects of Multiple Use of Transportation Corridors in Canada. Research on other aspects of air rights utilization is continuing. Subsequent parts of the study, to be published during the coming months, will examine Land Use and Economic Aspects, Transport Implications and Community Consequences. The entire study is scheduled for completion by January 1970.

VII. Conclusions and Further Study - Socio-Economic Impact and Transport Consequences

A. General

The consequences of multiple use of trnasportation corridors are wide-spread and extend far beyond the physical limits of the site. Analyses of these projects are hampered by the multiplicity of jurisdictions, each with its own separate interest. The analysis of Project 200 in previous chapters from the viewpoint of the developer, the city, and the nation, have revealed the significance of separate interests. Major weaknesses were found in the decision making process by the city, and the protection of the port function under the existing federal powers. Project 200 has been used in this study as an example but the analyses are relevant to major projects over transportation corridors in Canada.

Considerations by the developer before undertaking financing and construction are dependent upon maximization of the rate of return on the investment, except in those special situations where the advertising and publicity created by the development are more significant considerations. In a development of the scale of Project 200, where the multi-use aspect comes into prominence and where the restraints imposed by the conventional grid pattern are largely mitigated, the maximum emphasis is placed upon the securing of

adequate unencumbered site areas in a favourable urban location. In terms of total land needed and scope of design, the multi-use air rights project differs from normal city block developments. The additional cost imposed for decking to bridge the surface use (railway or road, etc.) increases costs from those of normal developments and generally requires high density multi-story structures in sites with high land values. In other respects however, the considerations of the economic return are little different from those undertaken in the usual surface building.

It was obvious from discussion with the principals of Project 200 Properties Limited that their decision to undertake the project was based on an analysis and knowledge of the demand for office space and retail outlets. In addition the air space was available and suitable for building, and expenditures and revenues could be estimated in sufficient detail to indicate a favourable return.

B. Municipal Interests

1. Social Aspects

If the trend towards multiple use of transportation corridors continues, and if the economic considerations do not change significantly, in major Canadian Urban Centers (Montreal, Toronto and Vancouver), the possibility of "Linear City" is not unrealistic. Because of economic aspects, the "Linear City" happens to be a high-density environment. While there is adequate experience in the social consequences of high-density offices, there is not enough known about the social impact of high-density living for the community as a whole.

Experience to date in Canada indicates that major air rights developments such as Place Ville Marie in Montreal, Metro Centre in Toronto and Project 200 in Vancouver have been welcomed and

treated as single projects rather than part of a total plan. For example, Project 200 plans show 3,000 dwelling units in high-density apartments. It is assumed that these are going to be traditional apartments in the high-rent bracket. This is equivalent to 5,000 to 6,000 people. Even assuming that this project will attract only young and single people, there is no provision made for community facilities such as libraries, parks and community centres, let alone schools. This assumes that these facilities are not the developers' responsibility and this assumption is quite valid. But the city has made no provision for these facilities either. An area accommodating 5,000 to 6,000 people needs these facilities without exception and to assume that all of these people are going to be "night club and entertainment" oriented is "fool's paradise" at best. There must be adequate provision made for these facilities either by the developer or the city and the responsibility is squarely that of the city planners.

Traditionally these air rights projects have been built over transportation corridors of shifting land values, often consisting of housing, hotels and businesses of marginal rate of return. When there is wholesale renewal of these areas, there is dislocation and displacement of people in the area. There has been no consideration given and no social analysis made by the city planners of the impact of Project 200 upon these people. They have to be found housing elsewhere at equivalent (very low) rents. Is this possible? If not, will many of these people become welfare recipients? If so, what are the social consequences? For a large scale project whether it involves air rights or not a thorough analysis of the displacement, dislocation and social impact must precede project approval. No such study was made prior to approving Project 200.

2. Land Use Aspects

In general, most major projects of a comprehensive and multi-use nature require rezoning by the City. This is the only

opportunity for the city to evaluate and assess public costs and consequences of the proposal. The decision to change existing land use and permit new development must be based upon a thorough analysis of shifting land values, values of land and air space and public sector investment (by the city) in additional services such as water, sewerage, lighting, streets, policing, etc. Only then the policy makers are able to weigh the benefits and the costs of the proposal. In case of Project 200, no such comprehensive analysis was made prior to approval of required zoning changes.

The rezoning application for Stage I and part of Stage III of Project 200 was submitted in October 1968. At this time the application was approved subject to granting of rights-of-way and other minor considerations. Little study had been given to the overall implications of Project 200 and that information on this aspect was scanty. After the rezoning was approved, staff studies showed that the project could increase downtown transportation demands by 26% requiring investment of $30 million. However, the emphasis was upon the need for development of this northerly part of the central business district as a nucleus for new development to bolster depreciating property values. "Any major development is obviously good for the city" seems to have been the basis for policy.

While civic officials state that the rezoning approval will not guarantee that similar densities will be permitted in later stages, one of the stated purposes of the developer's rezoning application was to facilitate "the establishmentof guide lines for the balance of Project 200 lands".[70] As Stage I was a part of

[70] Project 200 - Rezoning Application Stage I and a Portion of Stage III, File D.119.1, Appendix B, October 28, 1963, Vancouver: City of Vancouver Planning Department, 1963.

the overall development involving offices, retail stores, and residential units in which each use filled a dependent part, it would be almost impossible to isolate this stage from the remainder of the development.

The impact of complete development of Project 200 under current zoning standards, is of such proportions that a comprehensive analysis be made. Such analysis may well show that the public sector cost is beyond the capacity of the city indicating the need to examine large projects on a para-municipal basis.

3. Economic Aspects

Project 200 is a major private investment in urban development and is expected to provide a multiplier effect upon the local economy as well as enhance the quality of the urban environment in the project environs. The developers have conducted thorough economic analysis to determine the feasibility of the study. Although the results of such a study have not been released, it is presumed that an acceptable rate of return has been forecast. These studies have preceded the rezoning application, as they should.

The economic studies by the city to determine costs, benefits and the economic consequences of Project 200 have never been conducted. At best, little attention has been paid to determine the investment necessary to provide the needed public services to the project area. Community facilities such as schools, libraries, community centers, etc., have not even been thought of let alone an estimate made. of the cost of these services. The cost of new transportation facilities to serve the project area, even if the current traffic service level (15 mph.) was static, has been estimated at $30 to $50 million. These estimates have been made in a vacuumwithout relevance to emerging urban development policies.

It is necessary to examine the costs and benefits of large scale projects such as Project 200. The costs of additional services as well as benefits accrued by increased assessed values must be considered. An understanding of the multiplier effects upon the local economy will help guide policy formulation within available fiscal alternatives.

It has been recognized that Project 200 development will be an impetus to other improvements in the project area where property values have not been keeping pace with other sections of downtown. The effect will be that of large-scale urban renewal with private initiatives. It has been estimated, although no economic analyses were made, that the long term benefits in multiplier effects upon the local economy may outweigh civic commitments.

4. Transportation Aspects

Grade streets and railways in the Project 200 area were operating at capacity in 1969, with traffic service level being at 15 mph. The project is estimated to employ and house about 30,000 people, according to the developers. The additional investment required for facilities to cater to traffic generated by the project has been estimated at $30 to $50 million, even without improving the traffic service level. If nothing is done the service level is estimated to go down to 10 mph. The cost of catering to new traffic generated by the project has been estimated at $30 to $50 million depending upon service levels and assumed potential employment in the project area.

Local traffic planning in relation to Project 200 has been a state of designed confusion with several studies related to assessing traffic generation, making widely varying assumptions regarding the nature of Project 200. For example, the assumed total

employment in Project 200 at total development potential has varied from 6,300 to 30,000. Hence naturally, the traffic forecasts as well as the type of facilities needed have varied widely. The planning approach has been one of ad hoc-ism.

The developers feel that a potential employment of 27,800 is economically essential to make the project feasible and that their plans are based upon this assumption. Their studies seem to indicate that there is potential demand for all the office, hotel and apartment space planned in the project. If these figures are realistic, and even assuming a very high proportion of these workers and shoppers travel by an assumed east-west rapid-transit line, others are resident in the complex, and some would walk, it is estimated that such densities would produce more than 7,500 auto trips per peak hour. This traffic is equivalent to 13 grade street lanes or 5 freeway lanes. To accommodate such traffic volumes would require the replanning of the entire downtown area.

The city has three basic choices of policy to follow:

i) invest $50 million in new traffic facilities to serve Project 200 area either in grade streets or freeways;

ii) prevent Project 200 development; or

iii) ignore the entire problem and let traffic strangulation ultimately find its own devil's balance and suffer the economic consequences -- higher transport system costs.

C. Civic Policy and Air Rights Concept

1. Air Space Development and City Streets

The City of Vancouver has no policy regarding the development of the air and subsurface rights related to its many acres of downtown streets and other public property. The same is also true of all Canadian cities, except Montreal and Calgary which have some

minimal requirements, the former discourages all air rights development and the latter regulates a portion of the air space to a pedestrian system of skywalks. This has resulted in developers having virtually a free hand in obtaining the public property and generally paying a token rent which is seldom above 6% of the value of the occupied portion of public land.

Air space development in Canadian cities over and under public property has been minimal to date and comprises a handful of projects, usually pedestrian and skywalks and undergound tunnels, car parking areas and in a few cases some retailing outlets in the form of boutiques, newsstands and mall stores. The developers in most cases maintain that these schemes have generally been marginal economic investments and are usually constructed for the "public good". Undoubtedly the extra construction (decking) costs of surface and subsurface buildings are greater and range from 5% to 15% above the standard construction costs. Vancouver, Montreal and Toronto have downtown land values in the in the neighborhood of $50.00 per square foot, and at a few intersections these are as high $100.00. In comparison to their American counterparts, land values in New York, Chicago and San Francisco range between $200.00 to $300.00 per square foot. If there are accelerated increases in land values in Canadian cities, there is expected to be a parallel interest on the part of developers to obtain the surface and subsurface rights to city streets. In such a case developers could be buying the air rights over the smaller 2- and 3- storey buildings and decking this for either commercial or parking space.

This raises the issue of expropriation. Presently cities have the powers of expropriation which have been very rarely used due to the negative public reactions. However the expropriation of air rights or subsurface rights would be a pill less bitter to swallow, as has been experienced in Montreal with its Metro

System. Here owners were compensated $1.00 for the subsurface easement used by the Metro, and to date no individual has received a higher compensation, although many have attempted to. At present this form of mass expropriation of air and subsurface space has only been substantially tested in Quebec where the legal system differs to that in the rest of Canada, and it remains to be seen if similar powers are available to other Canadian cities. It is of paramount importance that Canadian cities develop policy guidelines for air rights development. These guidelines should clarify ambiguities and set the costs and patterns of development. Clarity of purpose and ability to estimate ultimate costs will be very attractive incentives to developers.

2. Value of Air Space

Canadian cities have no common or consistent methods of evaluating the air space and each assessment department establishes its own method. The assessors invariably indicated that it was not an easy task, however in all cases they indicated that they followed the principles originating from the United States examples discussed in Chapter IV.

Major developers were a little more specific in their methods of evaluation, perhaps as they have had more experience in the air rights development. The Canadian National Railways and Marathon Realty Co. Ltd., are not prepared to divulge the details of their evaluation procedure. However, the general procedures have been as follows: that in determining the value of the property required, the railways generally consider such factors as basic land value, value of continuity or plottage factor, severance damages, inconveniences and increased operating costs, added construction costs, added interest and carrying charges and of course, income from the proposed development. It appears that the evaluation of

air rights basically stem from the character of utilization, so that the intensity and quality of that use become critical factors. The developers also indicated that the cost of the land surrounding the projects is equally critical. As neighbouring land values increase so the intensity of the air rights development increases, and it would appear that a "take-off" point for development is in the neighborhood of $30.00 to $40.00 per square foot. Thus for example, the Strathcona Apartment development in Edmonton, despite the high intensity of use, barely meets the economic criteria of development, and developers maintain that this is offset by the residents having a panoramic view as well as a unique location.

This factor of adjacent land values seldom being above $40.00 per square foot is a major reason why Canadian developers are unable to establish formulas for air rights evaluation, and each development is thus determined through negotiation, with no two being alike. This has resulted in evaluations of air space ranging from 50% to over 100% of the value of the land involved.

In spite of the complicated nature of Canadian experience of air rights evaluation, the developers are producing attractive economic returns on their projects and the railways seem to be satisfied with their lease terms. However this is not the case with air space development over and under public property, here there is still a need to develop both guidelines as well as a systematic approach to evaluation.

3. Air Space Ownership

Legal and ownership aspects related to air space have been discussed in an earlier study.[71] A summary has been presented in

[71] V. Setty Pendakur, Neil J. Griggs and Peter Tassie, Multiple Use of Transportation Corridors in Canada, Part I, Legal and Conceptual Aspects, School of Community and Regional Planning, The University of British Columbia, Vancouver 8, B.C. July, 1969, pp. 31-40

in Chapter I of this study.

The type of ownership of air space is a major determinent of the feasibility of air rights projects. Air space over streets and highways is generally in the public domain and such space is seldom available for outright sale. Space over railway corridors is often in private ownership and available for lease and/or sale.

The common maxim of land ownership is: Cujus est solum est usque ad coelum et ad inferos: he who owns the soil owns everything up to the heavens and down to hell. Many provincial statutes and the interpretation by the Land Registrar prevent outright alienation of air space. For example, in the Province of Alberta, air space can be alienated (sold) and registered in the Land Registry Office by reference to geodetic datum. In contrast, the Land Registrar in British Columbia refuses to register any air space before structures have been built. Even though the British Columbia Land Registry Act does not have preventive sections related to air rights development the Land Registrar has the discretionary power not to register air space per se. This interpretation and procedure by the British Columbia authorities is detrimental to free market development of air space.

In Ontario and Quebec, ownership has been primarily through long-term leases. In both cases, the owners of transportation corridors (Montreal Metro and Toronto Transit Commission) have taken the lead in air space development. In Ontario, several titles to ownership of air space in fee simple have been issued.

Land registration is under the sole jurisdiction of the Provinces. In view of the pressures upon urban land and the multiple use of transportation corridors, the Provinces should take the lead in making necessary statutory and/or procedural amendments to make it possible for alienation of air space as the owners see fit. These amendments will make air rights developments more attractive and feasible.

D. Provincial Interests

Historical evidence and the analysis of Project 200 points out clearly that the Provincial Government and its agencies in British Columbia do not take a direct interest in large-scale urban development. This policy is based upon the fact that most of these developments come under the sole jurisdiction of the urban governments under the British Columbia Municipal Act. Only when the projects require the services of the various government departments and the agencies, do they become involved. In most cases, particularly agencies concerned with Regional Planning and Environmental Management, the policies have been concentrated towards non-involvement and at best defending the status quo.

The above policies might have been effective in the past. As the economic scale of these major urban projects increases to a level where they have cognizant economic multipliers to the province as a whole, the continuation of Hands Off policies could call for provincial investment in health, welfare, housing and highways at a later date and beyond the point of revision or return. Especially when air space developments involve major transportation corridors, the economic efficiency of the transport system must be vital to provincial and national governments. A recommended first step is active coordination by the Department of Municipal Affairs to protect long-range provincial interests in case of large-scale urban development projects. The initiative must, as it should, come from the Province itself.

E. National Interests

1. Dislocation and Social Aspects

Large scale projects such as Project 200 generally are located in areas of shifting land values and depict urban renewal by private

initiative. Seldom is any thought given to possible social dislocation of people currently living in these areas. Because of higher quality and higher rent in the new development, marginal business in the existing low-rent areas and residents in existing low-rent housing and hotels are forced to move out. Where are they moving to? Who provides low-cost housing for these people? What is the cost of relocation and displacement? Are these people forced to go on social welfare because alternative low-rent housing is not available?

Studies and analysis to date indicate that nowhere in Canada were these factors taken into consideration either by the provincial government or by the Federal agencies such as the Department of Health and Welfare or the Central Mortgage and Housing Corp. If the people displaced are not able to find suitable housing, the federal input into shared cost programs such as welfare and low-rent housing will increase substantially. There must be a mechanism found to coordinate and study the social impact of these urban developments.

2. Port of Vancouver

It is of paramount national interest that the Port of Vancouver be maintained as an efficient operation. The importance of this port as the predominant trade outlet not only for British Columbia and Western Canada, cannot be over-emphasized. By reason of the substantial investment needed for new port facilities and because of the scarcity of suitable sites for the trans-shipment of goods from sea to land, there is justification for maintaining the efficiency of the present port site.

In the current multi-use project proposed for downtown Vancouver adjoining the water front, (Project 200), it was seen that the free

market forces were strong enough to bring about a change in zoning and at the same time strengthen the case for rezoning of the succeeding stages of the project. In addition, the project will impose substantial changes required for civic transportation facilities. Moreover, as the physical limits of the project do not extend into the harbour, the project was not subject to control by the federal port agencies. In this regard the project has a double-edged effect on the port in that it is out of control of the harbour legislation, yet takes advantage of the harbour view as an amenity, and at the same time usurps the back-up land needed for port operations.

The pressures put into plan by the private sector in Project 200 are of such strength that they are able to minimize the importance of national concerns. Such disparity of interest is directly related to the time lage between immediate demands for urban uses and the long term future harbour needs, and that the solution to maintenance of national needs lies in extended port authority.

The existing harbour operations are under the aegis of the National Harbours Board Act and the Navigable Water Protection Act, both federal statutes. In both Acts the limit of authority is the highwater line, a sinuous line representing the average of high tides in the late nineteenth century, and markedly different from the corresponding line of almost a century later. The overlapping fields of interest of the various authorities also contribute to the difficult situation on the water front land use, zoning control and building construction codes pass from one authority to another at the high-water line. Inland the nature of cargoes over the railways is a federal responsibility, while fire protection resulting from the combustion or explosion of such cargoes is a civic commitment.

It is clear that if the federal role in the port is to be maintained then greater area control must be embodied in the national legislation. The limits of this area must include not only the land covered by water but also the adjoing water front service land in which the port andshipping facilities are the predominant users. In the Vancouver case the bulk of the harbour land in the tidal range is owned by the Government of Canada, with the result that the control of uses is by the federal government. The remaining large owner in Burrard Inlet, the Canadian Pacific Railway Company, is only subject to federal control of navigation structures. In some cases the National Harbours Board owns or leases land above the high-water mark for port purposes. If this policy is extended it would safeguard future needs. At the same time suitable design would allow incorporation of multi-use developments to provide returns on the investment. In the light of demands and implications of projects similar to Project 200, greater attention should be given to the maintenance of adequate port facilities.

Data and analysis presented in Chapters IV, V and VI have shown that Project 200 development could be detrimental to the Port of Vancouver if the impact of Project 200 is not clearly understood and if new public investment is not forthcoming to imporve the quality of public services in the project area.

The economic efficiency of the Port of Vancouver is of national importance. Even though the current proposal (Project 200) involves only 2,000 feet out of a total of 33,000 feet of water front classified as an area of deep sea cargo operations and if the trend of urban land use pressures continues upon the water front, the entire port might need to be relocated. A thorough study of the urban land use pressures upon the water front land in areas now used for port functions should be conducted at the national level soon to discern the policy implications and to protect the national interest.

Even if the port were to remain in the same location as it is now, transport consequences of Project 200 in relation to port efficiency and land linkages are too important and significant to ignore. New investment needed to maintain the same level of traffic service in the port area (15 mph) is estimated at $50 million. It is necessary to clearly understand this impact of Project 200 in terms of possible traffic congestion if no new traffic investments are made so that national policy changes can be made to protect and enhance the efficiency of the transport system in the port area, since any further reduction in the traffic service level would jeopardize and be of significance to the national economy. If the required investment of $50 million is not forthcoming from the city, the traffic service level is expected to go down to 10 mph. resulting in serious economic consequences to the port operation because of reduced efficiency and higher transport costs.

3. Freeways and Railways

Railways in the Port of Vancouver service area are operating at capacity in 1969. The growth trends of the port activity indicate more than tripling of deep sea cargo tonnage by 1985. The railways could prefer to move to less congested locations away from the present Vancouver waterfront because the new locations would provide scope for expansion and the disposal of railway property in the urbanized waterfront would provide highly lucrative economic gains. Whether the railways are relocated or not can only be decided after a thorough examination of long-haul freight traffic in Western Canada and inter-modal linkages. The Federal Government has the responsibility and the authority for assuring efficient linkage between ports and railways.

There has been no federal involvement in freeways except in the Trans-Canada Highway and a few bridges in Eastern Canada. Federal Government is now committed to contribute $100 million towards the cost of a new First Narrows Crossing (tunnel) and its approaches

in the port area. Even though there is no explicit policing of Federal assistance, the whole investment may have detrimental urban consequences. There is no assurance based upon prior economic study that the tolls can repay the total investment. In any event, further study of why, where, and when, and how much federal assistance to urban areas for solving urban transportation problems to formulate national policy is a necessary prerequisite to prevent undue chaos and formulate policies to protect the national interest.

F. Further Study

This study has demonstrated the complexity of issues involved in Multiple Use of Transportation Corridors in Canada. The focus has been upon Project 200 in Vancouver, British Columbia and the emphasis upon urban development policies at local, provincial and national levels with special reference to jurisdictional conflicts and the not clearly understood socio-economic impact and transport consequences of large-scale urban projects. The consequences of these projects trespass jurisdictional boundaries, statutory limitations and federal-provincial bifurcation of human endeavour. The study has pointed out the problems and the main inadequacies of urban development policies at all three levels of government. Several suggestions are made and further inferences could be drawn to improve the planning process.

The data and the analysis clearly indicate the following as the areas for further study of relevance regarding:

1. amendments to the Provincial Land Registry Acts to allow for alienation of air space;
2. amendments to the National Harbours Board Act to allow for zoning powers for the use of land constituting the immediate port service area, to protect the National interest, similar to the airport zoning legislation;

3. adequate socio-economic analysis and public feasibility studies to determine costs and benefits including the cost of all public services, e.g., water, sewerage, roads, etc., prior to approval of major projects by the city;

4. establishment of co-ordinating machinery at the provincial level for large-scale urban development projects;

5. effect of shifting land values and urban land use pressures upon water front land use, particularly the Port of Vancouver, to determine whether the port should be relocated at Roberts Bank or elsewhere;

6. effect of Project 200 upon the transport system serving the Port of Vancouver and the resultant port efficiency;

7. multiple use of railway corridors for non-transport purposes and possible relocation of railway freight operations;

8. formulation of policy guidelings based upon socio-economic analysis for the federal government (National Harbours Board) to be involved in establishing adequate rail and road (bridges) linkages in the port environs; and

9. an examination of the socio-economic cost of disruption and relocation of human beings by large-scale private urban renewal such as Project 200.

While not pretending to make the list of further studies endless, it is believed that the above listed studies merit immediate considerations by all three levels of governments concerned.

O.G.R.A. CONVENTION 1967 PUBLIC UTILITIES ON MUNICIPAL ROADS

Introduction

The purpose of my comments is to outline the legal framework under which public utilities are placed on highways. The problems the panel will be discussing arise in many cases out of the competing rights to use a highway right-of-way that have been granted to various organizations. I will, therefore, attempt to outline how these competing rights arise and to indicate how they affect the rights of one another.

Legal Nature of a Highway

For the purpose of my comments the word "highway" will be used in the sense of a common and public highway as described in The Municipal Act. It will, therefore, include all municipal streets, arterial routes, expressways, etc., and all of the Provincial highways.

The highway has been defined by the courts as a "public road or way open to every one to travel." This right of the public was at common law a right to travel upon the full width of the highway right-of-way with the additional right to stop for reasonable purposes in connection with such travel. Under the common law, this right of the public to use the highway was a paramount right in the sense that anything that interferred with this right such as an obstruction on the highway was illegal. Such an obstruction was considered a nuisance and the person causing it could be sued to recover damages caused by the nuisance and to compel him to remove it.

This common law position still applies today except to the extent that it has been altered by specific legislation. It, therefore, follows that the rights of utility companies to occupy and thereby obstruct highways with their plant and equipment must be found in legislation authorizing such use of the highway.

Statutory Authority to Place Utilities on Highways

The following is a list of the major statutory provisions authorizing the placing of utilities on highways in Ontario.

The Municipal Act

Under paragraph 53 of section 377 of The Municipal Act, all municipalities may pass by-laws authorizing the placing of

pipes or conduits for transmitting gasoline, petroleum or petroleum products, anti-freeze, brine or other similar products along, under, in or upon highways and for making such annual or other charge for the privilege conferred as the council may deem reasonable and for entering into agreements with persons for the use by them of such pipes or conduits on such terms and conditions as may be agreed upon.

Under paragraphs 96,97, and 99 of section 379 (1), local municipalities may pass by-laws authorizing the placing of poles, wires, conduits and pipes on or under highways for the purpose of transmitting electricity for light, heat, power or communication purposes.

Under paragraphy 100 of section 379 (1), local municipalities may pass by-laws authorizing the laying down, maintenance and use of pipes and othe necessary works for the transmission of water, gas or sewage on, in, under, along or across any highway under the jurisdiction of the council.

The Public Utilities Act

Under section 4(2), a municipality may, for the purpose of constructing or maintaining a water works, lay pipes in, through, over and under highways within the municipality or within fifteen miles of the municipality.

Under section 21 a municipality may, for the purpose of constructing or maintaining a public utility for distributing artificial or natural gas, electrical power or energy, steam or hot water, install the necessary plant and equipment on, over, under or across any highway.

Where a public utilities commission has been formed by a municipality, it has, under section 41 of the Act, all the powers conferred on

the corporation and, therefore, such a utility has the power to place public utilities on highways to the same extent as had the municipality. Similarly, where the municipality has established a public service commission under section 64 of the Act for constructing and operating railways or telephone systems, such public service commission may also place its plant and equipment on highways to the same extent as may the municipality.

The Power Commission Act

Under section 37 of The Power Commission Act, the Hydroelectric Power Commission is authorized to place its plants and equipment under, along across or upon any public street or highway.

The Ontario Energy Board Act, 1964

Under section 42 of The Ontario Energy Board Act, 1964, a corporation that has been authorized by the Energy Board to construct a pipeline for the transmission of hydro carbons may be authorized to construct the pipeline upon, under or over a highway.

The Railway Act (Federal)

Under section 378 of the Railway Act any company empowered by the Parliament of Canada to construct, operate and maintain telegraph or telephone lines may, for the purpose of exercising such powers, place their plant and equipment on any highway.

The National Energy Board Act (Federal)

This Act which deals with pipeline companies under Federal jurisdiction does not have a specific section authorizing pipeline companies to use highway rights-of-way. However, the material to be filed and other provisions of the Act and the regulations made under the Act make it clear that the Act is intended to authorize the use of highway rights-of-way.

Miscellaneous

Some private utilities, such as Consumers' Gas Company Ltd. and the Bell Telephone Company of Canada, were granted rights to use

highways by the statutes under which they were incorporated. Representatives of these companies are on the panel and they will, no doubt, give you more detail on these rights.

Road Authority's Control Over Placing of Utility on Highway

The Municipal Act

The power under paragraph 53 of section 377 to authorize the laying of certain pipes in highways also authorizes the municipality to enter into agreements with persons for the use of such pipes on such terms and conditions as may be agreed upon. Since the passing of the by-law is a condition precedent to the exercise of the privilege granted by it, the municipality is in a position to control the location of the pipeline.

The powers under paragraphs 96, 97 and 99 of section 379 (1) also contemplate agreements with utility companies or are otherwise made subject to other legislation which would give some degree of control over the location of the utility.

Section 3(1) of The Municipal Franchises Act provides that a municipality shall not grant to any person nor shall any person acquire the right to use or occupy any of the highways of the municipality, except as provided in The Municipal Act or to construct or operate any part of the public utility in the municipality or to supply to the corporation or the inhabitants of the municipality, gas, steam or electric light, heat or power unless a by-law setting forth the terms and conditions upon which, and the period for which, such right is to be granted or acquired has been assented to by the municipal electors. Thus, upon the granting of a franchise under The MunicipalFranchises Act, an opportunity is provided to the municipality to exercise some control over the location of the utility.

The Power Commission Act

The placing of plant and equipment on highways for the Hydro-Electric Power Commission requires the agreement of the municipality as to the location of the plant and equipment and in the case of disagreement the location is determined by the Ontario Municipal Board.

The Ontario Energy Board Act, 1964

Where a corporation that has permission to construct a pipeline under The Ontario Energy Board Act wishes to use a highway and has not reached agreement with the municipality it may apply to the Energy Board for authority to construct the pipeline upon the highway. Where this is done, the Board holds a hearing and where after the hearing the Board is of the opinion that the construction of the line upon, under or over a highway is in the public interest it may take an order authorizing the corporation so to do upon such terms and conditions as it considers proper. The municipality would, of course, have ample opportunity to make representations to the Board at the time of the hearing.

The Railway Act (Federal)

Where a telegraph or telephone company wishes to place its plant and equipment upon a highway, it must obtain the legal consent of the municipality having jurisdiction over the highway. If the company cannot obtain such consent from the municipality or cannot obtain such consent otherwise than subject to terms and conditions not acceptable to the company, the company may apply to the Board of Transport Commissioners and the Board may determine the terms and conditions or limitations that shall apply to the placing of the plant and equipment on the highway.

The National Energy Board Act (Federal)

A pipeline company must apply to the Board for permission to construct a pipeline and, although the Act does not require that notice of the application be given to municipalities through which the pipeline will pass, it does require publication of a notice of the application in newspapers or otherwise. Presumably a road authority could appear before the Board and express any objections it had to the pipeline.

Nature of a Utility Company's Rights in the Highway

General

Assuming that we can find some specific legislative provision authorizing a utility company to locate its plant and equipment on a highway, the next question that might reasonably be asked is, "What is the nature of the utility company's interest in the highway?". Two contending points of view have been expressed on this question. On the one hand it has been argued that the utility company merely has a statutory licence of occupation which does not amount to an estate or other interest in land and which must be construed as a right to occupy the highway in accordance with the conditions existing thereon from time to time. Supporters of this point of view further argue that since the right of the utility company is a special statutory privilege to use property of the road authority, the utility company has no right to expect the highway to continue in its present condition, grade or form and that, if the highway is changed and the utility disturbed the costs of such disturbance must be borne by the utility company.

The contrary view is that, once a public utility has the statutory authority to place its plant and equipment on a public highway, it has by legislative grant acquired an interest in land as the legal right of ownership in so much of the highway as it necessarily requires for its plant and equipment. It is argued that this interest in land is private property belonging to the utility company and that if it is disturbed by any change in the highway, the utility company is entitled to compensation for any costs arising out of the disturbance.

Unfortunately for the road authorities, the courts have held that the statutory right of the utility companies to use a highway is an interest in land, disturbance of which entitled the utility company to compensation.

The Public Service Works on Highways Act

The effect of various court decisions in respect of the rights of certain utility companies in Ontario have been altered by the legislature. At present, insofar as provincial telephone or telegraph companies, provincial gas companies and provincial hydro-electric power companies including The Hydro-Electric Power Commission of Onatrio are concerned, their rights to compensation for disturbance of their statutory rights in the highway are governed by The Public Service Works on Highways Act. This Act provides that, where in the course of changing a highway, it becomes necessary to move any of the types of utilities I have just mentioned, the road authority and the utility corporation may agree upon the apportionment of the cost of labour employed in such move. However, if they do not agree, the cost is apportioned equally between them, subject to a right of appeal to the Ontario Municipal Board where either of the parties considers that special conditions render the statutory division of cost unfair or unjust.

Under this Act, cost of labour includes actual wages, most fringe benefits, the cost of mechanical labour saving devices, necessary transportation charges for equipment and men used in the work and the cost of explosives.

Your attention is drawn to the fact that the Act does not apply to waterworks, sewers or companies under Federal jurisdiction, such as the Bell Telephone Company and inter-provincial pipeline companies.

Utility Companies under Federal Jurisdiction

As previously mentioned the Ontario legislation, The Public Service Works on Highways Act, does not apply to utility companies under Federal jurisdiction. To determine the rights of these companies

in the highway, it is necessary to turn to the Federal legislation which granted the utility companies their powers. Thus, under the Railway Act, section 378(6), the Board of Transport Commissioners, upon the application of a municipality and upon such terms and conditions as the Board may prescribe, may order any telegraph or telephone line within the legislative authority of the Parliament of Canada in any city or town to be placed underground and may in any case order a change in the location of the line. This in effect places the cost sharing of utility moves necessitated by highway construction at the discretion of the Board of Transport Commissioners and they have not adopted the cost sharing formula set out in The Public Service Works on Highways Act.

The Provisions of the Railway Act above-noted are wide enough to give the Board of Transport Commissioners power to determine the cost sharing even where the relocation of the telephone or telegraph company is necessitated by the construction of a new highway.

In the case of federally controlled pipelines, the National Energy Board Act authorizes that Board, upon such terms and conditions as it considers proper, to direct a pipeline company to divert or relocate a pipeline if the Board is of the opinion that the diversion or relocation is necessary to facilitate the construction, reconstruction or relocation of the highway. Under the National Energy Board Act where a highway is being carried across a pipeline, the road authority must obtain leave of the Board and the Board may grant leave upon such terms and conditions as the Board considers proper. Presumably they would at such time determine how the costs of such work are to be borne.

You will note that this legislation also leaves the cost sharing of the utility relocation move to the discretion of the National Energy Board.

To Statutory Provisions for Cost Sharing

There are a number of instances in which present legislation does not specifically provide for cost sharing of utility moves. In Ontario, The Public Service Works on Highways Act only applies where appliances and works of a utility corporation have been placed on or under a highway and their relocation is necessitated by work on the highway. It, therefore, appears that if the relocation of the utility plant and equipment is caused by the construction of a new highway on a new right-of-way, the Act does not apply and presumably the utility company could insist upon its common law right to have all its costs borne by the road authority.

As has been previously mentioned, The Public Service Works on Highways Act does not apply to waterworks or sewers. Therefore, it would appear the cost of relocating these types of utilities must be borne by the road authority.

Conclusions

While it is necessary to have specific legislative authorization to permit the utility to locate on a highway right-of-way, it is not necessary for such enabling legislation to spell out the respective rights of the road authority and the utility company. In fact, some, but not all, utility companies have their rights in the roads subject to review by some board or agency of government. The extent to which such boards can review the rights of the utility companies and the road authorities varies considerably and different rules apply to the same type of utility depending on whether it comes under Provincial or Federal jurisdiction.

When the rights of two parties, (i.e. the road authority and the utility company) are in respect of what is essentially a similar

fact situation, (i.e. the location of a utility on a highway right-of-way) subject to such a wide range of legislative provisions and procedures it is not surprising that there is considerable confusion and misunderstanding of these rights. The comments of the other panelists will, I believe, draw attention to some of the problems which have arisen.

UTILITY CORRIDORS

Points Made in Discussions, October, 1970

The following comments were made by: C.A. Doxiadis, A. Spilhaus, P.H. Nash, J. Papaioannou, M. Mead, E.O. George, A.J.R. Smith, R. Bugher, H.A. Martin, D.E. Bell, K. Deutsch, Emrys Jones, R.H. Grierson, G.F. Papanek, C.M. Haar, E. Murphy, E.S. Mason, J.R. Pierce, R.M. Darrow, C.H. Waddington.

- One solution is to put the transportation network underground.
- Ground level is only a semantic notion: "ground" is where people's feet tread. We need only to build this ground level higher to have transportation "underground".
- A study showed that the average citizens of a German city wanted to go through the center. They had a psychological desire to see the city and did not want to by-pass it or travel below ground.
- However, it has been shown that once underground systems are built they are fully used - vide London and other cities.
- Networks are extensive users of the land surface. What are the possibilities of minimizing this by developing utility corridors in which all pipelines are laid together?
- Too much land has been used for utility lines in the past, due to poor planning. The Detroit plan for the year 2000 includes a corridor committee to plan for electricity, gas and telephone lines in the same corridor. Some of the necessary technologies still have to be worked out (at present we cannot bury high voltage electricity lines). This work must be done for whole regions, not just the areas of existing power companies.

- Utility corridors are a must, butthey have to be laid in conjunction with highways.
- Utilidors are already in use in Alaska, East Berlin, parts of London, Paris and Madrid.
- Technology is changing pipelines. For a start, they are getting much wider now up to 90 inches in the USSR. Another improvement is the introduction of spiral welding which is better than straight-line welding as it protects against explosion (fire unlikely to spread more than 500/600 feet) and it speeds conveyance. Also new wrapping techniques can give pipelines a life as long as 1000 years. Pipelines are also used for transfer of solids - coal, sulphur, potash, etc. - and costs may be drastically cut (in Canada, the cost of potash can be reduced by 60%). There is a problem in how to deal with the enormous quantities of polluted water needed to carry the slurried coal, copper etc. Pipeline systems are now lacing whole continents. USSR and Eastern Europe have a common oil pipeline system. A danger is that these systems will "lock-in" energy, because of the high investment commitment. San Francisco is linked to Alberta by a natural gas pipeline, but if this were disrupted, the city would lose 30/40% of its energy supply. Pipelines have great political implications, yet the only logical way of transferring energy is often by this method. e.g. Arctic oil and gas in Canada must be brought south along the Mackensie River Basin to urban Canada and USA Tankers would be unrealistic in ecological and cost terms.
- There are strong ecological arguments against running pipelines from Alaska across the fragile surface of permafrost areas, as well as severing caribou trails.
- A ten-mile test line is being built with bridges for moose and elk and matting to cover permafrost areas to check heat transmission.
- How far is it possible to devise an interconnected pipeline system? Gas systems in North America provide for interconnections,

but the possiblity of using a single pipeline for the transfer of different commodities is limited. Pipelines are not as versatile as the blood system. At most, different liquids may be run in sequence (as has been done in a military pipeline in Alaska).

- New networks strain national property concepts. Water from Canada to the US creates vital US interests in Canada that can be detrimental to Canadian interest. There will be increasing strain as China spreads into Siberia. We have no international control organizations. For instance there is a general international interest in organizing use of the sea bed and continental shelves, but unless some political machinery is invented there can be no controls.

- Consideration of technologies on a regional basis cannot be regarded as universally applicable. Even within national states problems arise: for example, water supplies in Arizona and California are political dynamite and even in a country as small as Britain, the water pipeline from Wales causes political ripples, and even bombs. Natural regions cross national boundaries, and the national state is the nearest thing we have to a closed system. Pipelines are vulnerable. They can be cut. Logically we can see the values of total inter-connections, but this is nonsense unless it takes into account the present very fragile system that is based on the way people feel and react.

- Nationalistic barriers cannot be wished away. This affects not only water and electricity but also the re-use of waste products. However there are some signs of relinquishments of sovereignty: oil pipelines to South Germany now pass through other countries. It might be thought that concentration of authority in national bodies might promote cooperation between the different networks. But British experience with the National Electricity Board, National Gas Board, etc., shows that there tends to be less cooperation - and even stronger vested interests that when the services were privately owned.

- Whose costs and whose benefits are being measured? The benefits of oil from Alaska certainly out-weighs the costs for the oil companies, and perhaps also for both Canada and the US. But early termination of the benefits of these oil markets may have a serious effect on several developing countries (Venezuela, Iraq, etc.). We need to pay attention not only to the overall impact of changes in network technology, but to what groups reap benefits, with its corollary: how are decisions made and by whom?
- All networks need a large amount of capital and cut right at the private interest/public interest interface. Should they be monopolies, or public services? Should they be centralized or taken over by each community? They cut through the territorial imperative, and impose an imperative based on functions or services. To arrive at an equitable allocation, moral and distributive imperatives may distort and over-ride economics.
- Transportation systems are increasingly being administered by the public realm. This is occurring late in the US, which poses a number of problems, one of which is how to calculate the value at which they should change hands. Transportation systems are in trouble everywhere and we cannot expect that they should pay their way by revenues. Administrators, but not politicians, prefer a tax based on use of the system. Electrical energy cannot be stockpiled. This is one of the reasons why countries feel so nationalistic about pipelines. They cannot face the danger that the connections may be cut by people outside their country. Within France it is becoming more difficult to get public consent to transport high voltage electricity than to build a highway, and 500 meter wide corridors must be provided.
- Communications networks can sometimes substitute for transportation networks. In India, coal is the primary source of energy, with oil as a secondary source, and transportation is based on the railways. If you generate electricity at the minehead you have no need to transport coal, and oil can be used to run the railways.

- We need systems that introduce economies of scale such as radio waves at 10 billion cycles per second and laser beams through pipes. Very fine glass fibres can send signals over 2 km., and bundles of these could be threaded through existing cables. All wires needed in the new city should be in utility tunnels and conduits with space left for new inventions.
- But integrated systems are not at all simple. The interface between systems at nodes is complex, and even dual mode systems are not solved. Any metropolitan area needs more than $1 billion to begin an integrated transportation system. How does the need and the benefit for a city for new transportation systems stack up against the other demands such as for housing, welfare?
- The energy barriers that block getting from the what is to the what ought to be are multi-dimensional problems. Links appear between such biological systems as the multi-dimensional systems. They can change, but the alternatives are fairly few. There may be bad effects if we alter one part of a social system - such as the transportation network. The Russians have done some work in studying the environmental effects of specific changes, but we need a number of experiments. What is neded is an increase in the amount of experimental towns with a great number of variables in physical design and life styles to find which multi-dimensional systems are most viable.

AMERICAN RIGHT-OF-WAY ASSOCIATION CHAPTER 54

Report of Utility Corridors Committee, 1971

Membership

E.S. Collins, British Columbia Hydro and Power Authority, Chairman
B. Guichon, Westcoast Transmission Company
W. Clark, Coates Field Service Ltd.
Elmer Rutley, Pacific Great Eastern Railway Company
N. Zapf, Department of Highways
R. Middleton, B.C. Telephone Company
R. Caverly, District of Surrey

Meetings

The Committee was established in April as a result largely of a letter dated 9th March, 1971 addressed by Mr. Louke B. Kleyne, Municipal Planner, District of Surrey, to Mr. John Riches, then President of Chapter 54. A copy of that letter and of the enclosure is attached to this report. The Committee has had the assistance of Messrs. J. Plotnikoff (District of Surrey) and J. Apps (B.C. Telephone Company). A number of informal contacts between members have also taken place in the preparation of this report.

Terms of Reference

To study the advantages and disadvantages to be derived by utilities, land owners and the community generally from the use of utility corridors and to provide information useful to members in determining the balance of advantage in particular cases.

Introduction

There are advantages to be derived from the use by utilities of a common utility corridor; there are also a number of difficulties inherent in such a project. It is important that in each case the advantages and disadvantages each be carefully defined and assessed, so that a balance of advantage can be achieved.

Advantages of a Common Utility Corridor

1. Effective land use

The main purpose of establishing a common utility corridor will usually be to use as little land as possible for utility purposes and thereby release other land for productive purposes.

This will usually be achieved where overhead and underground utilities occupy the same right of way, e.g. overhead electric transmission line and underground oil or gas pipeline.

The saving in land use is subject to some limitation where the facilities are all overhead or all underground. The total width of a common right of way will usually be less than the combined widths of separate rights of way. But there are some limitations:

(a) Topography may require the lines or pipes to diverge, thus creating a "no man's land" at the point of deversion.

(b) As the common right of way increases in width, the chances of effective use of the surface decreases, e.g. a narrow right of way can be more easily fitted into a residential or industrial subdivision than a wider right of way. In the case of a minimum lot size subdivision, the maximum width that can be absorbed into the subdivision is about 200 feet. Lots backing into a right of way of this width would have 100 feet encumbered by right of way and there would have to be a further 60 feet unencumbered to permit a set back from the road and space for a normal size dwelling. In cases where there is a high pressure gas main along the edge of the right of way, more than 60 feet would have to be allowed in order to avoid the hazards involved in patios, sundecks, etc. being built over the pipeline. Regulations under the Alberta Municipal Act require a minimum distance of 50 feet between the rear wall of a dwelling house and the centre line of a gas pipeline or the centre line of the right of way, whichever is the less.

Rights of way wider than 200 feet in residential subdivision therefore involve an area which cannot be incorporated into the lots. However, increasing thought is now being given to the possibility of utilizing these areas for non-intensive uses which do not interfere with the effective operation and maintenance of the utility systems. Consideration is being given to locating amenity features in these wide rights of way. Local parks and park strips,

trail systems, walkways, green spaces, and similar recreation uses are examples of the kinds of amenities that would make joint utilization feasible. These features are particularly desirable and compatible with increasing numbers of innovative "cluster" type housing developments where houses, condominiums or small apartments are grouped closely together with continuous open space surrounding the development.

In rural areas, rights of way might be used for recreation, crop cultivation, grazing, wildlife or botanical conservancies, Christmas tree farms, etc.

The concept of joint utilization is an area which has been largely untapped in the past and deserves more intensive consideration in the future.

Another purpose to be served by a utility corridor is to reserve the land in advance of requirements so that development does not inhibit the provision of services.

The advantage of a utility corridor is much enhanced in urbanized areas.

2. Municipal Services

Allied to the question of land use, is the planning and cost of municipal services in relation to a right of way. A right of way which has to be crossed by roads or sewers represents a length of road or sewer without return to the municipality or the developer in the form of connections to property in the right of way and at the same time presents an additional length of maintenance. If a municipality can establish a common utility corridor into which all main utilities are to be placed, this enables it to plan its services so as to avoid crossings of the corridor. This is the concern which lies at the back of the approach made by the District of Surrey to Chapter 54.

Some crossings of the corridor will, of course, be unavoidable and in these instances the problem is compounded because of the additional width the corridor involves.

3. Appearance

A common utility corridor can prevent the spoiling of a landscape by the proliferation of overhead utilities. This applies chiefly to overhead electric transmission lines. A haphazard pattern of wires proceeding in different directions introduces an unsettling feeling of disorganization into the landscape picture; parallel transmission lines can, on the other hand, give a feeling of unity. This point has to be carefully assessed in each case:

(a) There is an optimum width beyond which a right of way becomes increasingly unsightly and oppressive (usually this point is where there are already two major electric transmission lines in the right of way).

(b) In some circumstances, two narrower rights of way may look better than one wide one.

(c) Rather than have an electric transmission line alongside a highway, it may be better to locate it behind a ridge or wooded area.

(d) The wider a right of way, the more difficult it is to achieve satisfactory surface use (see 1.(b) above).

How is a Common Utility Corridor Owned and Administered?

There are several possibilities:

1. One utility owns right of way in fee and grants right of way to others with or without priority over its own facilities. The grantee pays appropriate compensation to the grantor. This method can be used where the second utility is prepared to adopt

the location already chosen by the first utility and where the first utility feels that these rights can be given without prejudice to its own future plans. In most cases, the first utility will require full indemnities from the second utility and where there is any possibility of prejudice to its future plans, will require removal by the second utility at its own expense of its equipment when so required by the first utility. These requirements lead to further difficulties which are referred to below.

2. Private owner owns right of way in fee and grants a right of way to each utility. The first grantee gets priority. If a second grantee is to have priority, the first grantee must give this by a consent or priority agreement for a consideration. In paractice, the owner tends to get paid twice for the same thing. The same comments apply to this method as to those referred to in paragraph 1. above.

3. The municipal, regional or provincial government or a company owned jointly by the utilities concerned or an entrepreneurial company acquires the right of way in fee and leases a portion to each utility. This avoids double compensation to the owner and should secure some resulting financial advantage to the municipality or company. The chief difficulty is to determine the route which would be acceptable to the utilities concerned. This, as suggested below, involves co-ordination in both time and space, which can be difficult.

Technical Difficulties of a Common Utility Corridor

1. Electrical Induction and Interference

The presence of an electric transmission line in the corridor may present problems to other utilities, and vice versa.

Under steady state conditions, there may be voltages electromagnetically induced from the electric transmission line into adjacent services because of unbalanced currents in the electric circuits on inadequately grounded communication circuits the result may be noise or excessive voltages. Buried pipelines can experience small induced voltages which may interfere with measurement of dc cathodic protection potentials unless adequate precautions are taken when making the measurements. In addition, voltages electrostatically induced into long lengths of pipe laid out above ground during pipeline construction may be a problem if the pipeline is inadequately grounded.

Under fault (i.e. "short-circuit") conditions, two cases must be considered -- faults inside the corridor and beyond the corridor. If a fault to ground occurs inside the corridor, a very high current may flow into the ground very close to the other services sharing the corridor, producing voltage gradients in the ground. As a result, hazardous voltages may occur on the other services, and equipment may be damaged. Elsewhere in the corridor, remote from the fault location, the large unbalanced currents flowing in the electric transmission line will electromagnetically induce high voltages into other services in the corridor. In some cases, protective devices may be required on these services to avoid personnel hazard and equipment damage. Long lengths of pipe laid out above ground during construction may have to be grounded at intervals to keep the induced voltages within safe limits. For faults located beyond the corridor, there are not the problems produced by the flow of fault current into the ground in close proximity to the other services in the corridor but there still remain the problems caused by electromagnetic induction from the fault current flowing through the electric transmission line.

Turning now to the question of how the presence of other utilities may present problems to the electric transmission line, first there

is the hazard of pipeline explosion or fire. The electric transmission line may flash over to ground, or the line itself may be damaged. In addition, there is the problem presented by dc currents flowing through the earth from pipeline cathodic protection systems. These currents may flow onto the sheaths of buried electric cables and cause corrosion.

2. Routing

Topography affects utilities in different ways, e.g.

variable grades are acceptable to electric and gas utilities, not to railways and highways, nor to the same extent, to oil pipelines;

muskeg can be traversed by pipelines, using winter construction techniques, but not by other utilities.

A route which is therefore suitable for one utility will often be quite unacceptable to another. A common corridor therefore has to accommodate a compromise route which all utilities are able to accept. Being a compromise, it will represent to each utility a less favourable route than one which is chosen with reference only to its own criteria. To this extent, a common corridor can represent technical difficulties and additional expense.

3. Damage and Indemnities

The presence of several utilities in one corridor magnifies the consequences of negligence, faulty materials and malfunctioning. It therefore increases:

(a) the risk of damage to its own equipment due to the presence of another utility or to work done in connection with it;

(b) the potential liability for damage due to the presence of its own equipment or to work done thereon.

A utility in a commanding position (e.g. owning the right of way)

usually seeks to protect itself against these by obtaining a full indemnity from a utility seeking to use its right of way. This is a disincentive to the incoming utility which, when added to other difficulties, may induce that utility to locate elsewhere.
Even if the liability of each utility is restricted to the results of the negligence of its own servants and contractors, this still leaves a large element of risk which any responsible utility must be bound to regard as a severe disadvantage.

4. Security

The juxtaposition of utilities in a corridor may have a potential for catastrophe which would not be present in separate rights of way, e.g. high voltage line and high pressure gas main may interact.

A common corridor exposes all utilities to risk of damage from the same source, whether natural, e.g. landslide, or man-made, e.g. civil unrest.

All utilities have the duty to do their utmost to maintain continuity of service, especially in times of severe weather and other crisis.

5. Timing

The most difficult element in planning a utility corridor may well be that of timing. If it is to be of use, the corridor must be available for the first utility needing it. Other utilities therefore have to advance their planning; possibly to the point where assumptions have to be made which later turn out to be unjustified. When the other utilities come to use the corridor, it may be found to be in the wrong place, not wide enough, or proceeding to the wrong terminus.

It is the common practice of highway and railway utilities to protect themselves against the problem of future requirements by making their permits to use their rights of way subject to the incoming

utility relocating at its own expense if so required. This may be a wise precaution, but is a disincentive to the joint use of a right of way.

There may also be the problem of financing a provision made well in advance of requirements.

6. To overcome the difficulties outlined above would require a concerted effort on the part of every utility involved. Mr. Plotnikoff noted that there exists no central authority charged with the responsibility of assisting utilities to overcome these difficulties and resolving conflicts which occur. Whether the establishment of such a body would be beneficial is difficult to determine in general terms and the Committee did not feel able to make any finding on this point.

Conclusion

It is the Committee's view that no general statement can be made either in favour or against the use of a common corridor. It is a matter of achieving a balance of advantage in the particular case and in order to achieve this balance both the advantages and the difficulties of corridors should be fully understood.

There is a growing body of experience in North America of the use of utility corridors. Some of the technical articles dealing with the subject are referred to in the Bibliography. In this report the Committee has dealt with these matters only in general terms. When particular cases have to be considered, then practical experience should be consulted as part of the evaluation process. In British Columbia moves have already been made toward joint use of rights of way. Some examples are set out as follows:

B.C. Harbours Board - utility transportation corridor, Delta.

B.C. Hydro - underground gas mains and overhead electric transmission line.

Peace No. 2 500 KV and 20" gas main

- Port Mann to Coquitlam Gate

- Port Mann to Ferguson

Highway-Gas-Electric - Town Line Road
60 KV transmission line
30" gas main (Nichol to For Langley)

Jet Fuel Line and Electric Transmission Line - Richmond
(Trans Mountain Oil Ltd. and B.C. Hydro)

Railway and 60 kv - B.C. Hydro Railway, New Westminster to Chilliwack

Freeway and 230 KV - proposed Arnott-Kidd 230 kv
Highway 499 - Deas Is. to Westminster Highway

Gas and Petroleum Pipelines - Taylor - Savona
- Westcoast Transmission and Westcoast Petroleum

Overhead Electric Transmission Line and Gas Pipeline
- Terrace - Price Rupert- B.C. Hydro and Pacific Northern Gas

Railway, 60 kv, Sewer, Water, Telephone - PGE West Vancouver

Highway Bridges carrying water, telephone, electric, gas eg. Aggassiz

Recommendations

(1) The Committee feels that the considerations put forward in this report should be further examined in a case study of a corridor in the Lower Fraser Valley - Greater Vancouver area. This would require more time than the Committee is able to devote to the task, but consideration should be given to the possibility of an inter-disciplinary and inter-institutional study of this nature (eg U.B.C.-B.C.I.T.).

(2) Of immediate advantage to all concerned would be a comparable map showing all existing rights of way in the Province. We understand that this is in the hand at the Lands Branch, Department of Lands, Forests and Water Resources, Victoria.

UTILIDORS PROS. & CONS. , January 12, 1971

B.G.E. Guichon, Lands and Right-of-Way, Westcoast Transmission Co. Ltd.

In choosing the route for a gas pipeline, the two most outstanding criteria are economics and continuity of service. One would assume that the best and, therefore, the most economical way to build a pipeline from point A to point B would be in a straight line; the biggest cast factor being the purchase and installation of the pipe, thus less pipe, less cost. However, particularly in British Columbia one encounters mountains, rivers, streams, gullies, canyons, rock muskeg and permafrost which all relate directly to high costs of construction, but also to maintenance and other lesser factors which must be taken into consideration.

In reviewing the above mentioned factors in relation to the possible multiple use of rights-of-ways, one must also relate to the nature of the various utilities, and to whether or not they are compatable. For instance, a gas pipeline is not normally concerned with grade, and for that reason only is quite similar to an electrical utility line. A railroad on the other had is a utility which is most susceptible to changes in grade, and therefore choice of location is limited. Next comes a highway which is less limited than a railway but grade must still be taken into consideration. An oil pipeline on the other hand is also restricted to grade, but is less limited than a highway providing the cost of additional horse power and steel in the pipe to surmount the excess of grades does not exceed the cost of additional length of pipe to cut down the grade.

Another matter to take into consideration is the type of terrain. Often the cheapest and best way to build a high voltage electrical line in rugged terrain such as British Columbia is to place towers on the high points and suspend wires between. The route taken by such a power line is completely unacceptable to most other utilities including railways, roads, and pipelines. While telephone lines could be suspended in this manner telephone companies now see fit

to use the airways for their long distance and trunk transmission, but tend to utilize the same rights-of-way as followed by the access roads and highways for their service and distribution lines. Another example is that by utilizing winter construction techniques, large areas of muskeg terrain can be traversed, thereby shortening the pipeline and decreasing the overall cost. This particular route would most likely be completely unacceptable to power lines, highways, railways and other utilities.

Another factor to consider when selecting a pipeline route is, of course, the cost of clearing and grading the right-of-way solely for the pipeline's use when possibly a power line right-of-way is available which is already cleared. However the cost of utilizing the power line right-of-way and providing adequate cathodic protection, thereby preventing corrosion of the pipeline because of the induced currents, must be taken into consideration. High voltage power lines are a particular problem from a safety standpoint not only during construction, but during operation of the pipeline. Often, as well, a power line can span a possible slide area and excessively steep terrain whereas a pipeline could not physically follow the same route due to construction problems as well as jepordizing safety of operation and continuity of service.

In the timbered areas of British Columbia, pipeline rights-of-ways and electrical power line rights-of-ways, completely separate from each other as well as from highways and railways, lend themselves to the overall development of the general area. They afford access to the Forest Service and to the timber operators and form natural fire guards which would be extremely costly to provide where it not for the utility. Again in the ranching country where cattle utilize the forested lands for grazing, these rights-of-ways provide trails for moving cattle from area to another, and also provide much additional acreage of good grass lands.

In the more sophisticated farming communities in suburban areas, pipeline rights-of-ways in themselves do little harm other than actual damage caused during construction. They do not take land out of use for farming purposes and provided proper location planning and construction methods are used, particularly in irrigated crop lands, no permanent damage results. However, in high density urban areas the utilidor can be the answer to many problems encountered by most modes of transportation. Here most utilities prevent land being utilized for building, or buildings. Therefore, due to the high land values encountered utilidors may become economically justifiable as long as necessary provisions for the maintenance and safety of each utility is made.

When reviewing the Westcoast system of pipelines which includes affiliate companies such as Western Pacific Products and Crude Oil Pipelines Ltd. an oil pipeline company, and Pacific Northern Gas Ltd. a gas transmission and distribution company, and the areas on which their facilities are located the following points may be of interest.

Starting with the Peach River District, centred at the village of Taylor, it would be illogical and uneconomic not to utilize the straightest possible routes to bring the gas from the various gas fields to the Taylor treating plant. Therefore, trunk lines were constructed close to the Alaska Highway leading to Taylor both from the Northwest and Southeast while gathering lines to the trunk lines were constructed so as to minimize the actual amount of pipe uses. Access to the various fields and to the pipeline rights-of-ways was adequately provided by the Peach River Highway and related road network which, other than the Alaska Highway, is on a grid system. On the other hand, our mainline between Taylor and Chetwynd traverses reasonably inaccessable country. However, the cost which would have resulted from the extra mileage in more or less following the Alaska Highway to Dawson Creek and the Hart Highway to Chetwynd would have far exceeded the additional cost of providing access to the straight line route selected.

The Fort Nelson pipeline was built from For Nelson to meet our mainline just to the South of Chetwynd. It was originally planned that this line would generally follow the Alaska Highway from the Taylor Plant. However, again economics dictated that the shortest possible route should be utilized particularly from Pink Mountain south to Willow Flats. The remainder of the line, while reasonably close to the Alaska Highway from Pink Mountain north, is still as straight as possible. While considerable rock was encountered between Hudson Hope and Willow Flats and considerable muskeg was encountered North of Hudson Hope, most of construction through these adverse conditions was offset by the lessor amount of pipe actually utilized.

In contrast, our mainline south from Chetwynd traverses the Pine Pass generally following the Hart Highway to Prince George. A shorter route would have been through the Monkman Pass but here access was a large factor to be considered and economics dictated that the Pine Pass should be followed because the Hart Highway was already constructed through it.

From Prince George southward to the vicinity of Savona our mainline follows almost a straight line. It is relatively close to access provided by the Cariboo Highway and secondary roads although in some parts the line is 15 to 20 miles from adequate access. From Savona south the Fraser Canyon Highway route was considered next to impossible for pipeline construction; with two Trans-Canada railways and the Trans-Canada Highway already utilizing this very narrow mountain pass. From Savona overland to Merritt, however, was an ideal route for a pipeline with relatively easy construction and reasonable access by secondary roads. From Merritt south to Hope the Coquihalla Pass was more acceptable because while it crossed very rugged and difficult terrain in spots, it was the shortest route. In addition the railway provided access particularly for the transportation of pipe and equipment. It should be noted that a

route from Williams Lake south through to Gold Bridge, Pemberton and down the Lillooet River to Harrison Lake was considered. While shorter, access was poor, and the main pipeline would be too far from the communities it would ultimately serve.

From Hope through to Chilliwack, and ultimately to Huntingdon, the prime consideration in locating the route of the pipeline was with regard to construction conditions and length of line. While physically possible it would not have been economically feasible to have followed any existing highways or utilities for any distance at the time of the original construction. It must be remembered that a service or commodity can only be provided if it can be competitive.

Five years after the completion of the original gas line it was proposed to construct an oil line from Taylor to Kamloops. It naturally appeared that an ideal route to follow would be Westcoast's right-of-way from Taylor as far as Savona, and because Westcoast Transmission Company Limited and Western Pacific were affiliated companies, willing to share maintenance costs etc., this was the approach used. Some difficulties were encountered with the respective Federal and Provincial Controlling Authorities because Westcoast is Federally controlled and Western Pacific Provincially controlled. Other difficulties, including somewhat higher interest rates, were encountered in the financing of the second pipeline because of the utilization of another company's right-of-way. Construction costs in areas of solid rock were higher due to the necessity of controlling the size of the blasts to protect the gas line only 15 feet away. However, operation of the two pipelines on the same right-of-way have not resulted in any insurmountable problems. The same approach is being taken with the construction of the companies 36" loops. In effect, Westcoast has been, and is, practicing multiple use of right-of-ways.

When the Pacific Northern Gas system was proposed early in 1967, it was proposed to generally follow highway #16 from Prince George westward to Prince Rupert. Further study revealed, however, that it would be more economical to keep the main transmission line as straight as possible, generally following the same route but cutting all the corners that the highway takes, and that it would be cheaper to service the various towns and communities by laterals of smaller pipe. It was also determined to cut across from Telkwa to Terrace through the Telkwa Pass, which was completely inaccessable but the pipe and construction cost of the shorter route far offset the access problems. The lateral from Terrace to Kitimat generally follows a power line right-of-way. Here the additional cost of cathodic protection necessitated by the pipeline being in close proximity to a high voltage power line was offset by minimizing the clearing costs as this was an area of very large and very heavy timber cover. Westward from Terrace to Prince Rupert, the pipeline also follows the power line until the river widens and the valley narrows, roughly halfway between the two points. From this halfway point to Prince Rupert it is physically impossible to follow the power line and a new route was selected, cleared and graded for the pipeline. In the area from Terrace to Prince Rupert if a new Highway had already been constructed, possibly the cheapest and most economical route for the pipeline to follow would have been alongside the new highway, and in a corridor already utilized for a good part by the C.N.R. Railway. However should we have laid the pipeline under present conditions it would have made it virtually impossible to rebuild the highway to present day standards without rebuilding the pipeline as well.

It is the considered opinion of our Engineers that the cathodic protection and safety of the pipeline becomes most difficult and complex (and in some cases almost impossible) if utilites in general are crammed into a single narrow corridor. Interference from high

voltage lines can become very complex and increases the possibilities of corrosion and resulting leaks. Naturally as the corridor widens these problems are diminished. The main concern, however, would be with high voltage D.C. current transmission systems. If these were to be placed in a common corridor with a pipeline a ground return for the high voltage D.C. should not be used but this would greatly increase the cost of the power line. From a safety point of view there is a definite hazard not only during the operation, but during the construction of the pipeline in the vicinity of high voltage transmission lines. During construction high voltage can be induced into the pipeline when the pipeline is still above ground. Lesser currents are also induced in the line after it is buried.

To sum up, the larger the pipeline the higher the cost of the pipe and installation costs and therefore more consideration must be given to selection of the route. The question which must be answered is; taking into consideration of the size of the pipe, accessability, aesthetics, future use of the land, maintenance problems, and financing of the pipeline, which is the most feasible route which will provide the minimum of risk to continuity of service? It is my considered opinion that utilidors, insofar as pipelines are concerned, would be of very limited benefit, if any, in the Province of British Columbia except for the Greater Vancouver and Greater Victoria areas, because of the sparse population, general terrain, and associated difficulties encountered in their joint use. I would also venture to state that one will find that by the time all of the requirements of the various utilities were met that assured their safety in a "utilidor", the resulting width of the right-of-way that would have to be cleared and/or graded would be such as to totally discourage a responsible ecologist. However, in densely populated areas such as the metropolitan areas of B.C., Southern Ontario and certain areas in the United States where the majority of the available land is used for subdivision and thus building purposes, the limited application of utilidors may prove quite beneficial for all concerned.

National Cooperative Highway Research Program Report 53
MULTIPLE US OF LANDS WITHIN HIGHWAY RIGHTS-OF-WAY
Barton-Aschman Associates Chicago, Illinois, 1968

Conclusions and Recommendations

Conclusions to be drawn from the research reported herein are as follows:

1. Opportunities for multiple use of normal, controlled-access highway rights-of-way by activities using only those rights-of-way are limited in number and significance (excluding consideration of air and subsurface rights).

2. Generally, uses which might occupy only median or sidestrip rights-of-way should:

a) Exhibit, or be able to adapt to, a linear configuration.

b) Not adversely affect freeway traffic through excessive noise, smoke, dust, or other distractions or hazards.

c) Not be adversely affected by close proximity to freeway traffic.

d) Be compatible with adjacent land development.

e) Not require direct access from freeway lanes (except in certain cases, such as special bus transit lanes).

Examples of such land-uses are bridle paths; hiking and cycling trails; commercial pipelines and associated pumping and pressure control stations; utility lines and associated control station; stock trails; bus and rail transit lines, stations, and stops; and small local parks and playgrounds.

3. Uses which might occupy normal ramp interiors and understructure areas are larger in number and significance - assuming local access is adequately provided. Generally, listed for median and sidestrip areas (except for not having to assume a linear configuration). Examples of such land-uses are vehicular parking, highway maintenance and storage facilities, transit stops, playgrounds, parks, and other recreational facilities.

4. Opportunities for multiple use of sidestrips are greatly increased if these strips of highway land can be combined with adjacent non-highway land to form developable parcels. This technique can be used to develop highway-oriented uses such as safety rest areas, as well as uses oriented to the surrounding area or community, such as parks, grazing lands, and vehicular parking.

5. A promising development concept in urban areas might be the combination of freeway sidestrips and parcel remnants with adjacent land acquired through the Federal Open-Space Land Program to provide needed parkland. The environment of both nearby residents and freeway motorists would be enhanced by this joint program.

Urban renewal offers probably the greatest opportunity for combining freeway sidestrips and adjacent parcels for multiple use in urban areas. This coordination is, of course, limited to routes through blighted areas which qualify for urban renewal.

6. The greatest potential for future multiple uses of highway rights-of-way lies in the coordinated planning and development of the highway facility and adjacent land-use - fromland acquisition through actual construction. Such a joint development concept provides an opportunity to optimize the use of these public lands by integrating the design of the traffic facility with the community which it traverses.

7. If appropriate design standards in terms of adequate speed-change lanes, sight distances, and signing are used, there seem to be no significant traffic hazards that might arise from multiple uses of rights-of-way (also assuming that traffic generated by the multiple use does not produce capacity problems).

8. Although safe auto access to median areas can be provided if adequate design standards are applied, land-uses requiring truck access are not recommended for median locations because of the

slower speeds and greater driver visibility problems associated with truck traffic.

9. The legal grounds for making multiple use of highway rights-of way are clouded by ambiguity in state enabling legislation concerning the acquisition, interim use, and possible disposal of lands acquired for "highway purposes." The term "highway purpose" has been broadened to include many uses other than the paved roadway and varies by state from a specific listing of what the term includes to delegation of general authority to acquire land "as needed"

10. The authority to acquire land for future highway needs is not clearly delegated in many states, nor is the authroity to lease on an interim basis lands not immediately needed for highway construction.

11. In many cases, the long-term lease of land no longer deemed necessary for highway purposes might be preferable to outright sale: however, many states are not legally empowered to make such leases.

12. At the state level, there is a serious lack of techniques to control or guide development adjacent to freeways, particularly in the vicinity of interchanges. Control of land-use in these adjacent areas is of significance to this study because it affects the context within which multiple uses of rights-of-way are developed. In effect, the appropriateness of multiple uses in a specific situation may hinge on the nature and character of land development adjacent to the highway facility. A lack of control over such development would seem to hamper approval of multiple-use development, while also being a possible source of congestion and hazard in itself.

13. There may be a need to consider the development of safety rest areas along freeways in major metropolitan areas. The vast

areas covered by these large urban centers suggest that opportunities should be provided for motorists to stop, rest, check maps, etc., without leaving the freeway and getting involved with local arterial traffic. Where possible, such areas might be developed jointly with local park facilities abutting freeways.

14. Development of road user services plazas as a multiple use of highway rights-of-way is still very much an open question, with present research directed to an identification of the adequacy of privately-provided services off the rights-of-way in meeting motorists' demands. Infrequent spacing of interchanges and urban areas of substantial size in the western prats of the country may create acute needs for special road user service centers along some Interstate routes.

15. For the foreseeable future, operation of large tandem trailer trucking units (up to 108 feet) is likely to be confined to toll roads and turnpikes. This suggests that tandem assembly and break-up areas will continue to be a multiple use of right-of-way associated uniquely with toll-road facilities. Should restrictions on double-bottom operations on Interstate highways be relaxed, tandem trailer areas might be developed as multiple uses of rights-of-way along these routes, but are more likely to be located on private property off the highway right-of-way.

16. Increasing sales of travel trailer and camping units strongly suggest that overnight parking facilities for such units on highway rights-of-way may be a significant future addition to safety rest areas, particularly on toll roads and turnpikes.

17. Operation of public mass transit facilities within freeway rights-of way is rapidly increasing across the country particularly the development of express bus operations with both interchange and main-line stops. The major potential for this type of multiple use is likely to be limited to urban areas of at least 200,000 population.

18. Interchange parking facilities located in ramp interiors and along ramp sidestrips can serve an important park-and-ride function when coordinated with public transit. Use of such facilities by car poolers also seems promising under proper circumstances of demand.

19. Some of the most exciting opportunities for multiple-use development relate to the coordination of freeway rights-of-way with linear regional or community parks. Such developments provide a pleasing environment for motorists, as well as accommodating an acute community need. On a smaller scale, there are opportunities to develop local parks on highway rights-of-way to serve adjacent neighborhoods.

20. Highway understructure areas can sometimes offer significant development opportunities, primarily in urban areas. Where clearance heights are adequate, understructure areas would seem suited for virtually any use that (a) does not require direct freeway or ramp access, (b) can be developed around the limitations imposed by pier spacing, (c) is compatible with surrounding development, and (d) is not adversely affected by the environment created by the highway structure.

21. Demands for use of highway rights-of-way are certain to be greater in number and significance in large urban areas than in small cities and rural areas, primarily because of high land cost and scarcity of development sites in large cities. These factors enhance the appeal of unused rights-of-way as development sites, even though construction costs may be somewhat higher because of the necessity for partial or complete air rights development, provision of pedestrian and vehicular grade separations, or other special design features.

22. Except for those activities providing an essential service to freeway traffic or generating a substantial volume of trips

that belong on the freeway, multiple uses of rights-of-way should generally depend on local access rather than direct access from the freeway lanes.

23. Through appropriate landscaping and building design, most multiple uses of rights-of-way can be developed as attractive elements of the highway environment. Certain uses, such as park facilities can significantly enhance the highway environment.

Recommendations

Pursuant to the conclusions stated in the proceeding section, the following recommendations are made:

1. Federal, state, and local highway and planning officials should actively pursue the coordinated planning and development of new freeways with land-use surrounding the highway facilities. The possibilities for joint acquisition of rights-of-way for highway and other community purposes should be explored. Where possible, departures from standard freeway and interchange design techniques might be considered to further integrate freeway and community design and development.

2. Local officials should actively seek opportunities to meet community needs for recreational areas, parking, transit, and other land-uses through existing and proposed freeway rights-of-way in their localities. State highway agencies, in turn, should seriously consider local proposals for the use of such rights-of-way and, to the extent possible, cooperate in facilitating such developments in freeway location and design.

3. It is recommended that states consider taking the following legal actions (where they are presently lacking):
a) State enabling legislation should spell out the land-uses

to be included in the term "highway purposes".

b) These "permitted uses" should be as comprehensive and inclusive as possible.

c) The states should enact legislation specifically delegating power to acquire land needed to meet future highway needs as defined by sound, comprehensive transportation planning.

d) The states should enact legislation specifically delegating power to lease on an interim basis highway lands not presently needed for highway purposes, and to lease on a long-term basis or to sell lands no longer needed for highway purposes. Long-term might in some cases include ramp interiors and understructure areas.

e) The states should enact legislation specifically delegating power to lease or sell air and subsurface rights on highways consistent with present federal policies on the Interstate System.

f) The states should consider legislation to empower state highway agencies to exercise police power controls in the vicinity of freeway interchanges to ensure traffic safety and efficiency. Such legislation should have a further objective of guiding land development in these areas so as to achieve orderly growth and optimize economic development opportunities.

Further Research

This study has provided a comprehensive survey and overview of multiple-use experience. Primary emphasis in future research should be placed on action-oriented projects directed to a demonstration of the feasibility of some of the forms and techniques of development described here. Top priority should probably be given to one or more demonstration studies in urban areas dealing with the coordinated location, planning, and development of a freeway with the community through which it passes. Demonstration studies along these lines are currently being considered by the U.S. Bureau of Public Roads and would represent an excellent opportunity to demonstrate the feasibility of multiple-use developments, particularly when they can be reflected in the original location and design of the freeway facility.

A second type of demonstration study might involve the development of multiple use of rights-of-way along an existing freeway through

a joint effort by federal, state, and local officials. Again, the major purpose of such projects would be to demonstrate how multiple uses of rights-of- way might be achieved and to further identify any adverse effects on freeway traffic which such activities might produce.

Similarly, additional research is needed to determine the adverse effects which freeway traffic might have on possible multiple users. For example, the effects of traffic noise, fumes, vibration, and air pollution on multiple uses, particularly those involving concentrations of people, should be examined. These effects would probably be most serious in association with air-rights developments, which have the most direct exposure to them.

Finally, subject to results of present research, the question of road user services on highway rights-of-way must be resolved through further study. One approach (being followed by present research) is to try to identify the adequacy of services provided by private enterprise at off-the-right-of-way locations. Another, possible more basic, approach might be to determine the total costs to the public of services "on" versus "off" the right-of-way. When the cost to freeway drivers of leaving the freeway to search for services, plus the possible congesting effects of such traffic on interchanging cross-routes, plus increased patrol costs on the freeways, are all considered, this may present a strong case for allowing services on freeway rights-of-way.

JOINT DEVELOPMENT AND MULTIPLE USE OF TRANSPORTATION RIGHTS-OF-WAY
Proceedings of a Conference Held November 14-15, 1968, Washington, D.C.
HRB Special Report 104, 1969
Preface

Until recent years, costs for right-of-way acquisition were about ten percent of the total highway construction costs. Today, on some

urban freeway projects, right-of-way costs have increased to 70 to 80 percent of the total construction costs. In addition to the increasing costs of right-of-way there is growing social and political resistance to the further intrusion of freeways into the urban environment. There is increasing concern that transportation systems improve our cities as well as our mobility. In response to these economic and social considerations, increased attention is being directed towards the application of multiple use of rights-of-way and joint development projects for transportation systems.

At the suggestion of the Institute of Transportation and Traffic Engineering at the University of California and the Civil Engineering Department at the Polytechnic Institute of Brooklyn, and with the support of the Automotive Safety Foundation, the Highway Research Board convened a conference on multiple use of transportation rights-of-way.

The concept of multiple use is space oriented. It uses a right-of-way corridor for more than one type of transportation or functional purpose. During the deliberations of the Board's conference planning committee, it became immediately evident that in order to achieve multiple use for functions not transportation oriented it would also be necessary to consider joint development in connection with transportation systems. Joint development is time rather than space oriented and is aimed at coordinating the development of the total transportation corridor rather than merely the immediate right-of way. Therefore, the conference was oriented to consider both the problems of multiple use of the right-of-way and joint development of the transportation corridor.

The concept of multiple use is not new. It has been with us for many centuries. However, economic and social considerations up to the present time have not warranted extensive development. We are all familiar with examples of multiple use and joint development. On the Interstate and toll road systems we have all used the safety

rest areas, the service plazas; we have stopped at scenic overlooks; we have seen truck weighing stations and maintenance sheds along the right-of-way. In urban areas like New York and Chicago, we have seen railroad and subway facilities parallel, above or below highway facilites. We have seen the construction of apartment houses, schools and public buildings over right-of-way in cities where the density of population and the high cost of land makes such opportunities feasible.

Because the people have demanded increased public services, new governmental organizations have been created to fulfill these requirements. Governmental responsibility for public construction programs has now become so fractionalized that it is very difficult to plan and develop unified urban transportation, construction and renewal programs. The concept of joint development puts emphasis upon coordinating the construction of new highways and other transportation facilities with long-term planning and development programs within an urban area. It seeks to plan for the entire transportation corridor and to integrate the social and economic environment with the transportation facility. Out of this need for joint development have arisen new conepts such as the transportation design team, the high accessibility corridor and the need to control developments at interchanges.

To design and implement joint development and multiple use projects a multi-disciplinary approach is needed. Therefore, the planning committee sought to bring together a broad interdisciplinary group of professional and community leaders to examine and discuss these topics and their potential applications.

The conference covered four areas. First, multiple use and joint development had to be described, defined and given a historical prospective. Second, examples of how the concepts of multiple use and joint development are being utilized in the planning of

transportaiton systems in a number of cities were presented. To point out some of the problems and impediments to the application of joint development and multiple use the third part of conference, was directed to analyzing the planning, economic, social, engineering and legal considerations. In the fourth section of the conference, the two agencies - the U.S. Department of Transportaion and the U.S. Department of Housing and Urban Development - which are primarily responsible for coordinating the Federal programs for transportation and urban renewal were asked to present their current positions and attitudes on these subjects.

The response to the invitations to the conference was overwhelming. Over 300 officials and professional people attended the conference. An additional 200 people des ed to attend the conference but were unable to do so because the facilities were limited.

The speakers and the panel discussions described a multiplicity of objectives that could be achieved through increased application of joint development and multiple use. For example, costs of right-of-way could be decreased. A transportation corridor could be designed not only to meet user demands but to actually reduce the demand for transportation. Land use could be arranged to preserve the capacity of freeways and arterial corridors. Transportation corridors could be designed so that mass transit could complement the automobile use through high-density corridors. By planning land use along transportation corridors, activities requiring high accessibility could be located in close proximity to the transportation facility and reduce travel on nearby local streets. By coordination of transportation and other land use activities, competition in the allocation of urban land among governmental agencies and among government and private interests could be reduced. By coordination of development programs a greater return of public expenditure could be achieved.

Through the use of these two techniques there could be better use of remnant parcels resulting from right-of-way takings. Local governments could be compensated for property tax loss from land taken for right-of-way by replacing taxes through multiple use functions. Multiple use and joint development might also be used to provide replacement housing and business sites for those affected by right-of-way takings and might redirect funds back into the central urban areas. Not only could multiple use and joint development make use of scarce urban lands but it might also provide a means for splitting neighborhoods and causing other adverse social and economic effects along the right-of-way corridor.

While joint development and multiple use offer a number of potential benefits especially to the urban environment there are a number of constraints and impediments to extensive application of these two ideas. First there is lack of clear jurisdictional authority. Within an urban area, frequently there are a number of agencies who have the responsibility for transportation and comprehensive planning. Intergovernmental relations and responsibilities have not been clearly defined nor has a well-operating coordinating agency in most instances been created. Also, there is a problem in planning and coordinating private construction with public planning construction. There are difficulties in tying together the construction practices and resources of different public agencies as well.

Economic as well as governmental and social considerations affect the application of multiple use and joint development. Joint development generally costs more in terms of construction costs. These must be compared to the economic and social benefits to be derived. Unless the governmental agencies involved are willing to underwrite construction and operating costs, it might be difficult to make multiple use development competitive with other sites near or along the corridor.

Multiple use must be considered in terms of return on investment and alternative investment opportunities. If public funds are involved these will be in competition with other public expenditure programs and they will accordingly compete in importance and priority.

If the projected multiple use or joint development program is deemed desirable construction and maintenance costs must be allocated. Which governmental agency should pay how much of the cost and how should it be funded? How should local tax basès which are lost to the new facilities be replaced?

In the engineering considerations, there are also a number of problems and impediments. There is currently a dearth of construction and architectural standards for multiple use projects. Design standards which take into consideration safety and public health, lighting, ventilation, vibration and noise, traffic capacity, maintenance, emergency services and compatibility with surrounding environment must be set up. Means for maintaining the facilities must developed. The effects of the multiple use and joint development must be considered in relation to possible future growth and needs of the transportation facility and the multiple user.

The greatest immediate impediment, however, to the applications of joint development and multiple use of transportation rights-of-way are legal constraints. Most states will need enabling legislation before there are clear directives and authority to acquire, lease or dispose of rights for multiple use. Similarly, there must be legislative standards for joint public or public-private ventures. The concepts require a much broader definition of the powers of condemnation and eminent domain than the state and local governmental units have had to date. The states and local governments either through a governmental agency or a third party will have to acquire property needed for the transporation facility as well as the excess property for joint development activities. It will have to sell,

lease or manage excess properties not needed for the transportation facility or for other governmental agencies. The notion of "public development corporations" to bring together the land gathering and physical development strength of various agencies has been suggested.

The function of the conference was to bring together a wide inter-desciplinary group of professionals and public administrators to review the state of the arts of joint development and multiple use of transportation rights-of-way. The value of the conference comes from establishing communications between the planners and administrators who have responsibilities of planning and developing our transportation systems. Since the conference, the U.S. Department of Housing and Urban Development has approved a major project for joint development for Washington, D.C., over the center leg of the Inner Loop Freeway. The U.S. Department of Transportation has issued two memoranda approving the use of Federal-aid highway funds for joint development planning and implementation of the corridor joint development plan associated with a Federal-aid project. Though these two memoranda have come out since the conference, they are included as part of the proceedings for the information of the reader.

If there were any general consensus of the conference, it might be that in urban areas major transportation rights-of-way should be considered in a context broader than that of the facility itself. Right-of-way now must be considered in a total corridor concept and transporation planning must consider not only the design of the facility but also its effects on the surrounding economic and social environment. Impact on the environment must be considered in both the location and design of the transportation improvement.

The conference is the beginning of what we hope will be continuing activities of the Highway Research Board in this field. In the future the Board hopes to deal with the specific problems involved in multiple use and joint development through broadly based work-

shops, committees and research efforts.

D. Grant Mickle
Conference Chairman

Highlights of the Conference of HRB, Held November 14-15, 1968
Kenneth E. Cook, Highway Economist, Highway Research Board

The two broad concepts of joint development and multiple use of transportation rights-of-way hold promise in helping to resolve some of the problems in the urban environment. However, they have not been discussed widely among engineers, planners, political leaders, and decision-makers. The Highway Research Board convened this conference to bring together a broad interdisciplinary group of professional and community leaders to examine and discuss these topics.

The conference was divided into four general topic areas. The first session was a general overview of joint development and multiple use of transportation rights-of-way with illustration of projects that have been constructed or contemplated throughout the country. The second session reviewed a number of case studies that utilized the joint development and multiple use concepts. The third portion of the program considered planning, economic, social, engineering and legal aspects of joint development and multiple use. The final portion of the program reviewedcurrent programs and policies of the Federal Highway Administration, the Bureau of Public Roads, and the Department of Housing and Urban Development toward multiple use and joint development.

In his opening remarks D. Grant Mickle stated that multiple use can provide economies in the use of land requiring high accessibility. It may also be utilized to imporve the structure of neighborhoods and add to any housing supply or supplement open space. However, the erection of high-rise apartment developments or multistory office

buildings straddling transportation systems may provide insurmountable obstacles to adding subsequent capacity to the transportation facilities.

Joint development and its related notion of multiple use of transportation rights-of-way was defined by Frederick T. Aschman as a "process of conceiving, designing, and carrying out a combination of urban development activities in a unified way, to the end that benefits are greater than if each individual activity were separately planned and executed. Aschman pointed out that the way land is used is a major determinant for the demand for transportation. Concomitantly, transportation is a major determinant of the extent and way land is used. Therefore, both transportation and land use must be jointly considered. Transportation rights-of-way, especially on a scale in which we think of them today, are themselves a major land use. The joint development concept is a potential method for reducing the frictions of competition in the allocation of urban land use.

Joint development sees its implication in the econimics of right-of-way acquisition and more efficient urban forms thatmay tend to reduce the need for actual movement. Joint development is a concept of collaboration and cooperation on a scale we have seldom before encountered. It demands an expanded view of cost and benefits. Some see joint development as mainly a means of achieving economy or public acceptance of plans. Others place its value on achievement of excellence in design and on reducing the frictions of competition for space and on the possibilities of achieving new city forms and structure. The corridor concept places emphasis on multiple-mode transportation routes as the core of linear concentration of land uses with accessibility requirements matching the level of access provided by the transportation systems.

Since the requirements for joint development and multiple use are interdisciplinary, a new design team approach is necessary to bring together the route location and design dimensions in consideration

of broad economic, social, and political impacts of such projects, especially in urban areas. The design team approach implies that transportation facilities can no longer be blasted through existing urban areas or expensively and inefficiently maneuvered through the city to avoid adverse economic and social effects to those within the transportation corridor. Instead the concept team approach advances the notion of replanning and restructuring the entire transportation corridor using the joint development concenpt as a means of adding new values to the corridor, compensating those affected by the transportation system and attempting to design a transportation facility that will enhance rather than deteriorate the environments through which it passes.

The presentation by David Levin was primarily direct at illustrating the many joint development and multiple-use projects that currently exist throughout the country, the proposals currently being considered, and further possibilities for the application of these concepts. He pointed out that new highway rights-of-way presently take taxed lands off the tax rolls. Multiple use offers an opportunity for restoring some taxable base or even expanding the tax base.

Another characteristic of multiple use in conjunction with freeway or other transportation development is the economy of space. When the land values are high enough to justify it, people may be generally relocated into about one-third of the space that they formerly occupied, at the same time, leaving additional open space for other kinds of uses such as parks or playgrounds.

The cost of right-of-way taking in urban areas is extremely high. Part of this high cost is due to the current policy of only acquiring the limited right-of-way necessary for the facility itself. In most cases the highway corridor requires only 25 to 35 percent of the block width, but the cost is approximately 65 to 75 percent of the

total block value. If the highway department or other public agencies could acquire total blocks, the remaining 65 to 75 percent of the area not needed for right-of-way would amount to only about 20 to 30 percent additional cost. This land then could be put to public or private uses that otherwise would not be economically justifiable.

Joint development and multiple use is applicable to all modes of transportation. Samuel Hellenbrand addressed himself to the topic from the railroad's point of view. He pointed out that the railroads have been in the multiple-use business for more than a half a century. He suggested that not only should other modes cooperate with railroads in designing multiple-use facilities, but also that railroads had a knowledge on the subject that they could share with highway and other mass transit interests. He pointed to the need to have cooperative planning by all modes of transportation in the locations of new facilities. With the growing shortage of industrial sites, it is important to avoid losing such potential sites by cutting of rail access service in locating a highway or transit facility.

The second session of the conference was devoted to examining case studies illustrating the use or planned use of joint development and multiple use of rights-of-way. Because of the magnitude of the subject the illustrative cases were primarily limitedto the urban scene. Case studies were presented for current projects in Chicago, Baltimore, Minneapolis, St. Paul, Los Angeles and New York. It is hoped that later workshops will consider joint development and multiple use as they relate to rural areas.

Milton Pikarsky discussed the planning of the Chicago Crosstown Expressway. Each potential alignment within the corridor was evaluated separately from three different aspects: engineering, community impact, and demographic and population effect. While relative values were given for each of the individual criteria in the three categories with respect to one another, alignments were rated separately for each category.

The category for engineering considerations included all technical and economic requirements of the facility itself. The community impact category attempted to evaluate ethnic, religious, and political bases and the extent to which people and business would be dislocated by the proposed alignment. The demographic survey investigated population trends, potential displacement of schools, churches, parks, and special purpose public districts.

One of the specific factors considered in the location of the expressway was an attempt to make the highway development compatible with the way those affected by the facility would like to see their community developed. Special attention was given to the addition of badly needed small parks and recreation areas, to the reduction of heavy trucking over residential streets, and to the minimum displacement of families. Location and design proposals attempted to eliminate the possibility of commercial strip development and to assist in consolidating commercial activities into efficient centers. Provision was also made for right-of-way for mass transit within the alignment.

A number of transportation agencies have recognized the need to consider social, economic, and aesthetic needs of the city's environment in conjunction with the location of a transportation facility. Some cities have created design teams including not only engineers but also economists, sociologist, psychologist, demographers, planners, architects, and representatives of other disciplines to develop a totally integrated transportation system in the urban environment. The city of Baltimore has probably had one of the most extensive design teams which is currently in the process of developing plans for a highway system though the Franklin-Mulberry corridor. The design concept team attempts to bring together consultants with expertise in urban affairs and local agencies responsible for the design location of the highway system. A number of consulting firms were retained by the State Roads Commission to plan the 24-mile route which passed through a park, a ghetto area, the waterfront,

and historical and industrial areas as well as open space. Norman Klein reported on the activities of the design concept team and how they have operated since their inception.

A general survey of the total route location has been completed and current planning activities are directed toward the development of a school multiservice center in Franklin-Mulberry corridor. The school system is to be built upon a platform over a right-of-way. Special attention is being given to the problem of acoustics and noise as well as that of pollution and of providing necessary ventilation incident to the highway below.

Robert Jorvig reported that in the Twin-Cities of Minneapolis and St. Paul many of the best examples of current development were related to urban renewal programs. He gave special attention to the large general neighborhood renewal project in the St. Paul area that consisted of a series of renewal activities accomplished over a period of years. A problem arose between the renewal program and the location of the Interstate Highway System. Because of problems of timing the acquisition and clearing of land for the redevelopment project and the ultimate location and construction of the freeway, the city and the highway department could not reach a mutual agreement. As a result the renewal project had to be reduced in size and the portion of the area within the highway right-of-way was deleted. The blighted area continued to deteriorate and ultimately agreement was reached between the two parties. A key feature in the design of the Interstate Highway System and the urban renewal programs was the development of attractive vistas, especially in the state capitol area as seen from the highways.

The metropolitan council of the Twin-Cities area was designated by the state legislature as the reviewing agency for any program requiring regional review by the Federal Government. The agency also has reviewed functions and the right to suspend plans of multi-

purpose special districts when they are not in conformance with the guide for the general metropolitan development.

The planning for the Century Freeway through Watts in the Los Angeles area was described by Stuart Hill. He pointed out that the introduction of any major transportation improvement in a city disrups the community. In addition, in Watts there has already been a riot. The proposed freeway is to have two interchanges in the Watts community. In addition, 2,600 families will be displaced, most of them from low-cost housing. Half the houses affected are owner occupied, and 20 percent of the occupants are retired or on a fixed income. The average value of the homes to be taken is about $13,000. Cost of comparable homes outside the Watts area is estimated to be between $18,000 and $22,000. Therefore, a compensation of the homeowner by fair market valuation techniques would prohibit the displaced families from finding comparable housing. Part of this probelm has been offset by the additional compensation provisions of the 1968 Federal Highway Act. The area affected by the Century Freeway is one of the most stable elements in Watts, and a survey indicated that only one-third of the residents really wanted to relocate outside of Watts. Most of them have lived in Watts for many years and had no desire to leave. In addition, nearly all proposals for community improvement began to be viewed with suspicion as an attempt by the white power structure to break up the Watts population and distribute its residents throughout the Los Angeles area.

With these problems before them, the highway planners developed a different strategy for land acquisition in the Watts community. The keys to the strategy were involvement of the community in the development of plans and the provision of replacement housing within the Watts area.

Local groups in Watts, including militant organizations, home improvement organizations, street improvement associations, garden clubs,

churches and every other group that would listen, were contacted and the effects of the highway on the community were discussed. The Watts Labor Community Action Committee has been one of the most active forces in the program.

At first the highway department had conceived the freeway as an attempt to upgrade living conditions in the Watts environment through the development of modern public buildings and parks. However, these plans did not represent the desires of the Watts residents, especially those most seriously affected by the freeway. The vast majority of the residents lived in single-family dwellings on individual lots. The house was a status symbol. Any thought of replacing houses by apartment units would be rejected by the community as not providing the same dignity, meaning, and comfort as their present homes.

There is still substantial undeveloped open space in the Watts area as well as sites of homes and businesses that were destroyed during the Watts riots. The joint development program, therefore, became one of replacement housing for the displaced residents mainly in single-family dwellings. Houses from the right-of-way could be removed and relocated on vacant lots in the Watts area and renovated using localcommunity labor. In this way the replacement housing program could offer the community an opportunity to change the shape of their environment in a manner that would most suit their own expectations and aspirations.

To make such a program possible, the California legislature passed a law enabling the highway department to acquire and condemn vacant unoccupied property outside the freeway right-of-way, providing for contracting with public and private entities for the financing, planning, development, construction, management, sale, and exchange or lease of replacement housing for low-income families displaced by the freeways.

For years there has been a need for an east-west expressway to serve the central Brooklyn area in New York City. As part of the Interstate program several alternative routes have been proposed for such an expressway. Cost and community resistance have prevented the development of such a route. Archibald Rogers reported on a proposed alternative route, the Cross-Brooklyn Expressway, that will utilize the existing right-of-way of the Long Island Railroad's Bay Bridge Line.

The land use along the existing railroad right-of-way is already incompatible with corridor development to a substantial extent, and the intrusion of the new highway could cause an even more detrimental effect to the east central Brooklyn area which is already seriously hampered in its efforts to achieve residential stability. Therefore, it was necessary to combine the highway needs and community needs and to develop a new linear community along and over the right-of-way. The new development would include housing, commercial facilities, and school and recreation centers. In this way the corridor would act as a means of bringing together the community in a more cohesive manner, rather than as a Chinese wall further dividing the area.

Current planning emphasis has been put on the development of a new full-range educational institution of 18,000 to 20,000 students. The eductional campus will have facilities for preschool through adult eductions and will reflect the needs and desires of the community. When the linear city is completed it will be six miles in length and will be anchored at one end by Brooklyn College and at the other end by another major institution.

Like the Baltimore approach, the planning is being done by a team using the multiple disciplines necessary for developing such a community plan. Also there is an attempt to obtain public participation, and all planning is done with as much public knowledge and participation as possible.

In his formal speech, Lowell Bridwell discussed how highways should contribute to the satisfaction of community desires and goals while at the same time providing mobility. He explained that the 1968 Federal Highway Act provided far-reaching relocation assistance programs to minimize injury and to provide equitable treatment for families to be displaced by the highway improvements. He pointed out that if adequate replacement housing could not be obtained it would be no longer possible to build hgihways in urban areas.

He also discussed the urban impact amendment to the 1968 Highway Act requiring that in addition to considering economic effects, highway departments must consider the social effects of highway location, and the impact on the environment as well as their consistency with the goals and objectives of the community involved.

Highway development has become more than the mere construction of the roadway. It requires consideration of the development of the corridor as an integral part of highway planning. Both public and private uses of corridor development should be considered by the community as a means of increasing the tax base. Highways can contribute to community development thorugh their ability to assemble large tracts of land.

Of special note was Mr. Bridwell's statement that "... rights-of-way for highway purposes are rights for the roadway plus whatever additional lands, or space, are necessary to assure compatible usage." In the panel discussion after the formal presentation, he amplified this statment to the effect that the right-of-way necessary for a particular project need not be totally contained within the normal right-of-way limits but may include adjacent land that is necessary for compatible use.

He pointed out that the question that we must resolve is whether we are going to have planned development or the development that will

occur inevitably by the mere fact of the existence of a highway facility. He advocated that highway funds be made available for the assembly of land, which could then be taken over by either the highway department or some other other public agency and sold by competitive bid to private investors who want to develop land in accordance with a compatible plan. Funds so received should be reinvested in the highway program.

Mr. Bridwell also discussed cases where highway location has provided residual landowners with excessive profits from the sale of land, especially around the interchanges. Such remainder parcels are sometimes used for a purpose that is not compatible with the highway. He indicated that he did not concur with such a policy.

In response to concern over whether highway user funds should be spent for activities such as joint development, he stated that he could not longer tell the difference between the highway user and the citizen of the country. He pointed out that the definition of highway use that would not allow expenditure for anything other than the roadway and its appurtenances is just as ridiculous as saying that property taxes cannot be used to support schools because the individual paying the property tax does not have any children in school.

The third portion of the conference sought to examine political, economic, social, engineering, and legal aspects of joint development and multiple use of transportation rights-of-way.

Charles Blessing spoke on policy and planning considerations. He pointed out that in order to prepare a comprehensive plan that will satisfy the human values and goals of the community it is first necessary to find better ways to identify such goals and values. He commended the recent developments of the design team approach and efforts at total transportation planning. He pointed out that people want to identify with the community, yet they also want to

be free from feeling that their lives are institutionalized. Over-planning and massive and sudden change resulting in human dislocation can cause such dehumanization. The objectives of urban planning are to provide an environment in which the individual, the family, and the ground can develop according to their desires and expectations.

He indicated a need to resolve the problems of intergovernmental relations and responsibilities for joint development projects and for projects incorporating multiple use of transportation rights-of-way. He pointed to the problems that exist between zoning ordinances and multiple-use projects. On the one hand, multiple-use projects may require a reconsideration of current zoning provisions. On the other hand, if we are to have orderly development of urban land use it is necessary to find some technique that will make zoning less sensitive to a change desired by special interest groups.

Philip Hammer addressed himself to the economic considerations of joint development and multiple use. His main theme was the need to rejuvenate the urban centers by utilizing joing development and multiple use as catalytic agents for precipitating reinvestment in the urban core. He felt that appropriate change in environmental conditions within the urban center could change people's attitudes toward it. In the next ten years or so the suburbs are going to have to absorb an additional 35 million or more people. If we can counteract the decay in the central cities we may also counteract the current exodus from the city to the suburbs. Investment is currently taking place where growth is taking place because these are the areas where a return can be obtained. Similarly we are not reinvesting in the central cities because the dwindling population results in the submarginal investment opportunities. Be redirecting public investment policy back toward the city center we may also redirect private investment.

In joint development projects there is always the problem of financing and allocation of costs. At the present time there are no

firmly stated policies and the cost allocation between the Federal governmental agency and the local community or private community is on an individual project basis. Like several of the other speakers, Mr. Hammer advocated the creation of a public development corporation to acquire necessary land for the development of joint projects either in conjunction with other public activities or private investment opportunities.

Roger Nusbaum presented the engineering considerations for joint development and multiple-use projects. He first compared the advantages and liabilities of the depressed as compared to the elevated freeway. Of the two types of construction he stated that the depressed urban freeway detracts least from the surrounding urban community in that the aesthetics are not marred by embankments or overhead structures, and it offers more opportunities for a safer design than afforded by elevated freeways. The advantage of elevated freeways is the possible utilization of the ground surface below the structure and the right-of-way taking is normally much less than would be required for a depressed freeway with the result that the land requirements for the facility are minimized with savings of right-of-way costs. An elevated structure will require higher maintenance costs. In selecting projects for joint development and multiple use Mr. Nusbaum pointed out that the freeway ramps cannot be constructed indiscriminately at locations to provide access for some joint project without seriously affecting the capacity of the system. In considering multiple use or joint development, the function selected should not increase peak-hour traffic flow by any substantial amount. Likewise, multiple-use projects can restrict future expansion of the transportation facility.

As was pointed out in several of the case studies, adequate provision should be made for light, open space, and air circulation, and consideration should be given for pollution, noise, dust, and distractions for the users of the facility and for the adjacent multiple-use activities. Pedestrians should be segregated from vehicular traffic. Vehicular traffic, on the other hand, should be protected

from vandalism, the opportunity for which may be provided by the multiple-use activity.

In designing the structure within the right-of-way, proper provisions should be made for fire and explosion hazards. The collapse of any structure within the right-of-way from any cause could result not only in a loss of life and loss of the structure but the closing of the transportation facility until such time as the debris could be cleared away.

Every effort should be made to provide for the normal movement of traffic during the construction period. The construction program should be designed so that all work on all phases could proceed without delay or interruption until the project is completely finished. Rather than the current procedure of constructing long segments, where one phase is completed in its entirely before construction of the next, urban construction programs should attempt to complete smaller segments and thus disrupt the community to a lesser extent. Fringe landscaping and other techniques should be utilized to shield businesses and residences adjacent to the freeway from the highway activities as much as possible during the construction phase.

In the design of the freeway, special consideration should be given to the maintenance and operation of the facility. The use of the area below the structure for multiple activity may have adverse effects upon such maintenance operations as full-depth deck removal and patching. Multiple-use structures whether below or above the right-of-way will require added maintenance and operating costs, and every effort should be made to reduce such costs and allocate cost responsibility and liability for such maintenance prior to construction.

Where multiple-use activities are located under the roadway structure, new and better ways must be found to provide drainage and snow removal.

of easements may be advantageous. If a highway department only acquired a so-called "tunnel easement" the adjacent landowner would still be able to utilize, sell, or lease the overhead airspace subject to limitations by law.

In some jurisdictions in the United States, in the absence of statutory authorization a municipality does not have the power to allow private encroachment to be erected over public streets. In other jurisdictions, some cases have held that the city possesses the inherent power to allow overhead encroachments even in the easement situation.

However, in the majority of states, according to Mr. Wright, in the absence of specific constitutional or statutory sanctions, the municipality or state holding a fee-simple title to the streets and highways can permit overhead encroachment into the airspaces so long as there is no interference with the use of the facility.

It was brought out later on in the conference that the Bureau of Public Roads of the Federal Highway Administration was in the process of designing a model legislation tht could be enacted by the states to provide a positive basis for multiple-use and joint development projects.

Frank Turner further expanded on the role of the Federal Government in encouraging joint development and multiple-use projects. He pointed out that the 1968 Federal Highway Act requires state highway departments to certify if they have given consideration not only to the economics of the highway's location but also to the social and environmental impacts and their consistency with community goals and objectives. The Bureau fo Public Roads considers the joint development and multiple-use concept a major component in comprehensive environmental considerations. The concepts are not limited to urban use and the Bureau of Public Roads is interested in encouraging rural applications of these concepts. Mr. Turner pointed out (as

did several of the other speakers) that it might be beneficial for the states to create a public or even private corporation to acquire and assemble the necessary land involved in a joint development project. In the future the Bureau of Public Roads will be issuing procedures permitting Federal participation in basic site development costs for joint use projects on rights-of-way, such as parks, recreational areas, and parking lots.

While endorsing the concepts of joint development and multiple use, Mr. Turner pointed out that under the currently accepted concepts of finance we cannot appropriately use highway funds for other than highway purposes.

In further defining the Federal role for joint development and multiple use, Don Hummel reviewed in the activities of the Department of Housing and Urban Development in this area. The 1964 Housing Act authorized renewal projects for air rights development but limited the sites for use to low and moderate income housing and closely related uses. It accepted the cost incurred for foundations and platforms but restricted such costs to be not greater than sites that could be provided through the use of cleared land. The Act prohibited the expenditure of funds for acquisition of airspace over publicly owned rights-of-way. In 1966 the Demonstration Cities and Metropolitan Act extended the use of air rights sites to renewal areas for industrial development where sites were unsuitable for low or moderate income housing. The 1968 Housing Act further extended the uses for eductional purposes with the same limitations. There have been only two instances of the use of air rights up to the present time under these Acts. One of the continuing problems that must be resolved in multiple use is intergovernmental responsibility and the gap between the agencies authorized to provide only a part of the solution to the problem. Resolution must be made of the problems of different time schedules, authority, jurisdiction, and allocation of costs. In particular the question of whether one governmental agency should pay another agency for the use of air rights must be resolved.

Mr. Hummel alluded to the concept of the three-dimensional city by stating that urban space should facilitate the conduct of business by vertical travel rather than by further extending the distances on the surface plane.

In the conference summary, D. Grant Mickle concluded that transportation systems must be considered as a part of the total economic and social environment in which the community and non-user must be given equal consideration.

Because of the increasing complexity of the urban transportation problems it is necessary to include many disciplines in the planning process. The community to be affected must be brought into deliberations at a very early stage in the planning process, and compromise must be reached between user and community interests. We must review and redefine goals and objectives, costs and benefits of transportation systems. We are increasingly moving toward an urban transportation program based on the consensus of those affected.

JOINT USE OF RIGHTS-OF-WAY CAN REDUCE COSTS OF SERVICES

T.W. Mermel, F. ASCE, Assistant to the Commissioner for Research, and chief, Division of General Engineering Bureau of Reclamation, Department of the Interior, Washington, D.C., March, 1967

In the spring of 1965 a White House Conference on Natural Beauty was held in Washington, D.C. The theme of the conference was "Beauty for America." One of the panels covered the subject of "Underground Installation of Utilities," and devoted its attention to electric power transmission facilities. In the concluding report, the panel chairman recognized that much progress is being made in developing and installing underground facilities to serve the new residential areas;that the cost of undergrounding continued high; that every effort should be made to study the factors affecting costs, and to do research and long-range planning to meet the growing

demands of the public to lessen the impact of the prolific overhead expansion of utility transmission lines. The panel recommended that utilities and all others responsible for rights-of-way planning explore the possibilities of greater coordination of the joint use of rights-of-way and common trenches for such services. The panel concluded that because other utility services are involved, such as communications, gas, water and sewer, encouragment should be given to the joint uses of rights-of-way, either existing- such as transportation- or entirely new ones.

More than 300,000 miles of overhead transmission lines extend over the United States. These lines embrace some 7,000,000 acres of land within their rights-of-way, an amount of land equal to the area of the State of Maryland.

With electric power loads tripling by 1980, this means that some 20,000,000 acres of land will be required by overhead lines if we continue to pursue present-day practices. This area is equal to all of West Virginia. Considering that other public services will continue to expand - highways, interstate gas lines and water supply lines or aqueducts - the demands for rights-of-way will be insatiable. Will such land be obtainable?

Power lines running across the countryside and through suburban areas are now discordant with the environment, frequently unsightly and considered by many as objectionable. Our open west and middle-west are at the threshold of cluttering up the country-side, unless changes are initiated now. The practice of each utility service having its exclusive rights-of-way spawned when land was cheap and sparsely settled, and when such phrases as "urban sprawl," "highway beautification" and poverty blight" were unknown. Environmental values were not than a factor in determining the lowest cost.

An obvious solution to the problem is to use the land more efficiently

and to locate several different utility services on the same right-of-way. To a very limited extent this is being done now, but more can be done. We are all familiar with the ribbons of telephone and telegraph lines that are carried along railroad tracks and along some highways. More recently some of these lines have been buried along side these facilities. There is no insurmountable reason why the idea should not be extended to include many other utility services.

In New York City, for example, about 94 circuit miles of 345-kv underground cable are buried in 47 miles of trench in the city streets. Using steel pole construction, these transmission circuits would require at least a 125 foot wide right-of-way. It is obvious why no 345-kv overhead circuits exist in New York City nor can there be any expectations that such overhead circuit will ever be built regardless of load expansions or demands. Future load demands will be met by placing additional
circuits under existing streets and along other rights-of-way. In Los Angeles more than 17 circuit miles of 230-kv underground cable are located under the streets, and about 3 miles are located along a railroad track. In several areas joint use of right-of-way with railroads, highways, gas pipelines and other utility services has been utilized.

Traditional R-O-W acquistion

Consider for a moment the present procedure for establishing right-of-way for transmission lines. Today virtually every utility, whether public or privately owned, has some measure of authority to acquire land on which its facilities may be located. If the land owner does not wish to sell or otherwise relinquish his property, the utility then has the right to eminent domain, usually a last resort.

First, the utility appraises the required property and makes an offer which may or may not reflect the value of the property to

the owner or the impact on the environmental value to the community. If negotiation does not result in mutual agreement on a sale, the utility usually acts under the provisions of eminent domain and the price is established according to the market price. Surely there is agreement that the market price is not necessarily the best measure of the public interest. If it were, we obviously wouldn't need to have any planning commissions or building codes. The market, of course takes an entirely indifferent view of the impact on environmental values.

The price paid for a right-of-way is the reward to the owner for relinquishing or for the use of his land, but no provision is made regarding the damage inflicted on the property adjacent to but not within the right-of-way take line. Consequently these property owners now become most vocal at right-of-way proceedings as interveners, and in many instances are successful in delaying project construction.

In theory, it originally was considered necessary to condemn land in order to obtain the benefits of the utility service for the many, over the opposition of a few. Today this premise can no longer be accepted without adequate and complete participation by the community in planning and consideration of all alternatives.

Utilities have recognized this problem and have been aware that communities might organize to object. They have spent huge sums on public relations to demonstrate, for example, that the presence of high-voltage transmission lines with their hugetowers does not affect the nearby property or environmental values. The communities have not always been convinced. Seeds of opposition have sprouted and rumblings are being heard. Consequently, the utilities have introduced new streamlined tower shapes and colors. In the 17 western states the Bureau of Reclamation has introduced low silhouette switchyards and tubular transmission towers. Some have been developed for voltages of 230-kv as single pole structures with such exotic

names as "Sunburst." The colors include a wide variety of pastel shades of greens and blues, intended to blend with their surroundings and the horizon. The rights-of-way have become narrower and some lines with single pole structures are installed along existing highways with no new demands for land. However, these "cosmetics" are only a partial solution to the problems. Admittedly they would provide neat-appearing corridors.

The influence of civic groups, fine arts commissions, conservationists, park and planning commissions, urban planners and wilderness associations have often proved more potent than laws. Acquistion of rights-of-way is not longer a matter solely of money and legal rights. Frequently major utilities have had to abandon planned projects which were feasible techncially and economically, because rights-of-way could not be obtained in the face of opposition by interveners who objected to the impact on the environment.

A Possible Solution

Community-established corridors or common rights-of-way would substantially reduce such conflicts and local opposition. This concept is gaining acceptance as a possible solution to the problem. It promises significant savings in the land required and in ultimate project costs.

As with many proposed changes, there are obstacles to implementing such an idea and these must be overcome. Studies of all aspects of the matter must be intensified. The public and the utilities must understand each other's problems and objectives. Perhaps as a first step, the condemnation laws could be changed to establish legal limitation and thus permit nonexclusive use of rights-of-way; future users would not be barred and additional services could be granted access to existing rights-of-way by community action. At present, the utilities are permitted by franchise to use the streets, a privilege granted by the community in the interest of and for the benefit of the majority. In most United States cities it is common

practice for trenches to be dug in or alongside main thoroughfares. One day such a ditch is dug for servicing water lines and another day for laying a telephone cable; it is dug up again for the installation of an electric distribution line, or a gas main, or even a high-voltage transmission circuit. Each of these diggings is at the convenience of the specific utility and frequently causes great inconvenience to the community. The additional and cumulative costs of all such duplicating operations must, of course, be passed along to the ultimate consumers.

The 345-kv transmission circuits under New Yorks's streets are hidden in a pipe about 10 inches in diameter. And since surface right-of-way requirements for the same conventional overhead line at that voltage would require in excess of a 125 foot wide strip, land values in a city or densely populated area would make the ratio of cost of overhead to underground many times in favor of underground. The requirements for right-of-way for a 230-kv transmission line based on conventional design require a width of about 125 feet. If the circuit is placed underground in a single 10 inch pipe, it could utilize a portion of the space occupied by the median strip of a highway or even be placed at the edge of a freeway with no added demand for land. The joint use of existing rights-of-way would reduce the cost to the ultimate consumer of electricity and other services.

Some progress has been made recently in the United States to prevent this ceaseless opening of streets through a community coordinating committee. It is the duty of the coordinating body to keep informed of all planned street openings for new and enlarged facilities and to schedule them, when possible, so as to avoid duplicate disruption and to promote common usage of a trench in a specific area. This is a good beginning, but it is only a beginning.

Make an Early Start

Ideally, when a community is planned, the community should provide for all public service utilities to be located in a "multiple use" corridor leading into the areas to be served. This corridor could consist of a series of tunnels. It could provide for a trench alongside a railroad system, or a conduit or covered trench alongside a highway, or perhaps in or beneath the median strip. Thus, all utility facilities would be readily accessible for additional installation and repair as needed. Such corridors could take on the appearance of a public parkway, perhaps devoted in part to recreational purposes. This concept is not new, for many university campuses and community shopping complexes put it to use in providing utiltiy services to their scattered buildings. A city could do this on a larger scale.

This procedure would in most cases require modification of existing laws with respect to the rights of condemnation and the exercise of eminent domain by each of the utility services. Procurement of rights-of-way would become an obligation of the city or county and would be exercised through a public coordinating commission. Visionary local governments would provide an underground tunnel or parkway corridor in which utility services would be placed, thus avoiding the constant digging and replacement of the street surfaces and consequent interference with public use.

The advantages to the community are obvious. The impact on the environment and the depression of adjacent property values would be significantly reduced. Lower costs to each utility which would be passed on to the public would also result from multiple use of the land and make ready access to the facility.

One of the early adaptations of multiple use was when the City of Baltimore installed a municipal conduit system in about 1908. It

provided space for telephone, power, telegraph, fire alarm and traffic control lines. Later in Montreal a similar system was installed. While such systems may not meet all city needs, the idea and policy can be expanded to cover other services. The systems were installed at city expense, and the rental costs covered the repayment of funds and operating expenses.

The burden of converting the common corridor concept into reality lies on the organizations within the community and the cooperation of owners of existing rights-of-way. For example,when a political subdivision of an area builds a bridge, its plans should permit and encourage utility facilities to be carried across this same structure rather than force each utility to find its own crossing. We have had specific cases in which local authorities allocated such a high proportionate cost to the joint user applicant as to discourage common occupancy, with the result that it was cheaper to condemn an adjacent right-of-way and construct a separate water crossing, all to the detriment of environmental values and higher costs to the public. Such practices increase costs, use more land, and are contrary to the interests of the community and the nations.

The principle of undergrounding in streets and on city-owned lands has already been generally accepted in highly populated areas. One sees no transmission towers running through Washington, D.C., New York City, or London. Beautiful or graceful towers notwithstanding, the pressure for undergrounding of high-voltage lines is an expression of the public's willingness to pay for the preservation or enhancement of environmental values.

The right of franchise should not include the right to be the sole judge of when and where transmission lines should be located. The municipalities and political subdivisions must also assume an obligation and responsibility to provide the right-of-way in an acceptable manner. Planning committees should be formed to develop the needs

and wishes of the community and aid the utility services in attaining mutually beneficial objectives. Should underground installations be desired by the community, it should be the community's decision to forego them or to demand them for it is the community that must pay the cost directly or indirectly through the utility service rates. Existing regulatory bodies could be empowered to provide such coordinating service. The problem of common rights-of-way does not present any engineering difficulties. It is predominantly one of cooperation, coordination, and a will to change outmoded practices and eliminate ugly sites.

Protecting the Rural Environment

The advantages of underground utilities to urban areas are perhaps more evident, and city building codes and ordinances are designed to protect the environment in the cities. However, similar protection must also be given to the rural areas. In the countryside, roads, electric power transmission lines, gas lines and water lines all require rights-of-way. The price at which land can be purchased should not necessarily determine the location of these lines if the spread of these facilities will detract from the rural areas. Here too, especially in the belt surrounding a city, there is a need for planning corridor-type rights-of-way since facilities of electric power and other services must of necessity cross such open space to reach our industries and cities.

The concept of a corridor or common rights-of-way for more than one use is gaining ground among civic groups, planning commissions, conservationists, and other public minded citizens. The plans should receive even more attention, as it would result in more efficient, more economical, and more esthetic use of the land than our existing "single purpose" right-of-way system. The planner-designer-engineer must hear the chant of the public and recognize the importance of environmental values in his engineering creations and emerge from his locked-in orbit.

The recent announcement of the British work on a 1,000-mva super conductive cable and Consolidated Edison's venture into a 345-kv 2,000-mva gas dielectric cable, point the way to where a 300 foot wide right-of-way for overhead transmission can be narrowed down to a 10 to 20 foot ribbon, or even placed underground in an unused portion of an existing right-of-way at practically no added land requirements.

While the Consolidated Edison Company's 345-kv underground cable link is for an application at a substation, it will provide new experience for future expanded oil or gas or electric cable installations. The 345-kv underground transmission system will be an isoltated-phase, aluminum enclosed housing with a concentric aluminum conductor, insulated with sulphur hexaflouride (SF_6) gas. This system will be capable of transmitting 3,350 amp at 345-kv (2,000 mva). The outside enclosure will be 18 inches in diamenter wil a 6 inch tubular aluminum conductor supported by epoxy disc insulators. The housing will have a protective coating against corrosion when buried underground. Imaginative engineers have open horizons in this field.

Our highways, interstate toll roads and the like, occupying a large network of already publicly owned land, could save the public huge sums if the joint use concept of right-of-way were used. The only obstacle is the will to make the change from the present practice of single purpose use.

The day will surely come when advanced technology in construction will make it possible for 750-kv and higher voltage overhead lines to be displaced by 2,000 to 5,000-mva underground super-conducting or cryogenic cables. These will share the rights-of-way with other utility services at fractional demands for land, thus utilizing our precious land more efficiently for the needs of the public and at great cost savings to the consumers.

The general adoption or acceptance of the joint use concept with emphasis on underground tunnels through the city to accommodate utility services with surface provision for parkways and parking spaces, could be a major factor in attacking the urban clutter and congestion that today threatens many of our cities and suburban communities. It would provide for a more efficient and economical utilization of the available land, and would contribute both to lower costs of undergrounding high-voltage power lines and other utility services, and to the enhancement of environmental values with large savings to the public.

A CHALLENGE TO THE PAST: MULTIPLE USE OF RIGHTS-OF-WAY , December, 1969
Keynote Address by Carl E. Bagge, Vice Chairman, Federal Power Commission

The convening of this Conference by the Engineering Foundation to explore the subject of multiple use of rights-of-way has national significance. Simultaneously, it provides a forum in which to discuss concepts that have evolved over years of operating experience and challenges the wisdom of those concepts. Unquestionably, there are those who will say that this conference and what it attempts to achieve come too late. That past practices of acquiring right-of-way have bred an incorrigible mode of operation. That they have shared the unenviable distinction of other land use practices which foretell the day when there will be no scenic land, the day when even bountiful vocabularies will not include words such as "aesthetics" "conservation" and"natural beauty."

But I do not agree that this conference is untimely. It comes at a time when different and heretofore competing disciplines are beginning to acknowledge the value of multiple use as a potential solution to many of the Nation 's awesome land use problems of the future. Represented at this Conference are engineers, right-of-way specialists, planners, landscape architects, lawyers, and policy makers. If this conference accomplishes nothing more than to impress upon its participants the essentiality of each of these disciplines

to the effective implementatation of multiple use of rights-of-way, it will indeed have served a useful purpose.

In the past, multiple use has been the subject of engineering and economic debate. Could it be done technically and inexpensively? These were the questions which were asked. If the anwers were no the subject was taken no further. If the answers were yes, there was still no assurance that multiple use would come about.

Today, however, there is a new dimension to the multiple use concept - a dimension which has emerged from an environmental ethic senstitive to the potential contribution of multiple use in preserving and enhancing the quality of our environment. Precisely because of this newly emergent ethic, multiple use no longer can legitimately be viewed through only it engineering and economic dimensions.

In recent years, we have seen flourish an unprecedented commitment by the public to aesthetic and other environmental values. It has become a vocal characteristic of our maturing, increasingly complcated society. Time and again the public has called for quantity to give way to quality. A maturing and more sensitive American public today is prepared to pay the price for air pollution control, for water pollution control, for the improved appearance of underground utility service and for the efficiency of mass transit surface transportation systems and high speed trains. The list is endless.

An industry and government have generally demonstrated that they are prepared to respond. Air and water pollution control devices are perfected daily. Metroliners and turboliners speed between major population centers. Statutes, ordinances , and grant-in-aid programs spring forth regularly from legislative bodies throught the Nation to meet the challenge. Indeed, the public is becoming increasingly aware of the fact that as man shapes his environment he shapes himself as well.

Lee Sillin, President and Chief Executive of Northeast Utilities, has perceptively analyzed the trend in public sensitivity to environmental values in the context of the electric power industry. In reference to the problems of electric utility companies proposing the construction of new transmission lines he has found a recurrent theme thoughout the Nation - what he has termed the "Don't put it here" attitude. I agree with Mr. Sillin that the posture of an increasing number of people today goes even beyond an unwillingness to have utility lines on their own property. I find that more and more people today are beginning to insist on a halt to the construction of electric power facilities. Bills are introduced in Congress to impose moratoria on the construction of electric generating plants. A genuine cynicism seems to be nourishing the attitude of many people as they appraise the regulated industries.

With the suspenseful qualities of a well-produced drama, we have repeatedly observed the public's concern to protect the integrity of its environment confront the utilities' efforts to provide additional service. At times the consequences of that confrontation have been harsh. Woodside, Cornwall, the so-called second battle of Antietam stand as contemporary tributes that technology has been called upon to pay to environmental quality.

Just recently we have again seen such a confrontation. Last month the Hudson River Valley Commission withheld approval of an electric transmission line proposed to be constructed by Orange & Rockland Utilities. Earlier, in testimony before the House Subcommittee on Communications and Power, the Federal Power Commission called this transmission line vital. The HRVC explicitly recognized the reliability benefits of this transmission line, but nevertheless concluded that the permanent adverse impact of this power line on the scenic and natural resources of the Hudson Rivery Valley required that approval to construct the line be withheld.

It was not long ago that this regulatory action would have been

challenged by some as outrageous. But today it is not, because most people believe that the exercise of responsible jurisdiction over the routing of public service facilities is an essential step in the development of comprehensive planning procedures which will benefit not only the public, but the utiliites as well. If the Nation is to benefit from the Woodsides and Antietams, it is clear that procedures must be developed to bridge the chasm that now exists between system planning and environmental planning. And with the establishment of these procedures, I believe that many of the rights of way difficulties of the past will be swept aside.

It seems abundantly clear that the utilities and other public service companies could benefit the Nation by taking a critical look at their past practices and evaluating these practices in the context of the new environmental ethic. It is no longer sufficient for management to look with deserved pride at charts and graphs which illustrate the impressive increases in the quantity of service it has been able to provide. More and more it is becoming imperative for management of focus on how it has moved ahead. Has it been sensitive to the public's increasing concern for the quality of its environment? Has it been responsive to changing values? Has it been prepared to enter into constructive dialogue with those who seek a departure from past practices?

I need not belabor the fact that today's public concern for environmental values co-exists with an unprecedented public demand for participation in nearly all facets of utility decision-making. Today, it is not uncommon for bills to be introduced in Congress to establish statutory consumers' counsel to intervene before administrative agencies. Bus boycotts are no longer considered extraordinary. Citizens groups are more vocal. And people are not surprised to see bulldozers frozen before chains of angry residents who oppose the routing of utility lines through their neighborhood.

At the Federal Power Commission, we receive, at this time, more mail and more protests in opposition to the proposed routes of power lines and natural gas lines than at any time in the past. It may well be that the hindsight of historians at some future time will reveal that the American public today is beginning to see utility facilities as it saw highways a decade ago. And the continuing problems of highway planners, in my opinion, will be those of utility and other rights of way planners in very short while.

In Nashville,Boston,Washington, D.C., New Orleans, and elsewhere, public opposition to the construction of major highways runs deep. One need look only to San Francisco to see the potential muscle that public opinion could flex against public service companies. Who would have believed fifteen years ago that the double-deck Embarcadero Freeway would come to an abrupt halt in mid-air? And who can imagine today that the future may see newly constructed power lines or pipelines quietly resting unused in the middle of a prairie? I submit that each of you should attune your thoughts to include that staggering possibility. For you can be certain that many of your potential adversaries before regulatory and judicial forums have not dismissed it.

The moderate, yet significant, success which highway planners at the Department of Transportation have begun to achieve, in my opinion, can be traced to the emergence of policy-makers with a broad perspective of the appropriate role of highway planning in contemporary society. The Department of Transportation today relies on the counsel not only of engineers, but of landscape architects, regional planners, sociologists, ecologists, and a variety of related disciplines whose relevance to highway planning cannot be overemphasized. While people once spoke of bulldozers and concrete as the only essentials to highway planning, today we know that transportation must be integrated into comprehensive regional plans, that natural beauty must be preserved, and that the intelligent application of ecologic

criteria is indispensable to effective planning. Scholars today devise theoretical and practical means of routing highways with minimal intrusion and maximum benefit to the natural environment. And some people speak even of the potential intrinsic beauty of well-designed highways.

I do not mean to suggest that current highway planning practices are approaching a point of perfection. The controversy over the Bureau of Public Roads' policy statements, the practical problems of highway planners throughout the country, and the inadequacies of mechanically applying cost-benefit ratios to qualitative values are testimony to the many shortcomings of modern highway planning. But I do believe that many progressive highway planners have taken the first essential step and have recognized the inevitable - that the public will not stand for the uncoordinated case-by-case planning of the past and that new means of acquiring and planning rights of way must be devised for the future. This challenge lies at the heart of this conference and is a burden not only of the embattled highway engineers but of all interests which employ land as rights of way.

A number of recent publications have emphasized the enormous amount of land that will be needed to meet projected power, communications, pipeline, and highway requirements in the future. Dramatic accounts are set forth of the serious consequences of meeting these land requirements without a re-examination of the pell-mell land use criteria which have taken hold over the past fifty years. Whatever may be one's station in life, he shares a sensible use of our limited, indeed precious, commodity of land.

But even beyond this compelling reason for the public to voice grave concern with the acquisition of land often by little more than happenstance , the interests of the consuming public in adequate transportation systems and reliable power, pipeline, and communications systems require that land acquisition practices be re-examined. For

if current trends continue, many of the efforts of public service companies to acquire additional land will become embroiled in regulatory or court proceedings, or both. The delay caused by these proceedings, or other potential detriment, will harm both the public service companies and the public at large. Yet, unless the adherence to past practices is ended, there is little chance that this can be averted.

It is with these thoughts in mind that the multiple use of rights-of-way becomes even more desirable. The use of a single parcel of land for two or more public service purposes obviously requires less land than if those public services were to occupy independent parcels. Equally important, the multiple use of land for two or more public services concentrates the burden of these land uses on a single geographic area. The public is thus given a natural corridor for future public service facilities to occupy at minimal cost to environmental values.

Knowing these benefits to multiple use, why has it not been more widely practiced by public service companies in the past? First, there have been technical reasons, such as the terrain of railroad rights-of-way, which often precludes use by other facilities, and the tendency of high voltage power lines to impair the efficiency of communications cables. Second, there have been safety reasons, such as the danger of pipeline explosions by certain multiple uses and inductive interference to railroad signal systems by high voltage power lines. Third, there have been legal and regulatory reasons such as joint liability problems and cost allocation difficulties. Fourth, there have been institutional reasons, such as the hard-and-fast policies of certain companies to maintain the physical integrity of their facilities on independent rights-of-way.

Fifth, there has been an absence of coordinated planning among public service companies. The desire of each company to preserve its internal decision-making process in large part contributes to this. Although most companies plan their growth for several years into the future,

competitive instincts sometimes deter them from making these plans public. The result is often parallel action by several companies planning to construct new facilities to a common location, but by different routes.

Sixth, there has been an antipathy between technician and conservationist. Historically, the conservationist has opposed the efforts of the technician to plan and construct utility facilities according to engineering and economic standards alone. In turn, the technician has sought to avoid confrontations with the conservationist. This, as well as the fear of skyrocketing land costs, has caused certain companies to conceal their right of way acquisition plans, which has not only prevented early opposition of conservationists but has precluded the disclosure of right of way acquisition plans to potential multiple users as well.

The benefits of multiple use by public service companies are so great that I believe the commitment of the financial and human resources necessary to resolve the technical and safety problems of multiple use must be made immediately. At present there are several meaningful research projects underway. The National Task Force on High Voltage Direct Current is examining corrosive effects of overhead direct current power transmission on natural gas pipelines and other buried metalic facilities. The Electric Research Council is supporting research on the feasibility of undergrounding high voltage transmission lines for long distances. And the American Public Works Association has proposed a project to determine the feasibility of utilidors to house the facilities of various utilities.

There are other related research efforts also. But to the present time the commitment by industry and government to the elimination of the technical and safety problems of multiple use has been inadequate. I believe that now would be the propitious time for industry

and government to join in a concerted effort to promote the kind of research and development that will be necessary to resolve the technical and safety problems of multiple use. Specificaly, I urge the various trade associations (such as EEI,APPA, AGA, INGAA, AAR, and telephone companies and pipeline associations), as well as individual companies and organizations such as the Electric Research Council, to join with appropriate planning agencies and departments of government to undertake projects aimed at eliminating the technical and safety barriers to multiple use.

I also believe that now is the appropriate time for industry, government, and citizens' groups to join in a concerted effort to develop and promote policies which will encourage the multiple use of rights-of-way by public service companies generally. In particular, I believe that the complementary efforts of the President's Council on Environmental Quality, the Citizens Advisory Committee on Environmental Quality, and the affected public service industries would provide the most effective level at which to meet the challenges of multiple use. The Nation would indeed benefit from such a comprehensive study of multiple use planning policies and procedures, and the President's Council would be in a unique position to coordinate such an undertaking.

Despite the modicum of multiple use that has characterized the past multiple use concepts have not gone without attention. Many public service companies share rights of way, and recently multiple use has been emphasized by government, industry, and citizens groups as a promising means of minimizing the intrusion of utility rights-of-way on the quality of our environment. Examples can be cited of low voltage power lines and telecommunications sharing rights of way with each other, as well as with railroads and pipelines. Along the edges of a 260 mile portion of the Sunshine State Parkway in Florida are two high pressure pipelines and in the median strip is a communications coaxial cable. Baltimore, Maryland, and Montreal,

Quebec, today have beneath their streets utilidors shared by various utilities. The Department of Defense uses utilidors in areas of extreme cold to reduce operating and maintenance problems. But, other than the recent coordinated efforts of electric and telephone utilities to share joint trenches for underground distribution conductors, simultaneous and deliberate joint planning programs by public service companies have been unusual.

In 1965, following the White House Conference on Natural Beauty, the Committee on the Underground Installation of Utilities concluded:

Because other utility services are involved, such as communication, gas, water, and sewer, encouragement should be given to the joint use of rights-of-way, either existing (such as transportation) or entirely new ones. The panel recommends that utilities explore the possibilities of greater coordination of the joint use of rights-of-way and common trench for such service.

The major publication of the President's Council on Recreation and Natural Beauty, From Sea to Shining Sea, stated:

> Whenever possible, public utilities [should] use combined or adjacent rights-of-way for overhead and underground lines.

Similar language was included in the report of the Electric Utility Task Force on Environment, which provided:

> Environmental objections to conventional transmission facilities can be reduced through careful route selection and advanced techniques in clearing and construction in forested and scenic areas. Routes can be selected which are both functional and unobtrusive. It is often possible to avoid the creation of new rights-of-way already used by the utility, or by some other right-of-way user, as recommended by the White House Conference on Natural Beauty.

And, the Report of the Working Committee on Utilities of the President's

Council on Recreation and Natural Beauty stated:

> Rights-of-way should be selected with the purpose of minimizing conflict between the rights-of-way and present and foreseeable uses of land on which they are to be located. To this end, existing rights-of-way should be given priority as the locations for additions to existing transmission facilities, and the joint use of existing rights-of-way by different kinds of transmission facilities should be considered.

Each of these reports expressly honored the value of multiple use of right-of-way. But it is noteworthy that none of the reports sets forth specifically the means by which the objective of multiple use should be accomplished. And it is this problem - the specific procedures to encourage multiple use - which I believe must be tackled forthrightly if the worthy objective of multiple use is to become more than simply a hollow platitude.

I would hope that the import of this Conference would be to impress upon each of you, as well as on public service companies generally, that the traditional right of way acquisition and planning practices are outmoded, that there must be a broadening of perspective and that much of the answer lies in multiple use of rights-of-way.

I believe that the overriding issue to which this Conference should address itself is how to put multiple use of right-of-way into practice as a relevant ingredient of comprehensive land use planning for the future. How, specifically, can this philosophical commitment be implemented by practical and effective means?

We have seen recently an excellent example of the coalescence of philosophical commitment and practical implementation in the efforts of many electric and telephone utilities to plan jointly the underground installation of distribution facilities to new residential subdivisions. Obvious cost benefits, as well as public and regulatory pressures, were catalysts in overcoming a variety of difficult

barriers to multiple use. The successful efforts of these distribution utilities at the local level should serve as an example of operating procedures to be emulated by public service companies generally in multiple use planning efforts at the regional level.

We know from experience that as the Nation 's population increases, the overflow from metropolitan areas will gravitate to open areas. Sociologists, urbanologists, and others can predict with remarkable accuracy the expected centralization of population over a period of years. With equally remarkable accuracy, ecologists and others can predict the impact of this growth on the environmental and ecologic values of these emerging population centers. Given the predicate of intelligent land use planning, transportation, water, sewer, and other essential services can be made available to those who inhabit these areas with minimal disruption and maximum benefit to ecologic values.

I believe that similar planning provisions should be made for the routing of power, pipeline, and communications facilities. The very large number of these facilities which will be constructed to meet the projected energy and communications requirements of the future can no longer permit passivity and tolerance by regional planners and other public policy-makers. Rights-of-way for the transmission of energy and communications must be planned simultaneously with the development of comprehensive regional plans. And the most prudent acquistion of land for these purposes may well be the establishment of energy corridors, or perhaps even combination energy-transportation corridors, embracing highway and other public service facilities appropriate distances from each other.

In examining several of the statutes delegating authority to the Department of Housing and Urban Development, one sees an unexplained absence of attention to energy and communications facilities and to the role of these facilities in the development of comprehensive regional plans. This, I believe, has been symptomatic of regional planning generally, until the recent emphasis which public concern

has placed on the routing of utility rights-of-way.

In my opinion there should be a re-examination of the HUD laws and procedures insofar as they exclude communications and energy facilities from the purview of comprehensive regional planning. If the consideration of these facilities in comprehensive regional plans should require amendatory legislation by the Congress, then I urge that action be taken so that the HUD laws are appropriately amended. In any event, I believe that HUD, within its existing legislative authority, should immediately begin to take cognizance of the importance of energy and communications facilities on the Department's regional planning functions.

Multiple use of public service facilities within regional plans should mean more than just the joint use of rights-of-way by several public service companies. It should mean the use of rights-of-way for any of a multiplicity of purposes, such as riding, hiking, and bicycle trails, parkland, and other recreational uses.

One instance of multiple use which has recently come to public attention is the proposal submitted to HUD by the Metropolitan Dade County Planning Department and the Florida Power & Light Company to use an electric power transmission right-of-way as a linear park joining several widely separated neighborhoods. This is an imaginative example of applying the inherent resources of rights-of-way to create social values rather than simply to serve them. I would hope that as time passes we will begin to pursue this objective more regularly.

Just as the routing of highways, if properly planned, can yield collateral benefits to the integrity of a community, the routing of utility rights-of-way could do the same. Historically, pipeline, communications, and power facilities have followed urban, suburban, and rural population growth in this Nation. These facilities have been routed to places where the population has moved and grown.

But, I believe that effective planning of public service rights-of-way should not simply follow progress, but should stimulate it. Comprehensive planning which seeks to place these facilities in the most propitious locations for the development of population centers could indeed be a major step toward coalescing a multitude of social and environmental values to the collective betterment of burgeoning urban areas. And the role that regulatory and other governmental agencies could plan in inducing private investment to follow well-planned comprehensive regional development could go far in eliminating many of today's planning problems.

Underlying the efficacy of comprehensive regional planning, which must embrace the multiple use of public service rights-of-way, is the need to replace the practices which no longer satisfy today's standards and values. I believe that the central theme of one aspect of effective regional planning must be the early acquisition and withdrawal of land for electric generating plants and public service rights-of-way. This is a matter of urgency in congested areas. Such early acquisition of land could be done by private consortia, public bodies, or quasi-public bodies. The form of acquistion could be easily determined once the philosophical commitment is made.

Sophisticated concepts and methods which could be applied in determining advantageous routes and sites for public service facilities have been and are continuing to be developed. These methods could serve as the bases upon which corridors for public service facilities are planned and reserved. One method of planning corridors for public service facilities might be adapted from Professor Ian L. McHarg's fascinating and comprehensive work, Design With Nature. This method, as well as others, seeks to apply ecology to actual environments and to pinpoint areas of minimal offensiveness to ecologic values. Professor McHarg postulates a means to maximize social benefit and minimize social cost in planning rights-of-way. He speaks of a principle of "maximum social

utility," a concept well worth the attention of rights-of-way planners.

But valuable contributions such as Professor McHarg's can be of benefit only if they are studies and tested objectively. The time is past when public service management could dismiss such works out of hand as "intellectual" or "professional." Today, these qualities may well provide the essential means for the Nation to extricate itself from the growing crisis in environment. Indeed, the problems of public service management in seeking satisfactory rights-of-way require a combination of both the intellectual and the practical if a solution is soon to be found.

The burden of making the multiple use of the rights-of-way a common practice is thus widely distributed. Management, technicians, conservationists, government, each share the onus of re-examining unrewarding past practices. An open exchange of rights-of-way plans is essential. A forum for public participation in comprehensive planning is required. What has been planned covertly must be planned overtly. New techniques must be forged. A new perspective must be born. Natural antipathies among competing disciplines must be stifled. The robust challenge of cooperation must take hold.

MULTIPLE USE OF RIGHTS-OF-WAY BY PIPELINES , May, 1970
By Frank J. Stastny, Commonwealth Associated, Inc. Jackson, Michigan

Any company engaged in the transportation industry needs a right-of-way on which to install its facilities. These facilities may be pipelines, cables and wires, roads, tracks or any other means which transport people, goods or energy from one place to another. The joint use of rights-of-way by these facilities can be divided into two general land areas - urban and rural - each presenting separate and distinct problems.

How new is this idea of multiple use of rights-of-way. We all are aware of urban areas where sewer lines, water lines, gas lines, electric cables, telephone cables and steam lines are installed above and beneath city streets and/or within easement strips along the rear of abutting lot lines.

All of us, at one time or another, have driven in the country and have seen power and telephone lines installed within the highway right-of-way. Some of us can remebmer riding in passenger trains and watching poles seemingly zip by the windows. These telegraph and telephone lines are installed on railroad right-of-way.

What most of us do not realize, however, is that in these same rural areas, pipeline facilities share the same right-of-way with the highway or railroad. Generally, the pipeline facilities cross under the highway or railroad, but there are places where the pipelines have parallel occupancy. For the foregoing, it is apparent that the idea of multiple use of rights-of-way is not "new", especially in urban areas.

The type of pipeline facility is as important as the land use when discussing the sharing of rights-of-way. Transmission pipelines carry a product from the source of availability to the point of usage, regardless of the produce carried. These transmission pipelines, for the most part, traverse rural areas. The distribution pipelines are the old ones best known to the public since they bring water, gas or oil into the house. Gathering system pipelines can be found in both rural and urban areas. Products gathered are crude oil, natural gas, sanitary sewage and storm water. Pressures range between atmospheric and 1000 psig or more.

Need Slight in Rural Areas

The need for joint use of rights-of-way in rural areas is slight, especially from the pipeline company's point of view for these reasons:

1. The route the pipelines traverse from source to point of usage does not coincide with the route of any other mode of transportation.

2. Pipelines want space to expand their system capacity by constructing parallel pipelines. They do not want any artificial restrictions.

Transmission pipeline facilities in urban and suburban areas is another matter. The tremendous population growth in the past 25 years has caused the urban and suburban areas to expand rapidly with respect to both space and time. Within the past 5 years, some transmission pipelines which originally were located in rural areas find they are in the middle of populated areas. Future expansion of the pipeline facilties is, therefore, seriously restricted.

Distribution pipeline systems are located within urban areas and are franchised by local governmental agencies. By virtue of these franchises, the pipeline systems may be and usually are installed within public rights-of-way - streets, alleys and dedicated easements. Sanitary and storm sewer systems are noramlly owned by a local government or governmental agency and these facilities are usually located within public streets and alleys. There are instances, however, where these facilities are installed in private rights-of-way.

Most transmission pipeline companies currently do not permit parallel occupancy of their right-of-way by other users. This parallel occupancy by other facilities would limit the space available for expansion of the pipeline system. Additionally, the parallel occupancy by others might hamper proper maintenance and the existing pipeline facilities. Right-of-way easements obtained by transmission pipeline companies usually grant the companies the right to lay additional pipelines in the same right-of-way. Thus, the companies guarantee that they can expand their system deliverability by installing parallel pipelines.

Although pipeline companies do not usually permit parallel encroachment, the crossing of their facilities is common place. The only restriction in these cases is the vertical clearance requirements between the facilities, which is normally one foot. Other reasons why pipeline companies do not permit parallel encroachment are safe operation and corrosion which will be discussed later.

Rails Discourage Dual Usuage

Railroads generally discourage parallel occupancy of their rights-of-way by pipelines. The reasons for this are not difficult to understand, since pipelines compete against railroads in the transportation of products, specifically crude oil, refined petroleum products, fertilizers and to a lesser degree, coal and chemicals. Some of the restrictions which tend to discourage such parallel occupancy are:

1. The vertical distance required between the top of pipe and bottom of rail:
2. The location of shutoff valves.

Other reasons which discourage pipelines from utilizing railroad rights-of-way are:

1. The cuts and fills required to maintain railroad grades, limit the working space available for pipeline construction;
2. The length of a pipeline laid within railroad right-of-way between two points is often greater than the pipeline would be if it were laid in its own right-of-way.

Pipelines have been installed within railroad right-of-way in the past and more will be installed in the future. Some instances occur when the railroad and pipeline are owned by the same interests; where thereis no other feasible location, as in densely populated areas; or when the pipeline and railroad are forced to by outside interests.

The Interstate Highway program has had a great impact upon the entire nation, providing the trucking industry and the travelling public an excellent system of highways between population centers. The widths of the right-of-way for these interstate highways, especially in rural areas where they are anywhere from 200 to 400 feet wide, seemingly provide an ideal situation for multiple use of rights-of-way. Actually, this is not the case. The following restrictions on locating utilities on Interstate highway rights-of-way are those with which I am familiar and apply to the states of Illinois, Missouri, Arkansas, Louisiana and Texas. Although my remarks pertain specifically to pipelines, the restrictions also apply to other utility facilities.

For parallel installations, pipelines may be installed in a strip 5 feet wide adjacent to a right-of-way line. Access to this strip for either construction or maintenance is only from service roads or private property, except for emergencies which endanger the motoring public. Since all interstate highways, do not have service roads, access to the pipeline facilities in these instances must be across private property. Generally, there is very little difference to the private property owner if he sells a pipeline company an easement for a pipeline or if he sells an easement for construction and maintenace access to the pipeline facilities because the damage to his property is caused by the equipment and not the pipeline itself. In urban areas, the pavement of the interstate highways extend, for the most part, across the entire right-of-way. This condition prohibits, for all practical purposes, the parallel installation of pipeline facilities within the highway right-of-way.

As yet, the need for joint use of rights-of-way in rural areas is not acute. The reasons for this are: pipelines do not traverse the same route as do other modes of transportation; pipelines do want the capability of expanding their system capacities by constructing additional pipelines adjacent to their present facilities; and,

as yet, right-of-way costs have not increased proportionately faster than other construction costs.

In urban areas, the situation is different. Land costs are soaring - ask any prospective home buyer. However, the bulk of the pipeline miles in urban areas is a part of the distribution system which are installed in public streets or dedicated easements. With the population spreading out around the central city, transmission gas pipelines are having to traverse these areas to reach the delivery points to the utilities. Oil and product lines, which once reached outlying tank farms or marine terminals without traversing populated areas, find that this is not longer true.

Right-of-way costs in urban areas increase as rapidly as do land costs. Also, multiple line rights are practically impossible to obtain. Further, maintenance costs in urban areas are far costlier than in rural areas.

Joint Use Needed in Urban Areas

These economic factors are causing pipeline companies to look at the possibiliites of joint use of rights-of-way in urban areas. Zoning Commissions are becoming more and more important in establishing the land usage in and around populated areas. Also, urban renewal programs are currently changing the faces of many of our cities. While establishing plans for the present and future use of the lands in and near our cities, the people responsible for the zoning and for the redevelopment should and must take into account the requirements of the varous transportation corridors or other similar reserved areas, which could accommodate the various transportation facilities.

Some of the problems connected with the multiple use of rights-of-way are safety, corrosion, future expansion and governmental directives.

The safe operation of their facilities is a prime consideration of each and every transportation company, regardless of the specific method used in transporting people, products or energy. Although each industry is aware of the problems involved with operating their facilities in a safe manner, they usually know very little about the safe operation of the facilities of the other industries. In fact it is possible that misinformation of the operation of other facilities is more prevalent, and will be more difficult to overcome than is the lack of information. Each company would want some assurance that its facilities would not be jeopardized in any way by the operations of the faciliites of others.

Pipelines are protected against corrosion by various methods. When other facilities are installed on a common right-of-way, the effect these facilities have on the cathodic protection the pipelines provide must be known, and the effect on the test devices pipelines use to determine the adequacy of this protection must be known.

Expansion of facilities located in a joint right-of-way is a serious consideration. Establishing which company has priority to expand its facilities, how these facilities should be expanded and the locations within the right-of-way all must be resolved. Governmental agencies are becoming more and more involved in establishing construction and operation practices. Up until recently, the ICC and the FPC were the Federal government agencies concerned with interstate pipeline companies. Now DOT is also concerned with interstate pipeline construction and operation. Public Utility Commissions or other similar state agencies are involved in authorizing the construction of intrastate pipelines and in establishing the rules to insure their safe operation.

Recently, the FPC has also established rules governing the design and construction of natural gas pipelines in the Gulf of Mexico. These rules have resulted in some companies abandoning or postponing

projects. In several cases these rules have resulted in companies combining forces in joint pipeline ventures.

Multiple use of rights-of-way does not present any insurmountable technical problems. Realistically, however, we must recognize that in conjunction with technical feasibility. Only after assessing all these factors can a decision be made in favor of, or against, joint use.

ENVIRONMENTAL IMPACT POLICY

STATEMENT OF PROCESS DRAFT BY NEW SOUTH WALES STATE GOVERNMENT

January 11, 1973

1. The State Pollution Control Commission has the task of ensuring through its own Act or any other Act, that all practical measurers are taken to control pollution, control the disposal of waste, to protect the environment from harm and to co-ordinate such activities by other public authorities.

2. To carry out this task the Commission has the responsibility to set standards or ensure that adequate standards are set and applied.

3. The Government's new comprehensive environment policy is made up of two distinct elements:

a) Strengthening the powers and responsibilities of individual Ministers and authorities to control pollution and prevent degradation of the environment;

b) combining the above traditional method of government administration with a completely new approach based on the "total environment" concept in order to make a comprehensive and co-ordinated attack on these problems.

4. In line with this policy, adequate attention must be given in planning a major project to its impact on the environment.

5. The responsibility for ensuring the necessary study to determine environmental impact is undertaken is one for the decision-making authority.

6. Every such project when approved must include adequate safeguards to prevent pollution and protect the environment.

7. Every environmental impact study for a major project will be made available for public inspection and must include the following:

a) A statement of the major objective sought by the proposed project.

b) An analysis of the technological possibilities of achieving the objective.

c) A statement of the alternative plans considered to be practical ways of reaching the objective.

d) A statement of the characteristics and conditions of the existing environment prior to implementing the project.

e) A separate report on each alternative engineering plan considered to be a practical way of reaching the objective. (These plans ordinarily will have analyses of monetary benefits and costs.)

f) For each plan, an assessment of its probable impacts on the existing environment.

g) A summary or recommendation, which would include the rationale supporting the selected plan.

8. The decision-making authority will continue to utilise the services of other authorities with special expertise or jurisdiction in considering environmental impact.

9. The study will be utilised:

a) by the decision-making authority -

i) in conjunction with economic or other studies in deciding upon the project;

ii) in determining environmental safe-guards to be included in the project;

b) by the State Pollution Control Commission in any necessary review of environmental safe-guards; and

c) by the Premier in considering any dispute.

10. The State Pollution Constrol Commission will normally be involved in major projects only --

a) where it is required to arbitrate on disputes on the environmental considerations; and/or

b) where the environmental issues are of major consequence or highly controversial.

11. In making its decision, the State Pollution Control Commission (constituted with a majority of non-government members) will approach the projects from the broad community viewpoint.

12. A common approach by all public authorities to environmental studies would be desirable in view of their multiple use. In drawing up the detailed assessment of the environmental impacts a standardized procedure is essential.

13. In action of lesser or minor environmental significance, the philosophy embodied in the above statement of principles should extend down to the grass-roots level of Government activity.

Possible Actions and Existing Characteristics and Conditions of the Environment to be Considered in Assessing Environmental Impact

Actions which may Cause Environmental Impact

1. Siting of Facilities
2. Land Clearing
3. Burning
4. Blasting

5. Earthworks:
   Cutting and filling, excavating, filling, drilling, etc.

6. Underground Works:
   Tunnels, wells, piling, pipelines, cables, conduits, tanks, structures, etc.

7. Waterworks:
   Dams, impoundments, weirs, canals, channels, irrigation works, drainage works, sea walls, aquatic structures, piling, submarine pipelines and cables, etc.; alteration of river banks and shorelines; alteration of ground water hydrology; diversion of existing watercourses; control or modification of river flow; etc.

8. Aboveground Works:
   Buildings, structures, bridges, processing plant, railways, pipelines, tanks, telephone and power lines, conveyors, etc.

9. Dredging

10. Filling of wetlands

11. Impervious Areas:
    Roads, pavements, airstrips, parking areas, etc.

12. Barriers:
    Fences, walls, ditches, etc.

13. Signs and Hoardings.

14. Stockpiling of materials.

15. Handling of materials

16. Emissions to Atmosphere;
    Smoke, grits, dusts, chemicals, gases, acids, hydrocarbons, fumes, odours, etc.

17. Effluents to Waterways:
    Raw or partially treated sewage; decomposable organic matter; toxic materials such as acids, alkalis, salts of heavy metals, chemicals, phenols, cyanides, etc.; disease producing micro-organisms; radio-active wastes; brines; fats, oils and greases; water treatment wastes; sediments; litter; fertilizers; animal wastes; run-off from agricultural lands; detergents; mine drainage and mineral washings; wastes from watercraft; run-off from roads; cooling water return; irrigation return; leachate from dumps and waste disposal areas; etc.

18. Wastes Desposed on Land:
    Solid and liquid industrial wastes, domestic garbage, tailings, slag, spoil, junk, etc.; plus many of the items listed in 17. above.

19. Generation of Traffic:
    Road, rail, air, sea and waterway.

20. Artificial lighting

21. Communications

22. Noise and Vibration

23. Extraction of resources
Water, minerals, timber, raw materials, etc.

24. Renewal of Resources:
Re-planting of natural areas; re-establishing of land-form; stocking of native fauna; re-charge of ground water; re-cycling of wastes; re-afforestation, etc.

25. Development of Resources:
Introduction of flora and fauna; improving soil productivity; improving marine productivity; etc.

26. Protection of Resources:
Erosion control; soil conservation; flood control; water conservation; etc.

27. Preservation -
of existing resources, features of species.

28. Landscaping:
Planting; construction of features; beautification; etc.

29. Amenities Provided:
Facilities for active or passive recreation; access to features or areas; etc.

30. Fishing:
Commercial and amateur.

31. Hunting:
Commercial and amateur.

32. Pleasure Boating

33. Use by Man:
Swimming, camping, hiking, picnicking, sports, etc.

34. Accidents:
Operational failures; spills and leaks, explosions; etc.

Characteristics and Conditions of the Environment

1. Earth

a) land form

b) reserves of raw materials

c) reserves of minerals

d) productive quality of soils

e) structural stability of soils

f) erosion of soils

g) salinity of soils

h) deposition on land

i) dereliction of land
j) flooding
k) wetlands
l) fields of force
m) radiation background

2. Water
a) quality of surface water
b) quantity of surface water
c) quality of underground water
d) quantity of underground water
e) quality of estuarine and ocean water
f) water temperature
g) siltation of waterways
h) quality of drinking water
i) quantity of drinking water
j) eutrophication

3. Atmosphere
a) air quality
b) air temperature
c) climate
d) air movements
e) rainfall, snow and ice

4. Flora
a) trees
b) shrubs
c) grass
d) crops
e) microflora
f) aquatic plants
g) unique or rare species
h) forests
i) barriers
j) corridors

5. Fauna
   a) birds
   b) land animals including reptiles
   c) fish and shellfish
   d) benthic organisms
   e) insects
   f) microfauna
   g) endangered species
   h) barriers
   i) corridors

6. Land Use
   a) for grazing
   b) for agriculture
   c) for residential development
   d) for commercial development
   e) for industrial development
   f) for mining and quarrying
   g) for passive recreation
   h) for active recreation
   i) as a resourt area

7. Recreation
   a) hunting
   b) fishing
   c) boating
   d) swimming
   e) sporting activities
   f) camping
   g) hiking
   h) picnicking

8. Aesthetics
   a) scenic views and vistas
   b) natural bushland

c) open space
d) landscape design
e) unique or rare physical features
f) parks and reserves
g) playing fields
h) monuments
i) historical or archaeological sites and objects
j) visual pollution

9. Amenity
a) personal comfort
b) human health
c) human safety
d) employment
e) population density

10. Ecological Relationships
a) ecosystem structure and function
b) nutrient cycling
c) disease - insect vectors and introduced hosts
d) energy flow and food chains
e) synergistic effects

11. Man-made Facilities
a) buildings and structures
b) transportation systems
c) utilities distribution systems
d) communication systems
e) processing plants

Use of the Matrix

New South Wales' Environmental Impact Policy favours the preparation of an Environmental Impact Matrix as generally outline in United States Geological Survey Circular 645 - A Procedure for Evaluating Environmental Impact (1971). Essentially, this is an analysis of the interactions between proposed actions which may cause environmental impact and the existing characteristics and conditions of the environment. It helps to identify the variety of interactions and implications involved in environmental planning. A large matrix with 8,800 possible interactions between causal factors such as Modification of Regime, Land Transformation and Construction, Resource Extraction, Industrial Processing, Changes in Traffic and Waste Replacement and Treatment are assessed with respect to their effect on environmental factors such as Physical and Chemical Characteristics, Biological Conditions, Ecological Relationships and Cultural Factors. The Matrix is reproduced in Figure below.

By expanding the details of the individual causal and environmental factors, a reduced matrix focussing on the essential relationships involved in a specific project can be attained.

The original test suggests quantifying the interactions by estimating separately the magnitude and the importance of each of the interactions on a scale of 1 to 10. In reviewing the applicability of the technique to New South Wales, it appears that a simpler ranking system based on low, moderate or high probability (or 1, 2, 3) as to the extent of impact should be utilized initially with possible improvements and revisions open to suggestion.

It must be emphasised the the Environmental Impact Matrix is an integral part of the total input of the Environmental Impact Statement as outlined in Part 7. It should be clearly understood that the matrix is an essentially graphic device for expressing professional and technical judgement in a clear and explicit way. It is not a

substitute for an Environmental Impact Statement; it is a checklist for, not a replacement of, the explanatory text.

An alternative approach to the methodology outline in U.S.G.S. Circular 645 has been devised for the coastal areas of California. The Stepped Matrix, as illustrated by Sorensen in A Framework for Identification and Control of Resource Degradation and Conflict in the Multiple use of the Coastal Zone, focuses on 55 individual Resource Uses divided into four major groups:

- Residential, Commercial and Agricultural;
- Recreational;
- Extractive;
- Transportational, Industrial.

The alterations or Causal Factors directly associated with the uses are assessed with reference to their Possible Adverse Impacts which are delineated as to Initial Conditions, Consequent Conditions and long-term Effects. Further reference to associated Corrective Actions or Control Mechanisms and a Reference Index for agencies responsible for control or bibliographical lists may also be included in the matrix.

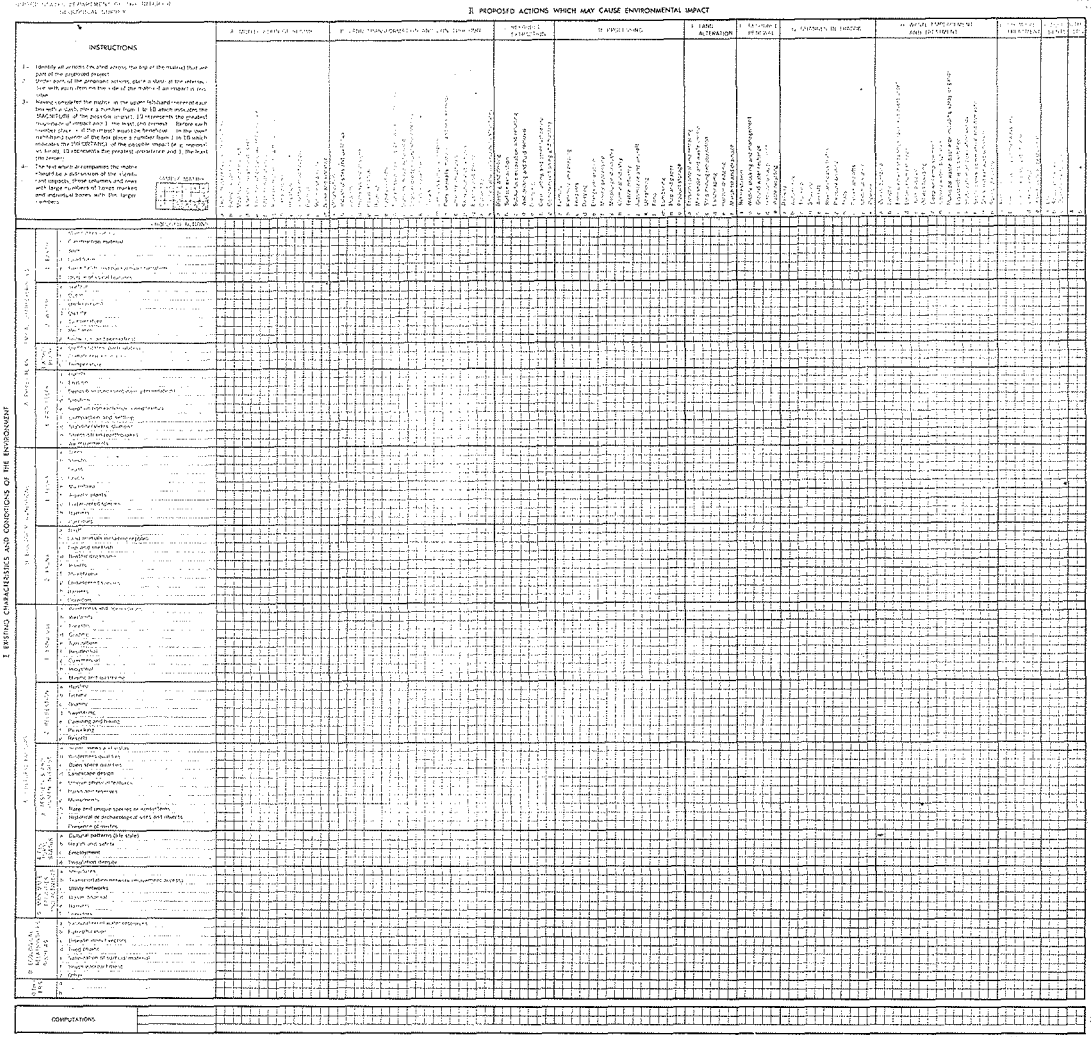
The components of the Possible Adverse Impact, Corrective Action and Reference Index sections of the matrix are numbered into hierarchical classifications with related subsections.

This type of stepped matrix permits some consideration of the cumulative effect of Causal Factors and detailed cross-referencing of Impact Conditions, Causal Effects, Corrective Actions and the details of the Reference Index. Ultimately, computerized data storage and retrieval, printouts of relationshps between various Uses, Causal Factors and Conditions and displays of composite matrices could be obtained. As suggested by the author "the framework does not presume to be able to answer many questions by direct information, but indirectly by way of reference to examples where nearly identical conditions were encountered, the resulting consequences and the corrective

actions taken."

This methodology and format are adaptable to specific projects and their associated environmental impact. IT provides a detailed check list of Possible Adverse Impacts and reference to possible corrective measures and information sources.

Other approaches to the matrix format are possible and it is anticipated that experience in preparation of Environmental Impact Statemetns in New South Wales will provide a matrix format in agreement with New South Wales Environmental Impact Policy objectives. It is intended that the matrix format should remain flexible and that the nature and scope of the project, the associated environmental conditions, and the possible adverse effects will dictate the methodology and format used.


II. PROPOSED ACTIONS WHICH MAY CAUSE ENVIRONMENTAL IMPACT
INSTRUCTIONS
I. PHYSICAL CHARACTERISTICS AND CONDITIONS OF THE ENVIRONMENT
COMPUTATIONS
INFORMATION MATRIX FOR ENVIRONMENTAL IMPACT ASSESSMENT

Guide to Significant Environmental Effects

Water

Resource Utilisation	Possible Environmental Effects
Fishery and other components of the biotic system	1) Changes in water temperature, pH, changes in levels of dissolved oxygen, trace minerals, toxic chemicals, nutrients and organic matter. 2) Silting
Domestic water supply and recreational and industrial uses requiring high quality water	1) Changes in water temperature and levels of dissolved oxygen. 2) Changes in the range of tolerances, related to resource use, of trace minerals, pH, toxic chemicals and nutrients.
Irrigation and industrial cooling	Changes in levels of dissolved salts and toxic materials, water temperature.

Air

Resource Utilisation	Possible Environmental Effects
1) Human health protection 2) Natural biosystem protection 3) Materials protection 4) Aesthetic protection	Changes in the level and combinations of oxides of sulphur, nitrogen and carbon, hydrocarbon, photochemical oxidents and particulate matter when compared with the ambient air.

Land

Resource Utilisation	Possible Environmental Effects
Land utilisation for residential, industrial, recreational, and educational purposes and scientific study	Man-induced changes in species composition, biomass, food chains, habitat conditions, predator-prey relationships and population dynamics.
Limited modifications to land utilisation to produce specific goods or services	Changes in - 1) Plant and animal species composition 2) Habitat for preferred species 3) Wildlife populations

Major modification to maximise output of a particular product or use	1) Large scale vegetative conversions 2) Major change of habitat for preferred species 3) Visual impact on a gross scale

Visual and Noise

Resource Utilisation	Possible Environmental Effects
Visual and aesthetic environments as related to recreational, residential and tourist purposes	1) Capacity for direct sensory involvement 2) Natural dominance of form, scale and proportion 3) Vividness, image creation and continuity
Cultural, historical and informational values for recreation and educational purposes	1) Unique, archetypal, rare or transitory artifacts. 2) Locations relative to the environmental context.
Personal and social experiences- crowding development, noise, etc.	1) Interaction with ambient environment. 2) Intrusion of man-made structures and facilities. 3) Changes in ambient noise level.
Natural, biological and physical features	1) Unique or dramatic landforms or features 2) Capacity for orientation as with landmarks 3) Rare or especially archetypal geological formations.

ENVIRONMENT, ECONOMICS, AND ELECTRIC UTILITY RIGHTS-OF-WAY

by H.J. Young and R.S. Thorsell, Edison Electric Institute, October, 1970

"Environment" has taken on some of the qualities of Mark Twain's "weather" everyone talks about it, but no one does anything about it. Economics, of course, is one of the hardest words to define in language. It has been called everything from "the dismal science" to "the mathematics of politics." Finally, we have "rights-of-way". That seems straightforward enough; but when we try to talk about rights-of-way in terms of value, we find, almost immediately that the value is in the eye of the beholder. And every eye of every beholder is different.

The thousands of miles of transmission line rights-of-way in this country are considered by some to be an eyesore, by some to be a prostitution of land use, by some to be a prime example of a deteriorating environment, and by others to be things of beauty. There is a substantial number of people, mostly in utility companies, who consider a high voltage transmission line on a well-planned right-of-way to be the culmination of a series of dramatic engineering achievements.

Obviously, what an electric transmission right-of-way means to one person may mean something different to someone else. Everyone enjoys the comforts of clean energy transmitted over these right-of-way, but most people are like the child who when asked where milk comes from, answered, "from the bottle." Electricity does not come from the wall switch. The number of people who really connect a right-of-way with the electricity they use is surely very small. For this reason, it is difficult, if not impossible, to establish the value of rights-of-way in social terms. A man with a power line running through his back lot is not thinking about the apartment dwellers using the energy being carried over the line. He is thinking about his view, or about the effect of the change the line

makes in his view on the dollar value of his land.

A number of electric utility companies have made evaluations to determine the effect, if any, that electric transmission lines have on the value of adjacent lands. These evaluations take the form of Land Economics Studies, which are analyses of the value of encumbered lands vs. unencumbered lands in the same general area.

Several years ago, the Committee on Environment of the Edison Electric Institute, realizing the increasingly difficult problem of obtaining rights-of-way, requested that a library of Land Economics Studies be compiled. This was done under the guidance of Mr. F.E. Manley, then President of Fitchburg Gas & Electric Light Company and Co-chairman of this committee of A.R.A. Twenty-seven Land Economic Studies and nine additional materials were accumulated. They were analyzed and published two years ago as Summaries: EEI Library of Land Economics Studies. Since the publication, more studies have been received. The studies indicate that an electric transmission line, in and of itself, does not affect the value of adjacent or near-by lands. This is true whether the lands were utilized for residential, commercial or industrial purposes. Further, electric transmission lines are compatible with adjacent land uses. In all cases, the evidence indicated that there are people willing to live, work and play near, around or underneath electric transmission lines. These people constitute a segment of the market large enough to maintain the value of adjacent or near-by lands. In addition, several studies indicated that some people prefer to live on contiguous property due to the spaciousness the right-of-way affords.

All over the country, electric utility companies are exploring multiple compatible uses of transmission rights-of-way which may result in a better environment for all - and the possibility of enhanced values to adjacent properties. Among these uses we find many forms: agriculture, almost limitless forms of recreation (from

snow mobiling to hiking, commercial uses, and just the blessing of open space.) At least 14 companies have programs to publicize and encourage the use of these areas.

Let us look at some examples:

Commonwealth Edison Company is serving scores of communities where land is scarce and at a premium by making 13,000 acres of its rights-of-way available for a variety of public and community uses.

Carolina Power & Light Company, as a matter of policy, puts farm land rights-of-way in condition for crop and pasture. In this way, the farmer gets a considerable benefit in addition to payment for the right-of-way.

Georgia Power Company has headed a cooperative program in which farmers are encouraged to plant designated crops, and in addition, has an active program encouraging the planting of crops to attract game birds and animals. Alabama Power Company has initiated a similar program.

Boston Edison Company provided a needed area for development of ski facilities where a portion of a transmission line is included in a golf driving range. The idea literally "got off the ground" with a 55 seat chair-lift located in the transmission right-of-way.

Southern California Edison Company is one of several putting acreage under transmission lines to productive use. The company has cut costs by leasing land under a number of its 220,000 volt lines. The land is used for tree farms which not only bring in money, but improve the appearance of the right-of-way.

Holyoke Water Power Company has planted tens of thousands of Christmas trees on over 70 acres of right-of-way. In a few years, when the trees mature, Holyoke will make them available free to local Boy

Scout groups which will be responsible for replacing them. (It is worth mentioning that the Christmas trees around the White House last year were provided by American Electric Power Company.)

Florida Power & Light Company is presently developing a plan with the Dade County Metro District to develop 4 miles of its right-of-way into a county linear park. This will be a cooperative effort between the County agency and will be partly subsidized by HUD funds.

The question we pose to you today is not whether it is possible to improve the dollar value of areas adjacent to a transmission line right-of-way by improving the attractiveness of the right-of-way itself, we are convinced it is. We recently completed a survey of 99 electric utility companies and found that about a quarter of them are making rights-of-way available for public use. There have been studies which have indicated that land adjacent to or near parks is enhanced in value. We know from experience that values of land adjacent to certain kinds of recreational or open-space areas go up in value. Should it not be possible to develop economic measures of the increase in values of land next to rights-of-way available for uses compatible with the supply of electricity? The question we pose is whether it is possible to predict with any accuracy what the economic improvement of various approaches might be.

This question takes on more than academic interest in the general context of the power supply picture across the nation. EEI has recently made a survey of the reasons for delays in high voltage transmission line (230 kv and above) construction. Late delivery of equipment, shortage of construction labor, and strikes have been the principal factors in delaying completion of these lines. Inability to acquire rights-of-way was also a major contributory factor. Without wishing to over-emphasize the importance of this last factor, it should be noted that most people agree that difficulties in attaining rights-of-way would be eased if the owners of property could be assured that their land values would go up, not down.

The examples of utility practice have been cited for three reasons. First, to make clear that with some innovative thinking and a little flexibility it is possible to develop a variety of compatible uses of utility rights-of-way. Some companies have made multiple-use of rights-of-way a firm part of their company policy.

The second reason is to indicate that multiple uses of rights-of-way have multiple benefits: public relations and economics. Company acreage can be enhanced in value when the concept is applied successfully. And many of the uses that can be developed will reduce maintenance costs measurably.

The third reason for mentioning these specific cases - and many, many more could be cited - is to underline the fact that we have no real economic measure of their benefit. In almost every case, the company in question will say that multiple use led to easier acquisition of the right-of-way or that it has provided easier acceptance by neighbors. In some cases, dollar income from rent or sale of products can be shown - but certainly these are only marginal portions of the economic picture. During this period of history, when so much attention is being given to environmental questions, it would seem of interest to attempt to quantify certain environmental values in economic terms. Attempts are being made to do this kind of thing in relation to resource development, air quality, and water quality. Is it not time the same kinds of questions should be raised concerning land?

It seems an odd fact that the dollar value of land has always been readily available, but that the value of the components of the whole - the esthetic component for example - has been difficult to define. We need to develop more sophistication if our land use decisions are to have validity.

We can look forward to a day when the concept of transmission rights-of-way will convey pictures of recreation areas, of open space,

and of other delights in the human experience - not just alleys of ugly towers. When this day comes, people will understand that transmission rights-of-way may enhance adjacent property values, not just leave them in balance.

This is a challenge for people concerned with the economics of rights-of-way. It is a challenge for the members of this Association. At EEI we are interested in exploring these questions with you. We invite you to join us in trying to find the answers.

NEW ENVIRONMENT CONTROLS FOR ALBERTA

by Oilweek, August 14, 1972

Alberta pollution controls will get much more severe for the petroleum industry in the near future and will affect all segments of its operations.

This was the eight-point message from William Yurko, minister of the environment, to a luncheon meeting of the Petroleum Society of CIM in Calgary. There will also be increasing attention to possible allocation of all types of non-renewable resources, he warned. One of the provincial government's major preoccupations, he explained, is the strategic and overall management of these resources, most of which are owned in the public domain. The adequacy of this management program has a vital bearing on present and future posperity of Albertans and the government takes this task seriously, he asserted.

Yurko cited recent remarks by Premier Lougheed indicating that the Alberta government will never again be playing what has traditionally been a passive role. It considers industry as a constant partner in both short and long range planning, but as the industrial segment of

the partnership expands it will be followed closely by expansion of the government sector. This will include overall planning and direction to weld and channel diverse individual, industrial and public energies towards composite and desirable objectives.

The minister drew a picture of strategic planning for programmed development of the Athabasca tar sands. An over-expansionary rate of these vital resources can pose great difficulties of both a technological and human nature, he explained, so government will establish a predetermined development model which can be used as a guide to control both human and physical growth in the area. Many factors, such as the human, economic, political, technical and ecological components must be weighed and then woven into the overall development management plan.

Eight major guidelines will control all policy in energy resource management, Yurko stipulated.

1. The energy resource industry is one of the basic pillars of the Alberta economy. It must be maintained in a healthy and expanding state. The announced drilling incentives were designed to promote extension of marketable reserves, but there will be no subsidies to generate short term artificial economic conditions which cannot be sustained by the hard realities of the marketplace.

2. Since Albertans own most of the province's energy resources, the government is obligated to see that they receive a just share of the benefits from the sale and use of these resources - to the extent of $70 million more in 1973!

3. It is recognized that fossil fuel energy resources are finite and that their rate of production must be related to a long term scaled program of maximized benefits for the people of Alberta.

4. It is recognized that the developer of energy resources must be responsible, in awareness, sensitivity and related action,

towards minimizing the permanent or lasting impairment of the physical environment. This means a management program related to enlightened environmental practices.

5. Conservation practices must embrace the most current technological methods, resulting in the highest possible utilization factors.

6. Adequate resource allocation studies must generally precede single resource development, so that multiple development can be programmed through assigned priorities to promote the maximum possible overall benefits. As a result energy resources exploration may take second place to use of other resources, as in wilderness areas, most provincial parks, certain mountainous areas and even some lakes and wet land areas.

7. A vehicle must be provided for promotion of direct participation by Albertans in the development of the province's energy resources.

8. It is recognized that industry must measure its activities and performance in terms of a social balance sheet as well as the usual economic balance sheet.

Yurko concentrated his talk on only two of the eight items; the finite quality of resources and the management program. He noted that Alberta fossil fuel energy deliveries in 1965 amounted to 209 x 10 trillion btu. By 1971 they has more than doubled to 441 x 10 tcf, averaging the btu values of all fossil fuels. At an average two per cent per year rate of rise, the annual growth rate which was 19.5 per cent in 1971 would incrase to 25.5 per cent by 1975. Such a rate would shortly exhaust the known energy reserves available for export from Alberta after meeting its long term internal needs.

As the rate of energy deliveries reflect itself in subsequent exploration, production, transportation, human buildup and accidents such as oil spills, Yurko noted, it can be calculated that there will be increasingly deleterious effect on the environment, unless

new and more stringent controls are introduced. The government proposes to anticipate this requirement, instead of trying to remedy damage after it has occurred. Private as well as public costs will increase substantially just to maintain existing quality, he warned.

In the field of environmental management, the petroleum industry will face the almost immediately more stringent conservation practices, of which the E.R.C.B. has already given adequate notice. Overall responsibility for pollution control has been assigned responsibility for devising and administering the ways and means to ensure that the standards are met. It will continue to be the principal link with the industry.

During the next legislative session two additional Acts are expected to be passed. One will be the Coal Conservation Act and the other the Land Surface Conservation Act. The former will be handled by the board but the latter by the department, with emphasis on prevention of air, soil and water degradation.

There are several serious deficiencies, Yurko cautioned, although the petroleum industry generally has done a good job. Its oil spill contingency plan is far from adequate. It is under organized, under equipped and under prepared. The level of petroleum based compounds in most surface waters is rising. An increasing amount of surface water is required for enhanced recovery and requirements are forecast to rise from 280 million barrels in 1971 to 677 million in 1979, then dropping to 295 million in 1989. Distribution of sources can be critical.

Seismic exploration has resulted in clearing 648,314 acres of land and oil and gas development has taken 130,700 acres for a total of 779,014 acres. There is particular concern about erosion in the Swan Hills area, where remedial action will be required immediately at a cost of about $4 million. In future, Yurko said, marginal

projects will be looked at with concern and major projects will have to undergo environmental impact studies as a matter of policy.

Gas processing plants are of great concern and the department will collaborate with the E.R.C.B. deadline of Dec. 31, 1974 for complying with the new sulphur recovery guidelines. High priority is assigned to reviewing and improving all standards, monitoring and reporting requirements.

TAR SANDS ACTIVITY GUIDELINES COULD FOLLOW ENVIRONMENT STUDY
- Oilweek, December 11, 1972

Guidelines for Athabasca tar sands development will probably result from a major study program being conducted by the Alberta Department of the environment.

E.E. Kupchanko, director of the department's pollution control division, told a meeting of American Insititue of Plant Engineers in Calgary that the study emphasizes safeguards which will be required to protect the environment from tar sands pollution and potential environmental impact.

An extremely comprehensive range of subjects covers location, capacity and density of each potential development; priorities; optimizing long and short range development; air, water and land type and quality; the ecological, economic and political components; social and cultural aspects. The overall objective is a development control structure for the whole region, including examination of the time structure physical planning and manpower training.

Dealing with plants generally, including gas processing installations, Kupchanko said all application material will eventually become public documents. An effort is being made to set standards tough enough to last for a long time, but plants already in operation when standards are set up will be given time to adapt to them.

Odors from plants can be gauged only by public reaction, Kupchanko admitted, because there is no realistic way of measuring odors by sampling. Pipeline river crossings are difficult to standardize too. Every crossing is an individual critical matter, with special emphasis on water levels.

Tar sands pipelines will present some future problems of space. The government may have to consider setting up a corridor concept if successive plant projects come along at close intervals.

United States Department of the Interior - Rogers C.B. Morton, Secretary
Geological Survey V. E. McKelvey, Director
By Luna B. Leopold, Frank E. Clarke, Bruce B. Hanshaw, & James R. Balsley

A PROCEDURE FOR EVALUATING ENVIRONMENT IMPACT

GEOLOGICAL SURVEY CIRCULAR 645, 1971

Development of an action Program; Generalized Procedure

Evaluating the environmental impact of an action program or proposal is a late step in a series of events which can be outlined in the following manner. Figure 1 is a flow chart of the recommended sequence of events which result in an environmental impact statement. The sequence is discussed briefly below and that portion which deals with impact assessment is expanded in more detail later in the text:

A. A statement of the major objective sought by the proposed project.
B. The technologic possibilities of achieving the objective are analyzed.
C. One or more actions are proposed for achieving the stated objective. The alternative plans which were considered as practible ways of reaching the objective are spelled out in the proposal.
D. A report which details the characteristics and conditions of the existing environment prior to the proposed action is prepared. In some cases, this report may be incorporated as part of the

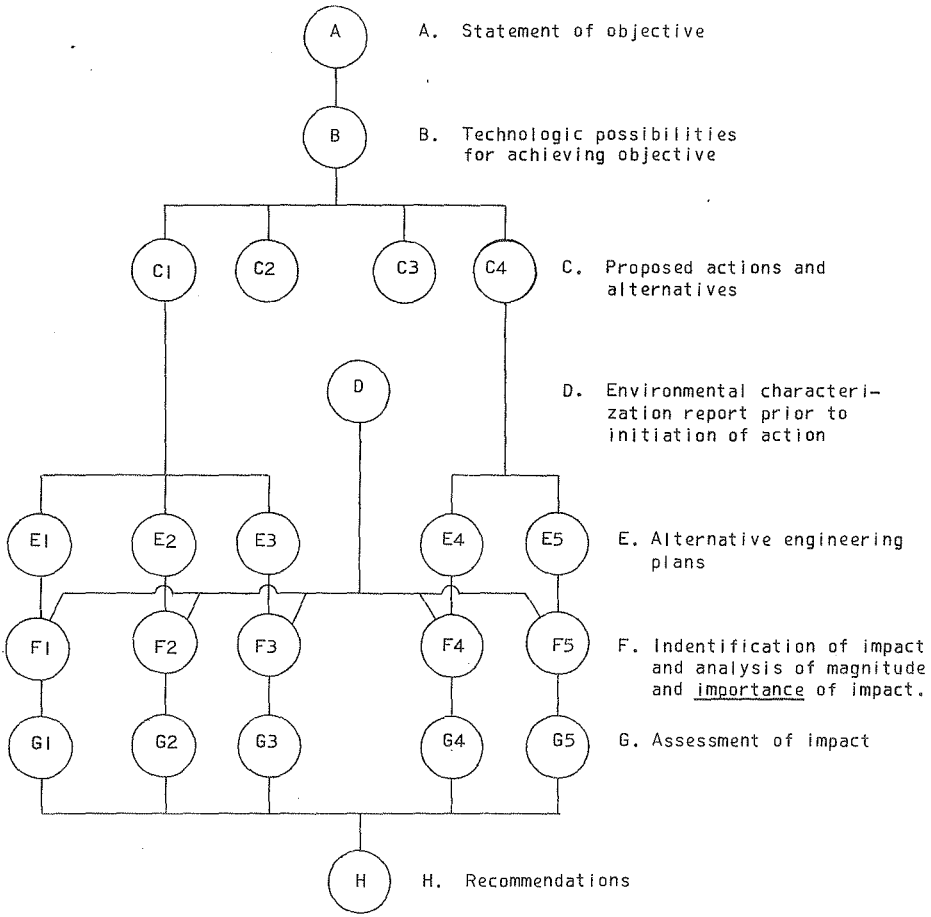


Figure 1. - Flow chart for development of action programs.

engineering proposal.

E. The principal engineering proposals are finalized as a report or series of separate reports, one for each plan. The plans ordinarily have analyses of monetary benefits and costs.

F. The proposed plan of action, usually the engineering report, together with the report characterizing the present environment, sets the stage for evaluating the environmental impact of the proposal. If alternative ways of reaching the objective are proposed in C and if alternative engineering plans are detailed in the engineering report, separate environmental impact analyses must deal with each alternative. If only one proposal is made in the engineering report, it is still necessary to evaluate environment impacts.

The environmental impact analyses require the definition of two aspects of each action which may have an impact on the environment. The first is the definition of the magnitute of the impact upon specific sectors of the environment. The term magnitude is used in the sense of degree, extensiveness, or scale. For example, highway development will alter or affect the existing drainage pattern and may thus have a large magnitude of impact on the drainage. The seond is a weighting of the degree of importance (i.e. significance) of the particular action on the environmental factor in the specific instance under analysis. Thus the overall importance of impact of a highway on a particular drainage pattern may be small because the highway is very short or because it will not interfere significantly with the drainage. Depending upon the thoroughness and scope of the report inventorying existing environmental conditions, the analysis of magnitude of impact, though in some details subjective, can nevertheless be factual and unbiased. It should not include weights which express preference or bias.

The importance of each specific environmental impact must include consideration of the consequences of changing the particular condition on other factors in the environment. Again, the adequacy of the report under D. would affect the objectivity in the assignment of the values for specific environmental conditions. Unlike magnitude of impact, which can be more readily evaluated on the basis of facts, evaluation of the importance of impact generally will be based on the value

judgment of the evaluator. The numerical values of magnitude and importance of impact reflect the best estimates of pertinence of each action.

G. The text of the environmental impact report should be an assessment of the impacts of the separate actions which comprise the project upon various factors of the environment and thus provide justification for the determinations presented in F. Each plan of action should be analyzed independently.

H. The Environmental Impact Statement should conclude with a summation and recommendations. This section should discuss the relative merits of the various proposed actions and alternative engineering plans and explain the rationale behind the final choice of action and the plan for achieving the stated objective.

Environmental Impact Statement

A complete environmental impact statement consists of four basic items;

1. A complete analysis of the need for the proposed action. This would include parts A,B, and C of the Generalized Procedures;

2. An informative description of the environment to be involved, including a careful consideration of the boundaries of a project. For example, every drainage crossed by a highway can be affected at that point of crossing but may also be affected downstream as well owing to erosion. Therefore, these effects beyond the right-of-way should be described in part D of the Generalized Procedures;

3. A discussion of the pertinent details of the proposed action -- part E of the Generalized Procedures;

4. An assessment of the probable impacts of the variety of specific aspects of the proposed action upon the variety of existing environmental elements and factors -- parts F and G of the Generalized Procedures -- and a summary or recommendation -- Part H -- which

would include the rationale supporting the selected plan of action.

The analysis of need, item (1) above, should be a justification which considers the full range of values to be derived, not simply the usual cost-benefit analysis. It should include a discussion of the overall objectives and of possible alternatives to meet them.

The characterization of the existing environment, item (2) above, should be a detailed description of the existing environmental elements and factors, with special emphasis on those rare or unique aspects, both good and bad, that might not be common to other similar areas. It should provide sufficient information to permit an objective evaluation of the environmental factors which could be affected by proposed actions. The description should include all the factors which together make up the ecosystem of the area. The vertical margin of the enclosed matrix can be used as a checklist in preparing this section.

The details of proposed action, item (3) above, should include discussion of possible alternative engineering methods or approaches to accomplish the proposed development (item 1). This should be done in sufficient detail so that all actions that may have impact upon the environment (item 2) can be checked. The horizontal margin of the matrix can be used as a checklist in preparing this section.

The environmental impact assessment, item (4) above, should consist of three basic elements:

a. A listing of the effects on the environment which would be caused by the proposed development, and an estimate of the magnitude of each.
b. An evaluation of the importance of each of these effects.
c. The combining of magnitude and importance estimates in terms of a summary evaluation.

In preparing this circular, it is not the intent to deal at length with items (1) through (3), and it is assumed that generalized procedures for their preparation are commonly followed since these items have been incorporated in many engineering feasibility studies and benefit-cost analyses of past projects. Rather, the primary intent is to focus on the new requirement and, therefore to address primarily the preparation of item (4) -- the environmental impact assessment.

Environmental Impact Assessment - Matrix

The analysis embodied in a,b, and c above is made with a matrix including on one axis the actions which cause environmental impact and on the other existing environmental conditions that might be affected. This provides a format for comprehensive review to remind the investigators of the variety of interactions that might be involved. It helps the planners to identify alternatives which might lessen impact. The number of actions listed horizontally in this sample matrix is 100 and the vertical list of environmental characteristics contains 88, which give a total of 8,800 possible interactions. Within such a matrix, only a few of the interactions would be likely to involve impacts of such magnitude and importance that they deserve comprehensive treatment. Although the items listed represent most of the basic actions and environmental factors likely to be involved in the full range of developments which require impact reporting, not all would apply to every project proposal encountered. However, the coding and format are designed for easy expansion to include additional items. Preliminary trials suggest that the number of applicable interactions for a typical project analysis usually will be between 25 and 50.

The most efficient way to use the matrix is to check each action (top horizontal list) which is likely to be involved significantly in the proposed project. Generally, only about a dozen actions will be important. Each of the actions thus checked is evaluated

in terms of magnitude of effect on environmental characteristics on the vertical axis, and a slash is placed diagonally from upper right to lower left across each block which represents significant interaction. In marking the matrix, it is important to remember that actions may have major short-term impact (for a year or so) which are ameliorated in a few years and thus of minor or negligible importance in a long time frame. Conversely, other actions with lesser initial impact may produce more significant and persistent secondary effects and, therefore, have major impact in a long time frame. In the text, which discusses the matrix, one should indicate whether he is assessing short-term or long-term impact. As an example, oil drilling rigs are commonly considered noisy and nonaesthetic but they are on location for short periods of time -- generally one to six months per site, whereas untreated spoil banks may silt and acidify streams for many years after completion of a project.

In marking the boxes, unnecessary replication can be avoided by concentrating on first-order effects of specific actions. For example, "mineral processing" would not be marked as affecting "aquatic life", even if the waste products are toxic in aquatic environments. The aquatic impact would be covered under "emplacement of tailing", "spills and leaks", or other processing operations which may lead to degradation of aquatic habitat.

After all the boxes which represent possible impact have been marked with a diagonal line, the most important ones are evaluated individually. Within each box representing a significant interaction between an action and an environmental factor, place a number from 1 to 10 in the upper left-hand corner to indicate the relative magnitude and 1, the least. In the lower right-hand corner of the box, place a number from 1 to 10 to indicate the relative importance of the impact; again 10 is the greatest.

As an example, assume that a particular engineering proposal recommends construction of highways and bridges. The proposed action as item II.B.d on the matrix. "Highways and bridges" might have environmental impacts through effect on "erosion" and related "deposition and sedimentation", among other things. "Erosion" and "deposition-sedimentation" occur under the main heading "Physical and Chemical Characteristics of the Environment" on the left side (ordinate) of the matrix and in the horizontal rows I.A.4.b. and I.A.4.c., respectively.

In this example, it might be that bridges will cause an important amount of bank erosion, because geologic materials in the area are poorly consolidated. This may lead the investigator to mark the magnitude of impact of highways and bridges on erosion 6 or more. If, however, the streams involved already have high sediment loads and appear to be capable of carrying such loads without objectionable secondary effects, the effective importance of bridges through increased erosion and sedimentation might be considered relatively small and marked 1 or 2 in the lower right-hand corner of the block. This would mean that while magnitute of impact is relatively high, the importance of impact is not great.

In the assessment of accidents (II, J) such as "spills and leaks", it would be desirable to have some guide which would be helpful in determining the probability and effect of accidents. In this matter, the inclusion of controls which would reduce the probability of an accident would lower the matrix entry of magnitude, but it would have no influence on the evaluation of importance of impact.

The next step is to evaluate the numbers which have been placed in the slashed boxes. At this point, it is convenient to construct a simplified or reduced matrix which consists of only those actions and environmental characteristics which have been identified as inter-

acting. Special note may be taken of boxes with exceptionally high individual numbers, as by circling the box. Although not used in this circular, we have found it convenient, when comparing alternatives in an action program, to identify the beneficial impacts with +, because alternative action plans may have different degrees of both beneficial and possibly detrimental impacts. However, in most cases the preparer will consider all impacts to be potentially deleterious because all the + factors would have been covered in the engineering report. Other investigators may wish to devise their own numberical rating methods; hence, the marginal boxes of Plate I are simply titled "computations".

It must be emphasized that no two boxes on any one matrix are precisely equatable. Rather, the significance of high or low numbers for any one box only indicates the degree of impact one type of action may have on one part of the environment. If alternative actions are under consideration, and a separate matrix is prepared for each action, identical boxes in the two matrices will provide a numerical comparison of the environmental impact for the alternatives considered.

Assignment of numerical weights to the magnitude and importance of impacts should be, to the extent possible, based on factual data rather than preference. Thus, the use of a rating scheme such as the one suggested here discourages purely subjective opinion and requires the author of an environmental impact statement to attempt to quantify his judgment of probable impacts. The overall rating allows the reviewers to follow the originators' line of reasoning and will aid in identifying points of agreement and disagreement. The matrix, is in fact, the abstract for the text of the environmental assessment.

Text

The text of an environmental impact assessment should be a discussion of individual boxes marked with the larger numberical

values for magnitude and importance. Additionally, those colums which cause a large number of actions to be marked, regardless of their numerical values, should be discussed in detail. Likewise, those elements of the environment (rows) which have relatively large numbers of boxes marked should be addressed. The discussion of these items should cover the following points as put forth in the Council on Environmental Quality's guidelines published in the Federal Register (1971):

i) A description of the proposed action including information and technical data adequate to permit careful assessment of impact. (This has been covered as items C and E in fig. 1.)

ii) The probable impact of the proposed action on the environment

iii) any probable adverse environmental effects which cannot be avoided.

iv) alternatives to the proposed action

v) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity

vi) any irreversible and irretrievable commitments of resoures which would be involved in the proposed action should it be implemented, and

vii) where appropriate, a discussion of problems and objections raised by other Federal, State, and local agencies and by private organizations and individuals in the review process and the disposition of the issues involved. This section may be added at the end of the review process in the final text of the environmental statement.

All of these points itemized above can be covered as part of a discussion of the matrix.

The text that accompanies the completed matrix should be primarily a discussion of the reasoning behind the assignment of numerical values for the magnitude of impact effects and their relative importance. The text should include a discussion of those actions

which have significant impact and should not be diluted by discussions of obviously trivial side issues.

To be fully understandable, the discussion of the magnitude and importance of applicable impacts and responses will require some discussion in the text of the principal characteristics, physical and ecological, of the environment itself and some of the important characteristics of the proposed action which govern its environmental impact. The environmental impact assessment thus relies on and refers to the data incorporated in items 1, 2, and 3 -- the full description of the geography, physical setting, vegetation, climate, and other facts about the environment and the physical and engineering aspects of the proposed development. This explanation is inserted here to caution that the environmental impact assessment need not be burdened nor should it be padded with descriptions of the project and the environment per se. It should include only such details as are needed for evaluating the environmental impact. The completed environmental impact assessment, together with items (1), (2), and (3), comprises the finished Environmental Impact Statement; all four items are required for review purposes.

In order to test the usefulness of the matrix approach, a matrix for an actual proposed mineral extraction and processing operation has been prepared and included as an appendix. This example is solely a model used for demonstration purposes and is not intended to be an impact assessment of the example project. A brief synopsis of the justification, regional setting, and general plan of operation extracted from a report which covers items (1), (2), and (3) of an environmental impact statement is included. In addition, for each of the boxes with entries, there is a brief discussion of the impact rating including the reasoning behind the assignment of values. (See reference article)

Concluding Statement

Obviously, the wide variety of projects and actions have such differing impact on environmental factors that no scheme of impact assessment will be universally applicable. However, greatest need is not for a single and universally applicable assessment method, but rather for a simple way of summarizing which impacts are considered of greatest moment by the people making the assessment. Different assessors will seldom come to identical conclusions, but it would be useful to know the basis for the difference.

The advantage of a matrix is in its use as a checklist or reminder of the full range of actions and impacts. The proposed manner of using the matrix is aimed at separating as far as possible factual information on magnitude of each type impact from the more subjective evaluation of the importance of the impact, the latter involving preference or bias to some degree. This separation of fact from preference is highly desirable.

Finally, the matrix and suggested method of use is presented as a draft, subject to improvement, expansion, and change. Because it is impractical to circulate unpublished manuscripts widely, this manuscript is being submitted for review by potential users as a U.S. Geological Survey circular, a series used for tentative, incomplete, or preliminary statements.

The authors acknowledge with thanks the cooperation of Robert H. Twiss for sharing his experience in matrix construction and for his thoughtful review of this manuscript. The help furnished through discussion, manuscript revision, and suggestions by Elmer Baltz and George Davis is also gratefully acknowledged.

EVALUATING THE TOTAL IMPACT OF HIGHWAYS, 1971

Eugene P. Odum, Institute of Ecology, University of Georgia

Environment has always been a major consideration in highway planning and construction, but what is new is that public opinion and the National Environmental Protection Act now requires that a broader range of environmental values must now be integrated with engineering and economic considerations so that the decisions on whether, where and how to build major highways, airports, dams, power plants and so on can be based on the sum total of all values. A move towards looking at issues and problems on a holistic basis is a perfectly natural trend that comes when the growth of a region approaches the saturation point in the use of space and resources. Unfortunately, such logical and necessary changes in approach are too often being pictured in terms of conflicts between engineers and environmentalists. We should not blame the press for playing up conflict because professional specialist often unwittingly fuel the fires of controversy by assuming a self-righteous attitude in defense of traditional ways of doing business. Highways are so important and valuable to man that their planning and construction cannot be left entirely up to engineers; likewise, the environment is so important and valuable that decisions concerning its use cannot be left entirely up to environmentalists. As we strive towards developing a greater synthesis, which I like to call "ecosystem management" (The ecosystem being defined as the totality of man and environment) every special interest group must consider ideas and help offered by other groups, and be concerned more with the quality rather than the source of the input. Most of all, the engineers' technique of "systems analysis" needs to be broadened to "ecosystem analysis" so that human and environmental values which are not so easily expressed in dollars can be given at least equal weight to that traditionally given purely economic cost-benefit data. Or to put it another way, cost-benefit analysis must now be broadened to include the cost of environmental

stress and more accurate accounting of future public benefits.

Some indication of how far we have come during the past two years in evaluating total impact of highways can be gained by examining case histories. Specifically, I would like to cite and briefly describe three studies which are available in printed or bulletin form. These can be arranged in a sort of evolutionary series, from relatively simple procedure to increasingly sophisticated ones as follows:

1. The Ad-hoc Panel Method. A 1971 report entitled "Interstate-75 Evaluation of Corridors Proposed for South Florida", is an example of the simple expediency of appointing an interdisciplinary panel which considers the qualitative advantages and disadvantages of proposed routes and makes a recommendation based more or less on a consensus judgment. Copies of this report can be obtained from: The Division of Applied Ecology, Center for Urban Studies, University of Miami, Coral Gables, Florida. The study was made at the request of the Florida Secretary of Transportation. The panel, chaired by Carl E.B. McKenny, Director, Center for Urban Studies consisted of 17 members with professional affiliations as follows: Engineers 5; biologists, 3; ecologists, 3; wildlife specialists, 3; hydrologist, 1; forest resource specialist, 1; and planner and architect, 1. This panel was apparently selected by the Center for Urban Studies, but the report does not spell out how the particular "panel of experts" was selected. After an initial meeting the panel was divided into subunits which prepared written reports of impact on specific values such as soil and vegetation, hydrology, human factors, recreation, wildlide and so on. These reports provided the basis for the final consensus judgment on total impact. Six alternatives were considered -- no road and five east-west routes across south Florida connecting Miami and Tampa. In all, nine panel deliberative sessions and three public

hearings were held, and members of the panel examined the five corridors on the ground and, on two occasions, from the air. The panel's consensus was that additional roadway construction across the Everglades basin would "result in serious ecological disruption; therefore its first choice is no road." However, the panel hedged in stating that "if demands and pressures of the southern Florida population make a roadway inevitable, the panel consensus favours a roadway lying as far north as feasible, thus removing it from the wetlands to the greatest extent possible".

2. The Linear Vector Analysis Approach. In the spring of 1971 the Georgia State Highway Department requested that the Institute of Ecology at the University of Georgia make a summary evaluation of all reports already prepared on eight alternate routes proposed for the uncompleted section of I-75 north of Atlanta. For this study we devised a more quantitative method than was used in the Florida I-75 study, one that could take advantage of the capacity, flexibility and statistical objectivity of computer programming. The method decided upon was essentially a linear combination of component values (the amount of urban land disturbed, the relative safety of a route, the cost of a route, etc.) multiplied by a weighting factor giving the relative importance of the particular component values. Values were then scaled so that a mean impact index could be calculated for each route. This procedure can thus be designated as a linear vector analysis. The 56 component values that went into the final data set were loosely categorized into four groups.

1. Group E - Economic and Highway Engineering considerations,
2. Group L - Environmental and Land Use consideration,
3. Group R - Recreation considerations,
4. Group S - Social and Human considerations.

Weighting and scaling of component values was carried out by a panel of six persons with a 50-50 balance between those expert in environ-

mental aspects and those skilled in dealing with human and economic values. Both present and future impact was considered and a 10-fold greater weight was placed on the future since most of the controversy regarding the alternates centered around future economic and environmental values. The advantage of having a computer program to sum the values stems from the fact that repeated "runs" can be made in which weighting can be varied and, especially important, error factors can be written into the program so that statistical confidence limits for each total impact index can be calculated.

In the Georgia I-75 study, a clear separation of indices into two groups was obtained, even with 50% error written into the program. The four western routes proved to be clearly superior in terms of total impact to the four eastern routes, but there was no significant difference between routes within each group. The results of this study were used by the State Highway Department as a basis for recommending a western corridor, and the Federal Highway Commission has now approved this choice. A copy of the complete report, as well as a paper submitted for publication, can be obtained from: Institute of Ecology, University of Georgia, Athens, Ga. 30601.

In summary, the linear vector approach makes it possible to add "apples and oranges", that is, environmental consideration and economic factors to obtain a single impact index for each proposed alternative, and to calculate confidence limits for each index based on realistic errors that are inherent in both expert judgments on environmental factors and specific engineering and economic cost estimates. We believe this method has the necessary flexibility and practiced credibility for wide-spread use.

3. Matrix Methods. While a linear vector approach will probably be adequate for many situations where choices differ in major ways, future procedures will undoubtedly rely more and more on some form of matrix system. Since factor interaction can be included in matrices, both the capacity and the descrimination of the analysis

can be increased - especially important where differences in proposed options are not clear cut. On the other hand, better input data than that usually available are needed, so there must be considerable improvement in gathering of environmental data before matrix methods can be effective.

A good source on matrix use in evaluating environmental impact in general is the Geological Survey Circular #645, entitled "A Procedure for Evaluating Environmental Impact", prepared by Luna Leopold and colleagues. This bulleting is available free on writing the U.S. Geological Survey, Washington, D.C. 20242. As an example of use in highway location we can cite the report issued by The Environmental Awareness Center, Department of Landscape Architecture, School of Natural Resources, University of Wisconsin, Madison, and entitled: "Interstate-57 - An Application of Computer Technology to Highway Location Dynamics", by B.J. Niemann and A.H. Miller.

The I-57 study consisted of four phases:

1. Data Bank Development - involving generating a list of variables, inventorying and interpreting data, storing data and displaying and verifying data in computer print-out form.
2. Corridor determinant establishment - involving establishing what major factors should and do affect corridor locations, what variables affect each corridor determinant, and consequences of choice and weight of variables.
3. Corridor alternate analysis - involving combining and weighing determinants for evaluating corridor location effect.
4. Corridor selection - involving identifying paths in the matrix which maximize the most appropriate multiple values (optimum pathway determination).

As it turned out the sensitivity analysis indicated that potential corridor linkages approximated each other so closely in numerical value that no clear cut decision could be made, although the analysis did narrow down the choices. The study is continuing in the hopes

that further refinement can bring better descrimination. The fact that no quick answer was found does not mean that the method used is bad; it just could be that the proposed alternatives in this case do not really differ in total impact. The question then is to consider not building at all if total impact of any choice is bad, or to survey and test additional alternatives to see if there are better choices.

In summary, I would suggest that State and Federal agencies charged with making and evaluating impact work closely with State and Regional Universities to set up training courses in impact analysis, since there is bound to be a rapid development of new technics in this field. Training sessions and conferences on an annual basis will probably be necessary over the next few years if everyone is to keep up with new developments.

Interim Report No. 2

ENVIRONMENTAL IMPLICATIONS OF THE ENGINEERING DESIGN OF A GAS PIPELINE FROM PRUDHOE BAY, ALASKA, TO ALBERTA

Environment Protection Board Sponsored by Gas Arctic/Northwest Project Study Group, June, 1972

Questions Arising From Factors Requiring Consideration

The questions presented in this section have been generated by the discussion in the preceding sections. They are listed here as a separate entity for reader convenience, to prevent repetition, and to avoid cluttering the previous narrative. The order of presentation is roughly the same as that of the topics in the preceding section.

1. General Queries

1.1 What detailed information on the pipeline route(s) and the terrain through which it will pass can be made available to

the Board at the present time? The Board requires air photos (preferably annotated to show the terrain classifications), alignment sheets, spread sheets, etc., which show in detail the following:

a) The primary and alternate pipeline routes.
b) The locations at which rivers and streams will be crossed
c) The locations of pumping and compressor stations, meter stations and main line valves.
d) The locations of construction camps.
e) The locations of material stockpiles.
f) The locations of construction access and tote roads.
g) The locations of river docks and wharves that will be used for material supply.
i) The locations of maintenance access roads and helicopter pads.
j) The locations of borrow areas which will be used as sources of material for berm construction and other fill requirements.

1.2 What is the present schedule for pipeline constructions? The Board requires a detailed breakdown on the sections of line which will be constructed in relation to the time of year. In addition, the Board needs to know:

a) On which rivers and streams crossing will be constructed during winter (i.e., when ice-covered).
b) On which rivers and streams crossing will be constructed during summer (i.e., when ice-free).
c) On which rivers and streams crossing construction will likely extend through two or more seasons.
d) On which rivers interruption of flow during construction of a crossing will be necessary.
e) The proposed dates or time periods over which construction will take place for each of the river and stream crossings mentioned in a), b), c) and d).

1.3 What will be the range of operating gas temperatures for various sections of the line? Where will refrigeration of the gas commence and cease? What are the plans for insulation under the pipe in ground ice areas?

1.4 At which locations will depots be established for maintenance and repair? What will each entail in the way of services such as sewer, water, and transportation facilities? If lagoon and other waste pit locations are subject to subsurface investigation, details of soil and ice or water content profiles are needed.

1.5 Have terrain investigations delineated the sections containing excess ice? The Board wishes to receive the relevant logs and other data.

2. Permafrost Degradation

2.1 What portions of the pipeline will be buried? (We need this answer in terms of mileposts.)

2.2 What is the predicted thaw bulb or forst bulb for typical cases with respect to time?

2.3 How deep will the pipe be buried (minimum and maximum depths)?

2.4 How will the trench be excavated and backfilled? Details required are:

a) A sketch of a typical buried section
b) Specifications for bedding and backfill
c) Specifications for compaction and grading (where applicable).
d) Types of excavation equipment or techniques and general conditions under which each would be utilized.

2.5 What differential movements are expected and what differential movements can be tolerated in such a buried pipe?

3. Berms and Special Structures

3.1 What will typical berm sections be like for well drained and poorly drained terrain? The Board requires sketches showing:

a) The sideslopes

b) The range in height

c) The top width

d) The pipe location

d) Ditches, roads and other features.

3.2 What sections of the pipeline will be handled by a berm? (The Board needs to know the actual limits, stated in terms of mileposts.)

3.3 In addition to the prediction of the thaw or frost bulbs for trenches (question 2.2), what is the prediction for berms? What also is the estimated range of surface ground temperatures that will be established on the berm itself?

3.4 What specifications will govern the use of fill and borrow material? Information is required concerning:

a) The type of borrow fill for berms

b) The type of native fill for berms

c) Compaction of berm fill

d) Surface preparation for revegetation

e) Treatment of borrow areas.

3.5 What will be the long-term stability of berms?

3.6 What sections will have special structures such as trestles or surface piping?

3.7 What types of foundations will be used on special structures, and what will be their effect upon the thermal regime of the ground due to installation and operation?

3.8 What protection will be provided to prevent erosion of berms and at special structures?

4. Hillsides and River Crossings

4.1 Will most river crossings be accomplished with a buried pipe? The Board needs sketches of typical crossings showing minimum depth of burial and details of backfill. Since several options will exist, details will be required.

4.2 Which streams and rivers will be crossed by a buried pipe?

4.3 Which streams or rivers will have bridges?

4.4 What restrictions will be imposed on contractors regarding stream and river corssings? The Board needs to know what control will be exercised over:

a) Alteration of slope geometry
b) Blocking of streams
c) Passing traffic across streams
d) Finishing slopes and banks.
e) Installation methods to be used at river crossings.

4.5 What protection will be provided to prevent surface and toe erosion? Is any special revegetation planned for riverbanks and valley slopes?

4.6 What hillsides and riverbanks have been or will be subjected to stability analyses? The Board needs results of analyses, including the following:

a) Drill hole logs
b) Temperature and water content profiles
c) Strength tests
d) A stability analysis for factor of safety.

4.7 Are borehole data available for river crossings? The Board requires these data.

4.8 What measures will be taken to stabilize critical slopes? Which are they? What factors contribute to their instability?

4.9 What monitoring will be undertaken on most slopes? On critical slopes?

4.10 What methods will be implemented to stabilize slides that are not detected until after the pipeline is in operation?

4.11 At what river crossings has surface icing (aufeis) been found to occur?

5. Drainage Implications

5.1 The Board presumes that drainage intercepted by the pipeline will be channeled along the line to pass over or under it at selected points. What are the boundaries of the drainage areas involved? What are the before-construction directions of

surface flow and subsurface seepage within these drainage areas? What are they anticipated to be after construction?

5.2 Into what streams and rivers crossed by the pipeline will drainage water be diverted by channels running along the line? What are the estimated flow quantities that will be diverted in each instance?

5.3 Where drainage water is diverted into streams and rivers, will the flow be sufficient to cause thermal and/or hydraulic erosion of the banks?

6. Mechanical Systems

6.1 How will pipeline leaks be detected? Is there any type of leak that could not be detected?

6.2 In the event of a leak how much gas would likely be released before valves would close the line?

6.3 If a break occurs in summer, how would repairs be effected?

6.4 What is the yield strength of the steel at operating temperatures?

6.5 What differential movements can be tolerated by the pipe before permanent deformation of the steel commences under the projected loading conditions?

6.6 What factor of safety or loading stress factor will be used in design?

6.7 How will heat be dissipated at stations?

6.8 How will methanol or other dehydrating agents be disposed of?

6.9 What noise will emanate from stations and valves? If noise suppressors are to be used, what type will they be?

7. Construction Aspects

7.1 What technical specifications will govern the use of resources during construction (specifically: water, borrow and timber)?

7.2 How will the bases for stockpiles and camps be prepared and how much land will be cleared?

7.3 How will sewage and garbage be disposed of?

7.4 What specifications will govern access, tote, and winter roads?

7.5 What specifications will govern the provision and operation of fuel and maintenance depots along the pipeline routes?

7.6 How will the right-of-way be cleared and cleaned up?

FISH RESOURCES OF THE MACKENZIE RIVER VALLEY

Interim Report 1, Volume 1 by C.T. Hatfield, J.N. Stein M.R. Falk and C.S. Jessop

Environment Canada Fisheries Service, 114 Garry Street Winnipeg, Manitoba R3C 1G1 February 28, 1972

Abstract

In May 1971 the Department of the Environment, Fisheries Service began a four-year investigation into possible effects of northern pipeline construction and other northern development on the fish resources of the Mackenzie River Valley. Fish are caught in standard size mesh gill and seine nets at sampling stations on the Mackenzie, Liard, Great Bear, Arctic Red and Peel main stems and all significant tributaries crossed by the proposed pipeline routes. Species composition, distribution, age and growth, feeding, length-weight and spawning characteristics are under study. Baseline data on contamination of fish with heavy metals and pesticides are being collected. The compilation of a stream catalogue, covering chemical and physical water quality, water flows, spawning gravel areas and major obstructions to fish migration is underway. Sport and commercial fishing potential and an assessment of domestic fishery requirements are also being investigated.

Siltation or removal of fish spawning gravel, the blocking of migrations during biologically critical periods, destruction of rearing areas or chemical contamination of the aquatic environment

from spills, are possible adverse effects from the northern pipeline construction and geophysical operations. Species age composition studies determine the sensitivity of certain populations to siltation, gravel removal and any chemical pollution resulting from pipeline construction. Plots of fish migration routes and times, and knowledge of spawning and nursery areas will be used in evaluating proposed pipeline construction routes and schedules. Sampling of fish sizes, age composition and growth, aid in defining of life histories, habitats and resilience of fish populations. The assessment of present contamination of fish with heavy metals, pesticides, mercury, etc. provides baseline data for future use. Food habit studies indicate the major items fed upon by each species providing an indication as to the possible effects to the resource, should vulnerable organisms be destroyed. Sport, commercial and domestic fishery potentials and requirements are being studied in an attempt to identify species and geographic areas of particular value for human use of the resource.

Substantial fish runs were found in the Peel, Mackenzie and Arctic Red rivers in 1971. Over thirty species of fish were regularly caught. Arctic char, lake trout, inconnu, humpback and broad whitefish, Arctic and least cisco, walleye and Arctic grayling appeared to be the species which could be most affected by construction of a northern pipeline. Fish distribution varied widely depending on the species.

Age and growth and age class compostion data for some northern fish populations appear comparable to those of more southern commercially fished species. For most species, growth is slow and age class composition spread wide.

Based on stomach analyses, it appears that some fish such as chub and trout-perch, normally considered not economically valuable, are important forage fish for the economically important inconnu, pike,

walleye and lake trout. Aerial insects make up a large portion of the diet of some fish species during the summer months.

Spawning areas for the various fish species are extremely difficult to define. Tributary streams flowing north into the Mackenzie River between Great Slave Lake and the junction with the Liard River are very important for grayling spawning as are some clear running streams around the Normal Wells area. Large migrations of humpback and broad whitefish, Arctic and least cisco and inconnu, south through the delta area, indicate spawning takes place at some points upstream, particularly in the Arctic Red River. Generally, it appears that the clear east side Mackenzie streams are more important than the larger turbid west side streams for fish production. These streams would be particularly suitable for sport fishing. The delta area has the potential for a small commercial fishery. Sizeable domestic fisheries exist in the delta area and around many settlements throughout the valley.

Based on the 1971 data, tentative recommendations for protection of the fish resource of the valley are presented. These cover geographic areas biologically senstitive to northern pipeline construction, seasonal times sensitive to construction, safeguards to fish during northern pipeline construction, safeguards during pipeline operation and specific safeguards for the domestic fishery during and after pipeline construction.

Specific spawning, nursery and feeding areas will be further delineated in 1972. Migration routes and times will also be better determined and population estimates verified by a tag recovery program. More emphasis will be put on lakes along the pipeline routes in the Mackenzie Valley and delta region. Intensive study of some small representative stream systems is planned.

Tentative Recommendations for Protection of the Fish Resource

1. Northern Pipelines

A. Geographic Areas Biologically Sensitive to Northern Pipeline Construction

On the basis of fieldwork done in 1971, some streams and river areas can be classified at this time as being biologically sensitive to disruption. Assessment in this field is preliminary, however, and the naming of some sensitive areas does not imply that many others are not sensitive. This appraisal applies to fish resources only. Sensitivity listings will be updated as more data is collected in 1972.

Generally, one could say that clear running streams on the east and south sides of the Mackenzie would be more sensitive to environmental disruption than the turbid west side streams. Clear streams generally contained more resident fish, especially of species considered economically or aesthetically valuable. Silting is rare and gravel clean. Siltation should be closely controlled on these streams and gravel removal not permitted. Turbid streams with their already high rate of silt load and history of extreme natural events (eg. flooding, scouring, eroding, stream bed shifting, etc.) would seem less likely to be affected by man-caused physical disruptions. Chemical contamination would be a danger to both stream types. In the case of an oil line crossing, the west side turbid streams might be less desirable because of the greater possibility of land erosion caused breaks leading to oil spillage.

The Mackenzie main stem is turbid and, therefore, less sensitive to silting than the other systems. Blockage is unlikely. Gravel removal could probably be permitted in some areas although some gravel bars are probably used for spawning. Chemical contamination by pesticides, petroleum materials, or heavy metals could be disastrous for the delta area in the north.

In 1971, only one observation of a spawning area, actually in use, was made in the Mackenzie Valley. This was immediately upstream from the moraine area on Fish Creek, a tributary of the Rat River. A large number of Arctic char (or Dolly Varden, depending on the classification system) were spawning in this creek. Presumably these fish migrate up through the system from the Mackenzie Delta in late summer. No gravel removal from, or siltation of, this bed could be permitted at any time of the year, as eggs, fry, juvenile or adult fish would be present on a continuous basis.

The Arctic Red and Peel River systems have large migrations of fish. Specific spawning areas in the rivers have not been located and are difficult to speculate on because of turbid waters in both systems. Siltation would be less of a problem than blockage and gravel removal on these systems. The Tree River, a clear west side tributary, supports a grayling run. Several important grayling streams also exist in the Norman Wells area. Two west side streams, Stewart and Slater creeks, and two east side streams, Bluefish, and Vermilion creeks, have substantial runs. The Great Bear River supports an Acrtic cisco run. Siltation, blockage or gravel removal on these systems would not be ecologically acceptable.

Near Fort Simpson, the Jean-Marie, Trout, Kakisa, Rabbitskin, Spence, Trail and Martin tributaries would be extremely sensitive to siltation, gravel removal, migration blockage or chemical contamination. They serve as important spawning and nursery areas. The Mackenzie and Liard main stems in the Fort Simpson area appear less sensitive to disruption than major rivers in the more northern study areas. Fewer fish migrations and less permafrost would seem to lessen the probability of construction on the main stems affecting the fish resource.

In conclusion, preliminary results from our study indicate that the

west side route down the Mackenzie is best for a gas pipeline from the point of view of protecting the fish resource. Because of the extreme consequences of an oil pipeline break, however, the east side route along the Mackenzie is recommended for this line as watersheds are more stable along this bank. It is assumed, when making these recommendations, that engineering of the lines would be such that stable non-silting river crossings would result once lines were in place two or three years. If both gas and oil lines are built, or associated services such as railways, roads and powerlines included, a "corridor concept" along one side of the river may be preferable.

B. Seasonal Time Biologically Sensitive to Northern Pipeline Construction

Migration and spawning of most species takes place primarily in spring and fall. Some summer migration does take place in the Arctic Red area and to a lesser extent Norman Wells. With the exception of Arctic cisco and flathead chub, a "summer lull" in fish movement appeared to be evident from data collected from mid-July to mid-August. Runs of spring spawners generally tapered off to this time and runs of fall spawners increased after this time.

Information gathered from local fishermen throughout the valley indicated that runs of Arctic grayling begin a few weeks before breakup. Our data indicated the main runs had ceased by mid-June in the Fort Simpson area and late June in the Norman Wells and Arctic Red areas. Early May to mid-July would be critical times for the grayling streams as adults, eggs and fry would be in the stream during that time. More detailed study on life history is needed to precisely determine the total critical times of this species. There is some evidence that overwintering in lakes at the heads of the tributaries may occur (eg. Swan Lake near Arctic Red River) in which case systems supporting significant numbers of grayling may be sensitive to disruption in any season.

Arctic char streams, where they are found, would be sensitive to disruption in any season since eggs, fry, juvenile fish or adults would be in the system at all times of the year. A crossing of Fish Creek on the Rat River would require stringent safeguards against disruption.

Arctic and least cisco and flathead chub would be vulnerable to stream blockages during their runs in summer.

Broad and humpback whitefish and inconnu in the Mackenzie delta, Peel, Arctic Red rivers and Mackenzie main stem could be disrupted during their downstream post spawning run after freeze-up in late fall. Mid-September to the latter part of November would seem the most critical times. Limited siltation and gravel removal could probably be tolerated by adults of these species since their normal habitat is in the large turbid rivers. However, spawning grounds would be susceptible to siltation during winter development period.

Pike and walleye, most abundant around the Fort Simpson area, spawn around spring breakup. Where large populations of these resident fish occur, such as the Jean-Marie, Rabbitskin, Spence, Trail and Martin rivers, stream blockage or gravel removal should not be permitted. The latter species would be somewhat more sensitive to siltation of reproducing areas than the former.

In summary, one can say that east and south side are probably sensitive to disruption in all seasons. Some of these waterways support larger numbers of important species than others, making them more susceptible to disruption. Turbid streams are probably most sensitive to disruption at times of the year when actual fish migrations are occurring. Limited siltation, gravel removal or blockage at non-critical times of the year could probably be tolerated. Chemical contamination of any kind would be unacceptable in either stream type.

C. Safeguards to Fish During Northern Pipeline Construction

Until pipeline routes are decided upon, it is too early to set out in detail specific requirements for the protection of the resource at each crossing. Nor is it the purpose of this report to cover the engineering involved. However, certain general statements concerning safeguards can be made at this time.

Wherever the fish resource appears threatened by siltation at a critical time in a life cycle, temporary coffer dams or stream diversions will have to be constructed to prevent silting of gravel downstream of the construction site. Disturbance of the stream bed should be kept to that necessary for installation of required pipeline facilities. Reshaping of the stream bed and stabilization of the banks to prevent erosion should be done upon installation of a facility. Where disruption of a spawning area cannot be avoided, compensatory facilities such as spawning channels should be constructed to ensure survival of fish stocks. Unnecessary surface disturbance near streams should be avoided to minimize future erosion and siltation of streams. Construction should be limited to the least sensitive season for the particular fish species in question.

Stream blockages should not be permitted during biologically critical periods on some stream systems. All blockages should be of a non-silt material and preferably be removed immediately upon completion of the construction. Any blockage to be left in the stream over a fish migratory period must have culverts or bridges which allow the free passage of fish.

Gravel removal for pipeline berms or equipment pads should be from turbid streams only. Removal from areas extensively used for spawning or feeding in any waterway would not be acceptable. In such areas that gravel removal is permitted, the stream bed must

be restored in such a way that major flow changes in the system do not occur.

Blasting for construction purposes, should not be permitted in any biologically sensitive streams except where absolutely necessary. No work in the water courses should be permitted during biologically sensitive times for fish in the system.

Chemical or waste pollution of any waterway should not be permitted. Garbage should be incinerated, domestic sewage treatment systems installed at all construction sites and fuel containers and construction equipment, material and buildings, abandoned equipment etc. should be removed to recommended disposal areas away from water bodies after use. Fuel storage should be well back from any waterway and adequately dyked to contain spillage. Pesticides should not be used unless absolutely necessary for the health of construction personnel. No chlorinated hydrocarbons would be acceptable. A contingency plan outlining specific steps for the control and cleanup of any chemical should be available to all personnel on the project.

It is intended that a full set of guidelines to protect the fish resource be drawn up when more data on specific areas is available. Guidelines would include detailed requirements for the sensitive watercourses and general guidelines for other stream types throughout the system.

D. Safeguards to Fish During Northern Pipeline Operation

Post-construction erosion leading to siltation and scouring or petroleum spills resulting in chemical contamination of the aquatic environment would appear to be the principle potential dangers to the fish resource. The latter would probably be a problem only in the case of an oil line.

Stream crossing sites should be stabilized and inspected regularly for erosion leading to stream siltation. This would be especially important during the immediate post-construction period, and in spring runoff periods.

A large oil spill in the Mackenzie Valley would be disastrous for the fish and wildlife resources of the area, particularly in the delta. To prevent such a calamity, additional automatic shut-off valves must be installed near biologically sensitive areas. If a line was installed near the Mackenzie delta, a large number of valves would be required as this area could not tolerate even a moderate spill. Valves would be necessary at most stream crossings on the Mackenzie west side route because of the higher spill potential. All crossings of biologically sensitive streams on the east side of the Mackenzie would also require shut-off valves. An extensive store of containment and clean up equipment would be required at strategic sites along the route. This equipment must be suitable for use in large rivers, adaptable to cold weather conditions and be transportable by air.

Use of chemicals which sink or disperse oil spills should not be permitted. Filing of a complete contingency plan in case of a pipeline break must be included as part of the permit to build a line in the north. A regular schedule for maintenance, up grading and practice of the plan must be maintained.

Other safeguards for the fish resource of the valley such as safe fuel storage, treatment of domestic sewage at permanently manned installations, and employee observance of local laws concerning fish will be expected. Specific guidelines for piepline operations, as they affect the fish resource, will be drawn up when more aquatic biological data becomes available.

E. Specific Safeguards to Protect Sustenance Fishery Before, During and After Pipeline Construction

Local residents along the proposed northern pipeline routes are the largest users of the fish resource at present. Information indicates that fish caught each year probably number over one hundred thousand. This number could be much higher if commercial catches are considered.

It is important that, from both the northern residents' and petroleum industry's point of view, conditions for the fishery are not jeopardized. Trouble in this area could be real or arise from misunderstandings between the interests involved.

Local participation in solving aquatic environmental problems should be encouraged and, indeed, sought when route selection, construction schedule , logistic and waste disposal plans are being drawn up. Since many northern residents gain much of their sustenance "off the land" (eg. local fisheries, etc.) hamlets in the north consider that their environmental interest extend to 100-150 miles around their community. Therefore, discussions on route planning should have input from local community leaders. These groups should be encouraged to attend federal government meetings dealing with local environmental problems. When final plans to construct the pipeline are cleared, local leaders should be kept fully informed on projects which could affect the fishery in their area. A definite point of contact should be maintained between government-industry and the community leaders to ensure the environmental interests of the northern residents are being protected.

After construction of the pipeline, a continuing government-industry contact should be maintained with local hamlet councils to handle any post construction aquatic environmental degradation problems that may occur. A continuing fish contamination monitoring program should also be set up to ensure that any chemical contamination of fish that does occur, endangers neither human, nor fish life.

II. Geophysical Operations

A. Use of Explosives

Use of high energy explosives in watercourses of the Mackenzie Valley should be limited to biologically least sensitive times and areas. Charges detonated in the relatively shallow water rivers and lakes are directly harmful to fry, juvenile fish and adults. Eggs in gravel may be similarly affected. Alternate energy sources are available for seismic work in water which are less harmful to the fish resource.

B. Construction and Removal of Stream Crossings

Ice bridges built to transport geophysical equipment into exploratory areas and along seismic lines pose some problems to the fish resource. Construction of the crossings should be strictly controlled and their removal after use ensured . In some cases, an ice crossing may not be acceptable and a bridge to allow the unhindered passage of fish may be required if crossing the stream system cannot be avoided.

C. Control of Chemicals

As set out for northern pipeline construction, fuel and industrial chemicals must be stored in areas well away from water. Residues and transporting containers should be either buried or backhauled to an approved disposal area. Materials containing mercury compounds, high contents of heavy metals or other substances biologically harmful in small amounts such as arsenic or cyanide should be used with extreme caution. Disposal of these substances after use must be by burying or backhauling to the place of origin. On making applications for exploratory work, lists of any chemicals used in the operation should be submitted. A complete set of guidelines for geophysical work in the Northwest Territories, as regulated under the Fisheries Act, is available from the Fisheries Service, Winnipeg.

III. Domestic, Commercial and Sports Use of the Resource

A. Control of the Domestic Fishery

It was observed during the 1971 field season that some runs of fish were heavily exploited by local fisheries. In some instances nets were set from bank to bank across stream mouths, when migrations of Arctic grayling were in progress. Reports were also received of large catches of Arctic char from the spawning beds on Fish Creek.

Native peoples have the legal right to take fish for the use of themselves and their families by whatever method they wish. The sale of fish taken in excess of their personal requirements is permitted in local communities subject to the approval of a fishery officer. A significant trade has developed in the delta communities subject to the approval of a fishery officer. A significant trade has developed in the delta communities but an increasing control is being exerted upon this activity.

Workable control of the domestic fishery probably will be obtained only through education and demonstration that good sustained fishing methods are in the participants' best interest.

B. Control and Development of the Commercial Fishery

On the basis of biological data gathered over the 1971 and 1972 field seasons, commercial licences could probably be issued for a limited fishery in the Mackenzie delta in 1973. Additional lakes through the valley could also be found suitable for commercial fishing. Conservative quotas should be set and rigidly enforced for these areas until more details of the productivity of these fish stocks have been obtained.

The potential for commercial sale of fish outside the delta area

has not yet been established. The Task Force on Fisheries Development in the Northwest Territories is currently attempting to determine the potential viability of fisheries such as this and the criteria to be met prior to the investment of development funds. It will be necessary to determine the existence of a market before any substantial harvest operations can be permitted.

A clear definition of the legislative boundary line between the domestic and commercial fisheries is needed and efforts are currently being made to provide this.

C. Control and Development of the Sports Fishery

With the completion of the Dempster highway linking Inuvik with the Yukon road system and the increase in the Mackenzie Valley petroleum industry personnel, greater sport fishing pressure on the resource is anticipated. To control this increase in use, conservation and protection enforcement staff must be substantially increased and the number of licence issuing outlets expanded. Since Arctic grayling, lake trout and Arctic char generally will be the species most prized by sportsmen, a regular creel census program must be established to ensure certain stocks are not overfished. Growth rates of these species are slow and preservation of adequate numbers in all systems is essential since recovery after overfishing could take up to thirty years. Areas close to centers of population or with easy access should be closed when fish stock numbers decline below biologically acceptable levels. Preferably, however, they will be protected by limited seasons before that point is reached.

Sport fishing promises to be an extremely important industry in the Mackenzie Valley. If managed judiciously, a good annual income and an aesthetically valuable resource could be preserved for northern and southern Canadians.

ENVIRONMENTAL IMPACT ANALYSIS , July, 1971

California Council of Civil Engineers and Land Surveyors

Glossary of Terms

Definition of Terms as used in this document.

Aestheitic
That which people find beautiful or attractive. The quality of being aesthetic is not the opposite of the qualities of "practicability" or "reality", but rather another aspect or way of experiencing the same real world phenomena. Thus, blue skies, uncontaminated water, and uncluttered urban landscapes all have aesthetic impact, because they imply health, pleasure and security.

Aesthetics
The science and art of protecting and helping to create that which is beautiful, attractive and pleasant.

Computer Graphics
The technique by which raw data can be programmed for computer analysis and printout in a form that can be read visually in terms of form rather than numbers or symbols. Thus, the computer can be fed data on proposed hillside residential schemes along with data on soils and topography to produce a visually descriptive statement of where residential structures should and should not be built.

Design Professionals
Engineers, architects, planners, landscape architects and related professionals.

Development Projects
Any physical development or change which significantly affects the environment. This ranges from such obvious actions as the construction of a residential tract or a dam to much smaller actions, such as localized grading or the erection of a power pole.

Ecology
The mutual relations between animals (including human beings) and plants and non-organic phenomena, such as air, earth and water. Ecology is concerned with both the functional and spatial characteristics of animals, plants and non-organic phenomena and also with the collective relationships that make the continuation of life possible.

Ecosystems
Ecosystems refer to such component systems of the environment as the life cycle of the salmon and its dependency on the natural "behavior" of rivers and oceans, or the mutual participation of bees and flowers in the cycles of pollination and feeding. An

ecosystem is simply a small part of the larger life system, but a part small enough to be comprehended and analyzed.

Environment

The environment is that which underlies and surrounds a person or a thing and which influences and is influenced by that person or thing. Thus, environment is a broad term which can range from the total environment of the earth to the immediate environment of a man, plant, micro-organism or a man-made structure or complex of structures. For analytical purposes, the environment can be considered in its "physical," "human/social," and "economic aspects," which are further discussed in the chapter on The Environment as a System.

Environmental Quality

Environmental quality refers to the properties and characteristics of the environment, either generalized or local, as they impinge on human beings and other organisms. Environmental quality is a general term which can refer to 1) varied characteristics such as air and water purity or pollution, noise, access to open space, and the visual effects of building and 2) the potential effects which such characteristics may have on physical and mental health.

Environmental Impact Analysis

The orderly and logical process by which the potential impact of a proposed development project on its immediate and more distant environments is analyzed. Types of analyses may range from impact on animal and plant life to impact on urban economy or health, depending on the nature and location of the development project.

Environmental Impact Statement

The actual presentation that results from an environmental impact analysis. It maybe in the form of text, statistics, matrices, visual overlays, film, computer graphics and other graphic techniques, or a combination of any or all of these, depending on the

client and the nature of the development project.

Importance

The importance of an impact is a relative term based on the value judgment of the evaluator or evaluators. Unlike "magnitude," "importance" cannot be measured objectively and is a relative term when comparing alternates. While the "magnitude"of a proposed airport expansion's impact on residential areas can be measured in decibels and in residents' complaints, the "importance" of noise pollution to the quality of the residents' lives and to long-range property values can only be estimated by all the parties involved. The quantification of a phenomenon, therefore, does not necessarily indicate its importance. (see "magnitude")

Indigenous

That which is native to a region, as contrasted with that which is imported and alien. Imported elements may or may not be appropriate to the region.

Land Use

The use to which any land area or three-dimensional space is put. The term is not limited to such categories as "residential, commercial, industrial," but includes any pattern of natural or man-made phenomena at any point on the earth's surface or subsurface.

Magnitude

The magnitude of an impact can generally be measured or determined objectively by commonly accepted standards of measurement. Unlike "importance," "magnitude" can be measured objectively. Air pollution can be measured in terms of foreign substances in the atmosphere, freeway noise in decibels, the blocking of views by horizontal and vertical degrees of visual obstruction.

Matrix

A rectangular arrangement of quantities or symbols in rows and

columns so that the relationship of numerous factors in a situation can be analyzed. See the subsequent section on "format" and "data analysis" for further definition. (Plural = matrices.)

Objective
That which can be measured according to agreed upon standards or techniques.

Physiographic
The geographic and topographic characteristics of an area.

Project
Same as "development project."

Significant
In relation to environmental analysis, the term includes considerations of importance and magnitude, primarily the former.

Subjective
That which cannot be measured according to agreed upon standards or techniques. Whether or not such agreed upon standards or techniques exist is in no way related to the importance or significance of an environmental impact question.

Substantial
In relation to environmental analysis, the term "substantial" implies an impact which is sufficiently great to alter the basic nature or substance of an environmental system or element.

Visual Overlays
The technique by which data is placed on acetate or other transparent sheets and placed on top of one another for analytical purposes. The technique is further discussed in the "data analysis" section.

It should be noted that these terms are used in recently enacted legislation and are subject to further definition by public administrators, legislation and court decisions.

Presentation

The possible uses of a variety of formats (e.g., computer graphics, visual overlays and matrices) have been discussed in previous sections. The basic information presented through the use of these tools can be amplified by using other, more familiar presentation methods, such as color slides, wall charts, etc. A small project may require only an accompanying written text or narration, while a larger project with more complex considerations might require a formal report that contains all textual, statistical and graphic data.

The basic concepts of a presentation are:

1. the nature of and the need for the proposed project and the characteristics having potential environmental impact.
2. the environmental systems and characteristics (e.g. physical human/soical, and economic) of the location for which the project is proposed,
3. analysis of the envirnmental impact of the proposed project,
4. identification of adverse environmental effects which cannot be avoided if the project is developed,
5. possible alternative approaches to the project, including actions which would mitigate negative effects,
6. relative costs in a) environmental quality and b) dollars, of various approaches; and
7. backup data (e.g., expert opinion consulted, related studies and experiences, etc.)

Summary

The final goal of the design process in general and the environmental impact analysis in particular is the creation of development projects

that:

1. have beneficial or no net negative impact on the environment,
2. provide for desirable living environments and
3. are economically feasible.

The environmental impact analysis consists of trial and error and the testing of alternative concepts and solutions, all in an attempt to achieve the most compatible relationships between proposed projects and the wide range of physical, social and economic imperatives.

From first step to last, environmental and project requirements should be considered as part of a single whole; man's actions inevitably alter the environment, and the altered environment provides the possibilities and limitations for man's actions. Computer graphics, visual overlays and matrices are simply tools for discovering the most compatible relationships between man and his environment.

A CANADIAN STOL AIR-TRANSPORT SYSTEM A MAJOR PROGRAM

For Transport Canada By Science Council of Canada, December, 1970

Conclusions

The growth of large areas of relatively high population density, sometimes referred to as "megalopolis" in the developed countries of the world, is creating a demand for new modes of mass transportation which will relieve the congestion, noise and air pollution associated with many of the existing systems. In the long run, some form of advanced high-speed ground transportation offers the greatest overall benefit, but the economic viability of such high-capital ventures will not be achieved until high-volume traffic is developed, which, for Canada will be a matter of at least two or three decades. In the U.S. there are indications that the high-volume traffic is available, but institutional barriers will delay the extensive application

of high-speed ground transportation. The STOL AIR Transport System offers a contribution to the overall solution, which could be brought into operation without heavy capital investment.

STOL systems have the inherent capability to promote regional development. There will be an intermediate period of two or three decades between now and the introduction of economic high-speed ground transportation systems and, during this period, patterns of regional growth could develop which would otherwise be prevented by the immediate application of "spinal" system of transportation.

A STOL Air Transport System satisfies the requirements of a Major Program suggested by the Science Council. There is an urgency to implement the program because of the technological lead which Canada now holds and the potential market available, which would support the air industries in Canada and provide a rare opportunity to produce a Canadian system.

The degree of public acceptance of STOL and the size of the export market available are the two primary unknowns in the analysis of the STOL system. Demonstration services on selected routes appear to be an essential step in any further promotion of the system. Ideally, such a demonstration service should be a joint U.S.-Canadian venture, as a major market for STOL lies in the U.S. and provision has been made for such co-operative action in the recent Canadian-U.S. agreement to co-operate in transportation research. The importance of timing, however, is such that, failing agreement on a joint service, a Canadian demonstration service should be considered.

Provincial and municipal governments must be involved in the program at an early stage, as STOL systems are intimately connected with the planning of these levels of government.

There are organizational and management problems associated with the

launching of a Major Program on a STOL Air Transport System. These require that industry organize itself, with or without government participation, into a viable consortium to accept public support of the system, and that the government designate an agency or project office to organize the public participation and administer the funds made available.

The funding of the program should be done over a period of 3 to 5 years in two ways"

a) Step-by-step funding to the extent of $150 million, with a formula for recovery in the event of success.

b) Fully-funded contracts on feasibility directed at maintaining a Canadian lead in the initial system and in future generations of the system, amounting to about $15 million per annum.

Detailed recommendations resulting from this assessment are listed at the beginning of the report in Section I, as steps for immediate action and qualifications for implementation.

GUIDED GROUND TRANSPORTATION STUDY TRANSPORT CANADA, November, 1971

A.1 - Northeast Corridor Transportation Project

Background:

The Northeast Corridor comprises a nine-state region of the United States extending along the Atlantic seaboard from Boston to Washington in a strip more than 400 miles long and generally no more than 80 miles wide. This narrow band consists of a string of urban centers which have expanded to form a continuous metropolitan region with a population of 44 million; which is expected to exceed 50 million by 1985. It represents 1.6 percent of the nation's financial activity 36 percent of its wholesale sales and 20 percent of its industrial output.

In spite of the expansion of transportation facilities which has accompanied the growth of population in the area, congestion, delay

and resultant economic waste and loss have increased enormously.

Many of the problems involving inefficiency and deteriorating services result from the inability of large fixed facilities to respond to rapidly changing demand for transportation services. For example, sections of the New Jersey turnpike are congested bumper-to-bumper during certain peak periods while adjacent railroad passenger capacity lies relatively idle; new and expanded airports are demanded to relieve nearly saturated facilities in Boston, New York and Washington, while other airports remain under-utilized. Only a major effort to correct these imbalances and plan an integrated transportaion system can alleviate these problems and their inevitable growth.

Objectives:

The Northeast Corridor Transportation Project (NECTP) was established in 1964 in order to determine the inter-city transportation facilities required. The objectives laid down for the project were to:

1. Analyze the complex interactions between transportation and the economic and demographic development of the Corridor.
2. Forecast the demand for inter-city transportation services by mode in the Corridor
3. Describe the characteristics of transportation services that might be supplied
4. Consider fully the potential of innovative technology in relation to costs
5. Develop the necessary analytical tools to accomplish the foregoing tasks.

Using systems analysis techniques, the project has made considerable progress in developing a comprehensive, general approach to regional transportation analysis. The alternative ways of meeting the inter-city transportation needs of the Corridor through 1980 are determined and evaluated for investment decisions. Estimated demand for transportation is compared with the capabilities for various systems

and each system evaluated on the basis of the resources it requires and the benefits it affords to both users and the community.

Institutions:

The NECTP came into existence through a series of events starting in 1962 with a Congressional bill introduced by Senator Pell of Rhode Island which proposed a compact between the eight states along the Atlantic seaboard from Massachusetts to Virginia for constructing a new high-speed railroad from Boston to Washington. The bill did not pass; however, President Kennedy appointed an Executive Task Force on Transportation in the Northeastern Megalopolitan Corridor which, in the same year, recommended the study of transportation requirements to determine whether rail or another means of transport could better satisfy the region's needs in the next two decades (1965 to 1985). The President directed the Department of Commerce to determine the inter-city transportation requirements for the region between Boston and Washington through 1980 and to recommend alternative solutions.

The 1964 Interim Report on the Department of Commerce Washington-Boston Transportation Study, like the earlier report, suggested that improved rail service might offer a short-term solution to the problem of increasing demand for transportation in the region, but recognized that there were other major needs which were outlined in the objectives set down for the Northeast Corridor Transportation Project on its inception (see above).

In March 1965, President Johnson sent a message to Congress requesting specific funds for a High-Speed Ground Transportation Study and, on 30th September 1965, he signed the High-Speed Ground Transportation Research and Development Act of 1965. The Act authorized $90 million expenditure for a three-year period.

The NECTP thus became part of the Office of High-Speed Ground Transportation (OHSGT).

In July 1968, OHSGT was transferred to the newly formed Department of Transportation (DOT) as part of the Federal Railroad Administration (FRA) and the Act was extended to cover a total of six years to June 1971. In 1970 a further extension of one year to 1972 was made. The activities of NECTP, while part of the OHSGT, culminated in the publication of the Northeast Corridor Transportation Project Report of April 1970 and its seventeen supporting volumes. Following this, the OHSGT mission orientation was changed from one of research and methodological development, with a task force approach, to one of development and demonstration, with closer integration into the overall program of the FRA. The NECTP staff, which comprised the Transportation Systems Planning Division of OHSGT, was transferred to the Office of the Assistant Secretary for Policy and International Affairs in order that the systems analysis techniques developed could be applied to National transportation planning problems.

Funding:

It is not readily possible to segregate that portion of the OHSGT funding that has been allocated to the Northeast Corridor Transportation Project. The total OHSGT funding for five fiscal years (1966 to 1970) involved appropriations totalling $76 million. This amount is $51.4 million below the $127.4 million authorized by the original Act ($90 million) and the extension ($37.4 million). A further request for $21.7 million was made for fiscal year 1971.

Table A.1 indicates the allocation of funding for 1970 and the totals for the five-year period 1966 to 1970. The systems engineering allocations are almost entirely associated with the NECTP; most of the funding of the other groupings are not.

Research:

The research performed for the NECTP has been largely in the realm of transportation systems analysis and evaluation.

($ THOUSANDS)

PROGRAM CATEGORY	OBLIGATIONS F Y 1970	5-YEAR TOTAL F Y 1966-70
RESEARCH & DEVELOPMENT		
Systems Engineering	$ 1,615	$11,274
High-Speed Rail Research	2,054	10,511
Unconventional Systems	5,182	10,873
Advanced Technology	4,897	13,690
Total R&D	$13,748	$46,348
DEMONSTRATIONS		
Washington-New York	$ 489	$12,634
New York-Boston	106	6,725
Data Collection	726	2,739
Auto-train	9	2,869
Airport Access	95	312
Total Demonstrations	$ 1,425	$25,383
ADMINISTRATION	$ 1,027	$ 3,335
TOTAL HSGT	$16,200	$75,066

Table A.1 High-Speed Ground Transportation Program
Allocation of Appropriated Funds
Fiscal Years 1966 to 1970 [S4]

The basic tool used by the project to analyze transportation system alternatives is an interlocking set of analytical and simulation computer models representing the transportation sector of the corridor and its interaction with the economy of the region. Models and procedures have been developed which (1) enable competing transportation modes to achieve a balanced condition of supply and demand in the marketplace (2) assess the direct and indirect transportation system benefits and costs and (3) allow comparison of a broad range of alternative transportation systems incorporating new as well as existing technology.

The major tasks these models perform are:

1. Generation of alternative transportation systems -- specification of service characteristics of all modes; selection of sets of alternative modal mixes; representation of the network corresponding to each modal mix and development of cost estimating relationships for each mode in its network.
2. Forecasting socio-economic variables-population, income and land use for each sub-area.
3. Forecasting transportation demands - number of travellers by mode between area pairs as a function of population distribution, economic status and modal service characteristics.
4. Balance transportation supply and demand - calculation of the levels of transportation services and fares, by mode, which would balance supply and demand for a given modal mix.

The model system can be operated in steps to trace the consequences of transportation changes over a period of time.

The first full exercise of the model system was performed for a single time slot (1975) and is reported in the NECTP Report [S1].

Details of the research involved in developing the models have been described in the sections of this report concerned with the state-of-the-art and the College of Europe symposium.

The subject of research in the Northeast Corridor is not complete without some mention of the OHSGT sponsored program. The turbotrain and metroliner demonstration are not strictly part of the NECTP though they are obviously associated with it in that data obtained on these programs has direct application to the model system.

Contractual participation in the Metroliner service by OHSGT permits government monitoring of service standards and implementation of programmed experiments such as use of coach attendants, meals

included in the fare and incentive fares. Demonstration provisions require the railroad to provide complete cost and revenue data as a basis of cost-benefit economic studies. The statistics being gathered should aid in identifying the paramenters involved in modal choice and in establishing elasticities of demand to various service characteristics.

Achievements:

The major achievement of the Northeast Corridor project was the development of an equilibrium-seeking demand and supply model for transportation with which the impact of alternative transportation mixes on the region may be evaluated. As described above, the model is in fact a set of linked models. The NECTP report of April 1970 with its 17 supporting volumes, comprising more than 3,000 pages of text, figures and tables, documents the results of the first full exercise of the model system. Nine alternative transportation mixes were considered in the time frame of 1975; these nine systems are briefly described in Tables A.2 and A.3 in terms of the vehicle types involved and how they relate to certain aspects of public policy. Some of the major operating characteristics are given in Table A.4 and the financial characteristics generated by the models are shown in Table A.5. These data are taken from the summary report. It should be emphasized that the results and conclusions expressed in the summary report emphasized that the results and conclusions expressed in the summary report represent the first exercising of the complete model system and are thus preliminary in nature.

Alternatives	Modal Composition
1	Auto, Bus, Conventional Air (CTOL) Demonstration Rail (DEMO)[1] - 125 mph
2	Auto, Bus, CTOL, DEMO Short Take-off & Landing Air (STOL)- 370 mph
3	Auto, Bus CTOL, STOL High-Speed Rail "A" (HSRA) - 150 mph
4	Auto, Bus, CTOL, STOL High-Speed Rail "C" (HSRC) - 200 mph
5	Auto, Bus, CTOL, STOL Tracked Air-Cushion Vehicle (TACV) - 300 mph
6	Auto, Bus, CTOL, STOL, DEMO Vertical Take-off & Landing Air (VTOL) - 265 mph
7	Auto, Bus, CTOL, STOL VTOL & HSRA
8	Auto, Bus, CTOL, STOL VTOL & HSRC
9	Auto, Bus, CTOL, STOL VTOL & TACV

1. Demonstration rail assumes that the present Metroliner and Turbotrain services will be expanded and extended through 1975.

Note: Source of A.2 to A.5: Northeast Corridor Transportation Project Report [S1].

Table A.2 Nine Passenger Transportation System Alternatives for the Northeast Corridor

POLICY OPTIONS

Alternatives	New Modes[1]	Degree of Technological Innovation	Orientation to Metropolitan Area	Capital Cost	Service Characteristics	Public Support Required	Institutional Change Required
1	DEMO	None	Center City	Low	Fixed Linear	No	Little
2	DEMO & STOL	None	Center City & Suburbs	Low	Mixed	No	Little
3	HSRA	Some	Center City	Medium	Fixed Linear	Yes	Large
4	HSRC	Some	Center City	High	Fixed Linear	Yes	Large
5	TACV	Much	Center City	High	Fixed Linear	Yes	Large
6	VTOL	Some	Suburbs	Low	Flexible Dispersed	No	Little
7	VTOL & HSRA	Some	Center City & Suburbs	Medium	Mixed	Yes	Large
8	VTOL & HSRC	Some	Center City & Suburbs	High	Mixed	Yes	Large
9	VTOL & TACV	Much	Center City & Suburbs	High	Mixed	Yes	Large

1. Auto, bus and conventional air are included in all alternatives
STOL is included in alternatives 2 through 9

Table A.3 Relationship Between Transportation System Alternatives & Public Policy Options

Alternatives	New Modes	Sustainable Top Speed MPH	Average Speed[1] Terminal To Terminal MPH	Average Speed[1] Door To Door MPH	Total Corridor Intercity Travel[2] Billion Pass. Miles
1	DEMO	125	72	46	19.4
2	DEMO STOL[3]	125 370	72 141	46 63	20.3
3	HSRA	150	109	58	21.1
4	HSRC	200	152	71	21.7
5	TACV	300	198	79	22.3
6	VTOL	265	147	74	20.3
7	VTOL HSRA	265 150	152 109	70 57	20.8
8	VTOL HSRC	265 200	152 157	70 70	21.5
9	VTOL TACV	265 300	144 205	70 78	22.1

1. Statistical averages computed for each mode by dividing total passenger hours into total passenger miles. Note the controlling influence of access-egress time on door-to-door speeds.

2. Includes auto.

3. STOL is included in Alternatives 2 through 9.

Table A.4 Summary of Major Characteristics of NECTP Transportation System Alternatives

NEW MODES

Alternatives	New Modes	Total Capital Cost $ x 10^6	Incremental Annualized Costs $ x 10^6	Annual Revenues $ x 10^6	Annualized Surplus or (Deficit)[1] in 1975 $ x 10^6
1	DEMO	70	61	144	83
2	DEMO	69	60	141	81
	STOL[2]	195	244	244	0
3	HSRA	1,590	240	213	(27)
4	HSRC	2,600	355	288	(67)
5	TACV	3,340	452	349	(103)
6	VTOL	1,060	318	318	0
7	VTOL	966	310	310	0
	HSRA	1,580	230	175	(55)
8	VTOL	971	292	292	0
	HSRC	2,590	340	240	(100)
9	VTOL	966	291	291	0
	TACV	3,330	440	292	(148)

1. STOL and VTOL service and fare levels were set to achieve break-even operation at a 10 percent return on investments; HSRA and TACV service levels were set to maximize profits (revenues less costs); DEMO figure represents the difference between incremental costs to provide DEMO service. It does not reflect any allocation to DEMO service of costs currently borne by the railroad.

2. STOL is included in alternative 2 through 9

Table A.5 Summary of Financial Characteristics of NECTP Transportation System Alternatives

The following general conclusions were drawn about future inter-city passenger transportation in the Corridor:

1. Automobiles will continue to be the dominant mode through 1980 regardless of improvements to other modes
2. Effectiveness of common carriers in improving door-to-door service will be seriously limited by delays and relative slowness of access to and egress from terminals in the metropolitan areas
3. If government agencies responsible for inter-city passenger transport do not act:
   a. major capabilities for providing rail service will not be used
   b. potential for short and intermediate air transport may not be exploited
   c. downtown -to-downtown transportation will contribute to congestion on urban transport facilities
   d. transportation facilities with high accident rates, heavy pollution levels and severe land requirements will expand
   e. rural and suburban areas will lose common carrier inter-city service
   f. the existing modes - auto, bus, air and rail - will not be coordinated for improved service and efficiency.

Specific conclusions reached in the evaluation of the nine alternative mixes were:

1. Boston -Washington rail service with Metroliner level of performance could realize revenues in excess of costs; however, for several reasons, including the high cost of capital to the railroads, it was thought unlikely that the railroads would provide such service without public support
2. Improvements to the Boston-Washington mainline could be made on a incremental basis, permitting testing of the attractiveness of better service at each step
3. STOL and VTOL aircraft modes could provide inter-city service, yielding before-tax revenues exceeding all non-government costs. Some improvements would be required in air navigation technology and in environmental impact planning, but only small technological

improvements in aircraft.

4. Either of two new HSGT modes - a rail system or TACV - would greatly improve inter-city transportation along the spine of the corridor; however, the present analysis shows neither of them to be commercially viable within the next decade

5. Combination of VTOL and HSGT would provide the widest choice of improved inter-city passenger transportation, generating the largest patronage, but it would result in the largest operating costs and capital outlays.

In the overall evaluation of the nine competing mixes, an effort was made to appraise such a mode in terms of environmental impact, dependence on improved terminal access-egress, dependability under all weather conditions, improved safety and ability to meet occasional peak demands. Relative evaluations of each system depend on the weighting assigned to these considerations.

Future:

The NECTP staff (The Transportation Systems Planning Division of OHSGT) has recently been transferred to the Office of the Assistant Secretary for Policy and International Affairs. This transfer essentially brings the project to a close in terms of its research and methodological development phase. More emphasis will now be placed by OHSGT in the area of development and demonstration within the overall program of the Federal Railroad Administration.

The use of comprehensive systems analysis can significantly reduce the probability of making capital outlays for transportation which are not responsive to public need or which may constitute inefficient ways of responding to public need.

The systems analysis techniques of the NECTP can be expected to be further developed, within the Office for Policy and International Affairs, for application to national transportation planning problems.

OUR PUBLIC RIGHTS-OF-WAY, April, 1973

by Verne R. Brown Engineering Supervisor Liaison - R/W for General Telephon Co. of Florida

Public Right of Way for The Utilities

The plight of utilities, particularly in our high density urban areas, is beginning to receive national recognition. Since the majority of utilities are located within our public rights-of-way, much of the utility's problems can be attributed to the lack of space for accommodating utilities within the public right-of-way.

The ever increasing demand for roads requires the utilities to expend large sums of monies and time that they may not have had the opportunity to plan. This in turn means service commitments will not be accomplished as planned and routine maintenance work will have to be waived in order to accomplish as much as possible. In the long run the utility gets further behind and the general public suffers.

The American Public Works Association in their Summary of a Symposium on Research Needs* listed various determinations of ways in which public right-of-way can be more efficiently used for construction of water, sewer, power and other utility lines, which bears reprinting.

a) Utility systems need to be considered as an integral part of the right-of-way, and their installation should be planned for before land acquisition to permit the most efficient use of the public way.

b) Guidelines need to be developed for designing highway structures to accommodate utility lines.

c) Cooperation and coordination among the several public authorities having jurisdiction in the region and the various utility systems are essential for efficient planning of utility installations and extensions and easement acquisition.

* Better Utilization Urban Space published by American Public Works Association, June, 1967

d) Coordination is needed for controlling use of space beneath public ways for public utility installation and all other permitted purposes. Uniformity in keeping and presenting information and use of standard maps are suggested.

e) Methods are needed for determination of priorities for installation of utilities as opposed to their installation on a first-come-first served basis.

f) Codes and regulations governing the installation of different kinds of utility services need to be examined and modernized so as to take technological advances into account in determining how close one service may be to another. A model set of criteria for regulations governing utility installations should be developed.

g) The compatibility of different utility systems must be considered with a view to their joint use of trenches or tunnels, in specific locations and with possible economics in installation and maintenance, and provision for installing and maintaining them with minimum opening of pavements and interruption to traffic.

h) Criteria should be developed on location, design, financing, etc., of utility tunnels or corridors ("utilidors") for orderly arrangement of utility services. As a place for shelter or movement, the utilidor may have civil defense value.

i) Use of pneumatic tubes should be investigated for possible value in mail collection and for transportation, of people, supplies and solid wastes.

j) Possibilities should be investigated and criteria developed for establishment of corridors for cross country installation of utility lines.

Only when utilities are recognized as part of the highway, will we have a totally designed highway that will provide the general public with economics and the service they demand.

In the meantime the utilities need to take the initiative of co-ordinating their designs jointly with one another and provide their conclusion on the highway plans. This will require coordination prior to the highway design.

To accomplish this feat the utility will have to "live" with the governmental agency, becoming almost an employee of that agency. He must be available, dependable and obtain a position of reliability with those responsible for the planning, scheduling and design of a highway.

As the trend continues towards the complete undergrounding of utilities and new systems come into being, the regulating and controlling becomes more stringent and the availability of right-of-way less and less. Innovations in utility design must be researched to keep pace. Many utilities today have or are adopting standard utility space allocations, joint trenching, random separations, joint use of structures and common tunneling.

This then is the major concern of the utility's right-of-way activities, that of keeping abreast with changing governmental policies and procedures and the coordination for the installation of utility facilities in a limited public right-of-way.

SEVEN PRINCIPLES FOR GEOGRAPHERS

by K.M. Clayton The Geographical Magazine, 1967

The environment is extremely complex, and anyone tempted to interfere with it, even in an attempt to reverse man-induced deteriorations, should wait until he has enough knowledge to predict the full results

of his activity.

> The interaction between man and the environment involves aspects of both the physical and social sciences, and an approach based on one alone is unsatisfactory.

The relationship between man and his environment is not simply the relationship that exists between the organisms of an ecosystem and their environment. Social and economic systems affect the interaction.

> Pressure on resources is a function of the social and economic system. Slash and burn economies with populations of a few persons per square mile are as capable of inflicting serious damage on the environment as the pressures found in small and highly industrialized countries.

The world pressure of population on resources, particularly of food remains serious. While both sides of this equation deserve attack, progress on reducing population growth requires a far more radical approach than we have achieved so far.

> The world does not run out of resources. With time they become depleted and more expensive, so that alternative materials become viable.

Resources available to man include the wasteproducts of his processing plants. As these wastes affect his environment, or as the alternative resources become scarce and expensive it is increasingly appropriate to recycle these wastes.

COMPLETE VALUE ANALYSIS: HIGHWAY BEAUTIFICATION AND ENVIRONMENTAL QUALITY From HRB No. 182, 1967

George L. Peterson, Assistant Professor, Department Civil Engineering Technological Institute Northwestern University

General Recommendations

Given the present state of the art with respect to understanding of environmental beauty, both for its own sake and in terms of its functional impacts, perhaps the best strategy to adopt on the question of highway beautification is the following.

1. Include excellent landscape architects, architects and designers in the decision process. Some are obviously better than others, but they are artists and part of their business is environmental beauty. Engineers have made great strides in the direction of understanding and controlling physical systems. but they know far less in the practical sense about environmental beauty than the architects and city planners. Let us give the artists a cautious ear. We might even listen to an anthropologist or two.

2. There is a great deal to be learned from plain old common sense and popular consensus. After all, it is only in very recent times that man has resorted to mathematics, models and rational analysis in making decisions. Men have survived far longer by doing what they feel is best than they have by doing what a computer tells them is the optimum solution to a linear program that one cannot even think about without getting a headache. Ask people what they want and, where possible, try to give it to them.

3. Engage in a continuing program of well-planned research. The costs, benefits, and substance of environmental quality have been largely untouched by the scientific method. This may be a very fertile field. People may object and say that art and people are things science should not invade, but the assertion that they are something is itself a contradiction of the position. Pleasure

objectified is not as great a mystery today as electricity was two-hundred years ago. Electricity is more a mystery than ever, but look what science has done just be observing its behavior.

This program of continuing research should not be allowed to suffer from a preoccupation with the environment alone. The research must study the environment in interaction with man and should thus be a cooperative effort, including not only environmental specialists such as engineers, architects, and planners, but also applied sociologists, psychologists, anthropologists, and others who admit the existence of man.

HRB No. 182 1967

Table 1

Evaluation of Effectiveness, Costs, and Ease to Administration of Mechanisms to Protect Scenic Highway Corridors

Mechanism	Effectiveness	Cost	Ease of Administration	Comments
Wider-than-usual right-of-way	Could be most effective, but the area would need to be very limited	Cost would be very high, probably prohibitive	Easy to administer because control would be obsolete	Private property owners would probably resent "excessive" acquisition by government.
Outright acquisition of either inner or outer zones of corridor	Very effective if authorized aid permitted by courts	Costs could be burdensome, even prohibitive	No special problems of administration except contesting some antagonism against public authority "being in the real estate business"	
Fee acquisition and leaseback	Very effective	Very costly and requires large capital outlays which are later repaid in part atleast	May be difficult to sell property owners on the idea; extends the public domain considerably	Facilitates maintenance; keeps the corridor "alive"
Acquisition of scenic or conservation easements	Could be quite effective if right kind of easement acquired	Cost would be reasonable in some cases, considerable in others, especially in or close to urban areas; costs in these instances might be so great that outright	No particular difficulties except one of educating the public	

Mechanism	Effectivness	Cost	Ease of Administration	Comments
		acquisition would be more reasonable		
Zoning at local level	Not very effective only as effective as zoning is; subject to pressure	No cost except that of administering the program	Same difficulties as those associate with zoning today and maybe a few more because this would be a new application	Generally, not a very happy solution
Zoning at state level	Hardly ever has been used-its legal fate is largely unknown; if politics were kept out of administration, might be reasonably effective, but it is essential that it be done	No costs other than administrative costs	Administration would be subject to the same detail as local zoning	
Scenic highway corridor reservation (state level)	If sustained in courts as a valid exercise of police power, could be reasonably effective; would require new legal concept; would have none of legal or popular encumbrances of zoning	No costs except costs of administration of program	Once the notion is clearly defined there should be no difficulties of administration; in fact, large areas could be so regulated with a minimum of public effort	Well worth a try

Mechanism	Effectiveness	Cost	Administration	Comments
Special Conservation or corridor districts	Could be one of the most effective, but would be a broad new application of a relatively new device	Would be negligible, only costs of administration	No significant problems of administration	Offers considerable promise
Comprehensive planning	Would be effective if the device is applied in its best and broadest connotations	Generally, only costs would be those of administration, unless acquisition mechanisms are considered part of this process as they might be	Usual problems, which may be many, of a comprehensive planning approach	
Restrictive covenants	Could be helpful in a small, limited area, but should hardly be relied on for an entire scenic road project; is more of a supplement, particularly in urban areas	None, except small costs to property owners	Handled privately, perhaps under government auspices	

GUIDE-LINES FOR THE EVALUATION OF ROUTE ALTERNATIVES IN FEASIBILITY STUDIES

Environmental and Operational Planning Branch - Operational Planning Services - Methods and Development Section

Prepared by A. Titishov February 1973.

Introduction

The increasing need and the demand for the diversity and efficiency within the transportation systems and a growing awareness by the public for affecting the decisions which influence and govern their daily lives, necessitated the reevaluation of the existing planning techniques.

In the past, with the abundance of the available space, the main emphasis, in locating a transportation facility, was placed on economical requirements. However as the conditions began to change, the need developed for the focusing of attention on social and environmental impacts and consequences produced by a transportation facility, and greater participation by the community. It has become necessary for the planners to apply methods, for the development of transportation modes, which will include the desires and needs of the community and the requirements of the transportation authority.

As a result this study was developed to provide the Feasibility planners with a tool for the location and evaluation of transportation facilities. It will endeavour to integrate the views of various disciplines such as engineering, economics, sociology and ecology and present them in an associated form, with the optimum involvement of each.

The task of developing such a procedure will never be completely finished; it is an evolutionary process both in the development and the use of it, and as our social and physical environment changes,

so must the techniques undergo the innovations of new disciplines.

Purpose and Scope

The evaluation plays a crucial role in making the following basic objectives of the location process:

a) To achieve substantial and effective community agreement
b) To assist the decision-making process

Consequently the purpose of this study is to develop a flexible methodology for the identification and the analysis of impacts and their consequences created with the introduction of a transportation facility; to develop practical and theoretically valid technique, for the evaluation of issues and alternatives and in view of the complex nature of the topic, to provide operational guide-lines. However the analysis and the evaluation presented in this paper is not to find decisions, but to produce results that will assist the decision-making process.

There is a tendency to reduce the location process into some form of mathematical formula, which will combine the involved issues and disciplines, however no way yet has been discovered to do so; it is highly doubtful whether really helpful decision guides can be developed that combine the tangible road-user considerations with the intangible non-user impacts into one overall index, pointing to the preferred alternative. It is rather the separation of issues according to the hierarchy of the decision criteria and according to the type of judgement that can be placed upon them.

The scope of the evaluation process, which is the main topic of this study, can be summarized with the following phases:

a) Summary and review of input on the basis of developed alternatives, affected interest and anticipated impacts.
b) Assessment of the evaluation process from the perspective of each involved interest.

c) Identification of areas of conflict and agreement based on the comparison of alternatives.
d) Identification of issues of feasibility and desirability based on the potential of alternatives.
e) Assessment of the potential of each alternative based on the proposed objectives.
f) Identification of priorities for the developed alternatives, based on impact prediction and community interaction.

In order to present a comprehensive outline of the evaluation process within the total framework of feasibility studies, this publication also briefly outlines the proposed framework and reviews topics which have been previously presented and issued under the headings of:

1. State-of-the Art of Formulating Objectives
2. Guide-lines for Weighting of Specific Objectives.

The additional topics, though not belonging to the evaluation, are the preceding phases and as such the necessary input.

The Feasibility Planning Process

The design of any transportation facility begins with the selection of a route. It is probably the most important and the most difficult part of the whole process. The best route will be the one on which the best transportation facility can be most effectively integrated into a community structure and its transportation system.

Since planning is a rational process, the essential andmore or less consecutive phases of feasibility planning can be arranged into the following categories:

1. The Study Design
2. Input
3. Development of Alternatives
4. Analysis
5. Evaluation

It must be noted, however, that any planning study should be governed not by the designated techniques or procedures, but rather by the needs and tasks of each project as they fit within the procedural framework.

ONTARIO TRANSPORTATION AND COMMUNICATIONS PLANNING DIVISION

Guidelines for Public Participation in the Planning Process, 1972

Introduction

> "Wiring 'the public' into the system making them a part of the guidance machinery of the society is the most critical political task of the coming generation." Alvin Toffler, Future Shock, 1970, pg. 479

This report outlines procedures for involving informed public opinion in the planning process. Its purpose is guidance. It is not to be misinterpreted as a rigid directive on public participation. The most important element of any such program must be its flexibility.

T here is a schematic representation of public participation in the planning process.

I-1 The Objective of Public Participation

To afford every individual who is affected by future transportation projects an equitable opportunity to participate effectively in the planning process. Ideally this includes all segments of the population; from the most apathetic to the most active citizen.

I-2 The Need for Public Participation

An increasingly aware public demands the democratic right of involve-

ment in planning that will affect their lives. The arbitrary imposition of a humane future is no longer tolerable or practical in many locales. "Spadina" and the "New Pickering Airport" are examples of the public's desire to be involved. The Federation of Ontario Naturalists (F.O.N.) had this to say concerning the new airport and the attitude of the Federal Government "it challenges the fundamental right of the public to be fully informed and involved in projects of such far reaching importance." F.O.N. Newsletter, Vol.13 No. 3, June - July 1972, Pg. 2

I-3 The Approach to the Guidelines

These guidelines for the design of public participation programs have been developed on the basis of actual experience to date and a judicious use of the existing knowledge. Such a program must effect the optimum balance between: community (public) needs, project goals and available resources, while maintaining the flexibility to respond to any unexpected development.

I-4 The Program Structure

A public participation program can be considered to occur in two basic phases. The first phase is the start-up and program design phase. The final phase is the integration of the public participation program within the planning process (implementation phase).

Two levels of participatory methods have been considered - prime and support. The prime methods (public forum and citizen's advisory group) are so designated for the following reasons. They are well adapted to a cyclical exchange of information with the public. They incorporate a high degree of flexibility in their composition and operation. They are efficient and well suited to a staged planning process. The role of the support methods is to improve the participation process by overcoming the shortcomings of a given primary method when it is applied within the context of a particular

community and a specific project. A total participation program is a composite of one or two prime methods and generally a number of support methods.

Before a public participation program can be designed and implemented the planner must have a working knowledge of the various methods of interaction and involvement. These are discussed in Section III.

I-5 The Dimensions of Public Participation

There are two dimensions that must be considered in the design and evaluation of public participation programs. One is the process of human interaction which occurs as people progress from the identification of a problem, or need, to its resolution. The other is the mutual eduction of the planners and the public through an exchange of information. The two dimensions are of course complementary.

Human interaction involves two fundamental types of contact - 1) people⇌people and 2) people⇌government (planners). There is a third, and that is planner⇌planner, however, for the purposes of these guidelines, it is assumed that this form of interaction is fully developed. The quality of interaction that occurs will depend to a large extent on the efficient employment of the available methods for involvement.

The educational role of a participation program must be assessed on the basis of two factors --1) how effective is it in educating the planners, and 2) how effective is it in educating the public.

The planners require information concerning local - knowledge, goals, values, priorities, preferences, attitudes and opinions. The logical, and in many cases the only, reliable source of this information is the people whom the planning process will affect.

Public education is a composite of three factors --1) the individual's educational opportunity, 2) the creation of public awareness, and 3) the proportion of the affected public reached by the program (coverage).

1) The individual's educational opportunity considers, how completely a person can become informed about the situation and the planning process.
2) There are two aspects to public awareness -- awareness of the study in general and the awareness of the means for involvement in the process.
3) The coverage of a program is the actual proportion of the affected community that is reached.

Each method for interaction can be evaluated on its potential for achieving the above factors.

I-6 The Performance Criteria

The fundamental principle is that -- every citizen affected by a project have an equitable opportunity to effectively participate in the planning process. This does not mean that every step in a study must be fully open to the public. For example, only the representatives (or their substitutes) are formally invited to the citizen's advisory group meetings. The reason for this, is that this method (or technique) of public interaction derives its main benefits by allowing the planners to work with a small representtative sample of the local population.

The following are the performance criteria of an effective public participation program:
1. Every individual affected by a project must have the means of participating in the study (accessibility). The awareness of a process without the means for effective involvement can lead to frustration and disillusionment.

2. Direct contact with the public must be maximized through both formal and informal encounters. This contact is essential to the program's credibility.

3. The program must be comprehensible by those whom it affects. Technical jargon should be avoided and instead lay terminology employed.

4. The program must be fully integrated with and complementary to the overall planning process. The cyclical public participation activities must coincide with the various stages of the planning study.

5. There must be a component of public participation at each stage in the study. The public must not feel they are being involved after the fact or in any way being prevented from obtaining pertinent, topical information.

6. In principle, all information relating to the study must be available to the public at all times. In practice, it must be provided at regular intervals that coincide with the stages of the planning process (i.e. a peaks and valleys function). This information should include the following: what has transpired, what is the present situation, what is the next step, and what should the public do to involve themselves further in the process.

7. The participation program must have the flexibility to accommodate the unexpected. Individuals and groups interact and react in complex ways. The planner may receive more or less participation than he has anticipated and must be able to adjust accordingly.

8. The honesty and validity of the public participation process must be protected. The public should be guaranteed that the program will be a fair and honest one.

9. The public must be fully aware that the responsibility for the final decision rests with the Ministry of Transportation and Communications.

10. The planners must be consistent in their dealings with the public. If more than one individaul is responsible for the

participation program, then a continuous review by these persons of the project's status is a necessity in the maintenance of a program that is completely coherent to the public.

11. No individual or group should be allowed to dominate in the participation process. Every affected person must have an equal opportunity to participate.

12. Where surrogate techniques are employed (i.e. citizen's advisory group) the planners must have some means of monitoring the effectiveness of their communication link with the public at large.

13. The process should achieve its objectives as efficiently as possible.

AN INFORMATIONAL REPORT ON TECHNIQUES FOR EVALUATING FACTORS RELEVANT TO DECISION MAKING ON HIGHWAY LOCATIONS

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I. Introduction

In the last few years, the decision processes underlying the location and construction of highway facilities have become increasingly more complex, and involve many facets of engineering, planning and community interaction and participation. An increased social awareness and concern for the environment have added to this complexity (see Appendix A). This document reviews and analyzes selected evaluation aids and comments on their respective advantages and disadvantages, and their amenability to use by highway administrators involved in local highway decisions. Recent modern commentary and concern on the impact of highway decisions in the neighborhood, the community and the region make a deeper, more comprehensive set of insights into evaluation of highway alternatives necessary

and desirable.

The modern highway decision process relates to generating a location and design alternative for the highway facility, predicting the consequences, evaluating these consequences, and accepting, modifying or rejecting the alternative. As such, the following consequences require prediction and evaluation:

1) Construction and right-of-way costs (including costs of relocations).
2) User costs of fuel, oil, wear and tear on vehicle.
3) Safety costs--accident rate; costs of accidents.
4) Maintenance costs of the facility.
5) Potential for multiple use and joint-development.
6) Environmental and social impacts:
   changes in land use and land value
   changes in distribution of wealth, by social-economic subgroup and industrial and commercial subgroups
   changes in noise levels
   changes in air quality
   changes in water quality and recreational use
   changes in the value and use of time
   changes in aesthetic appearance of the environment
   changes in neighborhood and dominance of selected areas, such as downtown, rural-urban fringe etc.
   changes in ancillary community services, polie, fire, etc.
   changes in community travel, parking and local circulation patterns of the circulation system
   changes in value added by manufacturing and commercial activities in the area.
   changes in population distribution, growth pattern and growth rate

Obviously, the decision surrounding such a wide and interacting set of consequences is complex, and evaluation is difficult. Some weighting technique of part of all of the above consequences is undertaken by indivudal citizens, or participation groups of citizens, the engineering and planning segments involved with the design of the facility, and the community government involved in administering

it, and appropriate state, regional and federal officials involved in participation and/or supervision at a local level. A summary of the above statement lies in the following gross aspects of highway decisions:

1) The have several consequences.
2) Few consequences are measured on a common scale, and little is known about operational measurement techniques for the more vague consequences, such as aesthetics, etc.
3) Different community groups place different values on the totality of such consequences.
4) Interaction, often in the form of conflict and competition may frequently occur between subgroups of citizens and the community government and engineering-planning officials, yielding a resultant compromise, modification, or rejection of location and design alternatives.
5) Interaction and modification on a location and design decision may occur, in conjunction with (4) above, up and down the hierarchy of relevant state, federal and local government officials.

Objectives: The Highway decision should be a step toward accomplishing relevant local state or federal goals which improved transportation systems can enhance, such as increased safety, lower travel time, lower commodity rates and prices, increased cultural and social mobility, increased trade between regions, etc.

Critieria: Where possible, as stated above, yardsticks for measurement of attaining the above objectives, termed criteria, should be employed. Relating to the above, some examples include: for increased safety-accident rate/mvm; lower travel time - trip time in minutes from point A to point B; increased trade-tons of commodity x shipped from A to B after facility opening as compared to before.

Alternatives: The reasonable set of highway locations and designs to be considered in fulfilling the objectives of improved transportation.

That is, the alignment, profile, right-of-way, cross-section, drainage, interchange and intersection configurations, and control types and devices.

Resources and Constraints: The "ammunition" or "restriction" one has placed on solving the location and design problems. Usually, money, time, soil type, original topography and surrounding land use, manpower, engineering designs, and local political pressures and viewpoints can be considered resources or constraints for a location and design problem, depending on the degree of positiveness or negativeness of each of them as they relate the local problem under consideration.

Model: An evaluation technique, termed a "model" should attempt to integrate the aspects of the decision originally discussed on the previous two pages within the above framework of objectives, criteria, alternatives, resources and constraints and yield a set of feasible alternative locations or designs, or if possible, a "best" location or design alternative.

Although many evaluation methods are currently in use or proposed, the utility of these methods depends greatly upon the knowledge, experience and personal values of the evaluator(s). In addition, many of the methods available have application to only limited factors (i.e., user costs and benefit-cost analysis) or project situations. The use of an evaluation method does not replace the elements of discussion and compromise which are needed to achieve a solution which optimizes the public interest. Accordingly, it is not possible at this time to recommend a single method, or combination of methods, for universal application.

It is possible, however, to describe some of the available techniques which can aid the evaluator in judging the comparative merits of various project alternatives. These "evaluation aids" have been classified by their general types and a description of them will follow.

Any of the aids discussed can be helpful, but they should be used only with full knowledge of the weaknesses inherent in each technique. For instance, the mathematical techniques generally strive to obtain a single indicator of effectiveness for each alternative. In so doing, many factors with differing dimensions (dollars, numbers or subjective descriptions) are reduced to a common measure. Such a reduction often destroys, or at least hides, most of the information which is needed by the decisionmaker. While the visual evaluation aids do not attempt to obtain a single "score" for each alternative, these techniques must often be combined with other evaluation aids to allow consideration of all significant factors. In addition, in trying to achieve a common denominator for factors which cannot be directly compared, data which may be important to the decision makers can be lost or obscurred. If evalution techniques are applied by persons other than the decision makers, these analysts should have a good understanding of the type of information which the decisionmakers need, and the most effective techniques for presentation of this information. An attempt should also be made to eliminate double or triple counting factors, unless this is desired to allow added weight to a certain set of effects. For instance, effects of dwelling unit acquisition are also reflected in numbers of persons displaced, relocation costs, right-of-way acquisition costs, etc. While all of these may require separate analysis in a given situation, it should still be recognized that these are not wholly independent factors.

Appendix A: Socio-Economic and Environmental Factors For Consideration in Highway Location and Design

The following lists identify general factors which may be deserving of consideration in the evaluation of a transportation system improvement. While the lists are reasonably comprehensive, the decision maker must exercise judgment in determining if other specific or unique factors should be considered in the analysis of a particular project.

For conveneience, the factors have been divided into four broad, although not mutually exclusive, categories:

1. Effects on the stationary environment
2. Effects on the transitory environment
3. Neighborhood and community impacts
4. Traditional factors in highway improvement analysis

1. Effects on the Stationary Environment

1. Aesthetics
2. Agriculture
3. Aquatic life protection
4. Coastal areas, estuaries, waterfowl refuges and beaches
5. Farms, forests and outdoor recreation areas
6. Flood plains and watersheds
7. Mineral land reclamation
8. Navigable airways
9. Navigable waterways
10. Raw materials
11. Scenic enhancement
12. Soil, plant life, erosion and hydrological conditions
13. Wildlife protection
14. Other topographic factors

2. Effects on the Transitory Environment

1. Air quality and air pollution control
2. Chemical contamination and food production
3. Climatological features
4. Disease and rodent control
5. Health hazards and other dangers
6. Herbicides and pesticides
7. Human ecology
8. Noise control and abatement
9. Radiation and radiological health
10. Sanitation and waste systems
11. Water quality and water pollution control

3. Neighborhood and Community Impacts

1. Activity patterns
2. Community pride
3. Cultural and recreational opportunities
4. Community protection services
5. Domestic privacy
6. Economic stability of the community
7. Educational systems
8. Employment opportunities
9. Energy general and supply
10. Historical and archeological sites
11. Housing and building displacement
12. Impacts on other institutions
13. Land values and uses
14. Neighborhood disruption
15. Personal and community identity
16. Population distribution
17. Preservation of open space
18. Property tax base
19. Relocation assistance
20. Special impacts on low-income areas
21. Utility services
22. Visual quality of the environment
23. Zoning regulations

4. Traditional Factors in Highway Improvement Analysis

1. Business and trade
2. Congestion in Urban areas
3. Construction material availability
4. Disruption during construction
5. Existing highway system
6. Facility appearance
7. Highway costs and system economics
8. International implications
9. Land access
10. Low travel costs

11. Modal choice and compatibility
12. Multiple-use of highway rights-of-way
13. Nationaldefense
14. Regional comprehensive planning
15. Special impact on regional jurisdictions
16. Tourism
17. Transport system reliability
18. Transportation and handling of hazardous materials
19. Transportation safety
20. Travel convenience and efficiency

INSTITUTE OF LAW RESEARCH AND REFORM THE UNIVERSITY OF ALBERTA
EDMONTON, ALBERTA REPORT NO. 12 March, 1973

REPORT ON EXPROPRIATION

I. Introduction

This subject was one of the first undertaken by the Institute on its establishment in 1968. Our study received the formal support of the Honourable Harry Strom, former Premier of Alberta, and of the Honourable Peter Lougheed, the present Premier.

There were strong reasons for undertaking this project. Although, the Expropriation Procedure Act of 1961 was a good step, there are still three tribunals that deal with expropriation: the court (with arbitration as an alternative) for Crown takings, the Public Utilities Board for municipal takings, and the Surface Rights Board (formerly the Right of Entry Arbitration Board) for the taking of rights-of-way for pipe lines and power lines.

In addition there has been wide criticism across Canada of the fact that in many cases the taker can acquire title without even any notice to the owner. Ontario's Royal Commission on Civil Rights (the McRuer Commission) made important recommendations for the

giving of notice to the owner so that he could object if he wished. The recent statutes of Ontario, Canada and Manitoba reflect this recommendation.

Another ground of complaint is that there is often a long interval between the taking of the land and of the receipt of compensation.

The criticism of existing law has not been confined to procedures. The principles of compensation have come under attack.

In Ontario, the Law Reform Commission in 1967 made recommendations for changing the basis of compensation. These recommendations together with those of the McRuer Report on procedures form the basis of Ontario's Expropriation Act 1968-1969. The Ontario Act in turn had great influence on the federal Expropriation Act of 1970 and Manitoba's Expropriation Act of the same year. In 1972 the Law Reform Commission of British Columbia published a thorough and helpful report on expropriation in that province, accepting in general the changes made by the recent Acts.

While we are indebted to the recent studies and legislation, and have borrowed extensively from them in our Recommendations, we have paid particular attention to Alberta statutes and decisions. There is one subject in particular on which the recent statutes are largely silent. They do not deal especially with exproporiation of rights-of-way; and they do not deal with rights-of-entry on to the surface of land by the person who owns the minerals beneath. This right-of-entry, which is very important in Alberta, has much in common with expropriation. We decided from the beginning that any report on the subject must include rights-of-entry.

In January 1971 we prepared a Working Paper on Principles of Compensation. It was circulated widely and a number of comments were received. In May 1972 we circulated a Working Paper in connection with Procedures, which also produced some comments. This Working

Paper did not cover rights-of-entry because the Surface Rights Bill was then before the Legislature. Later however we circulated to those particularly interested a short memorandum of the problems connected with rights-of-entry as they appeared to us.

While the number of comments is less than we had hoped, those we did receive have been thoughtful and constructive. We obtained much assistance too from discussions from time to time with a number of people.

The following monographs have been useful:

John Morden, An Introduction to the Expropriations Act 1968-69 (Ontario),

Eric Todd, The Federal Expropriation Act: a Commentary.

In this report we shall refer to the first as Morden and to the second as Todd.

In our examination of procedures we have tried to evolve a machinery that is fair and as expeditious as fairness permits. Procedural fairness seems to us to require

1) notice to the owner of a proposed expropriation;
2) provision for objections by the owner;
3) if his land is taken, the right to payment of a reasonable proportion of his compensation before he is obliged to give up possession;
4) that the time from the inception of the expropriation until surrender of possession should be kept to a minimum both in the interest of the public and the owner;
5) that the procedures be as uniform as possible, while recognizing that some types of expropriation may require variation from the general scheme.

The scheme whereby the owner is afforded an opportunity to object is this:

1) There is in every case an approving authority who is politically responsible and whose approval is necessary to the taking. Usually he is a Cabinet Minister. In some cases the expropriating authority and the approving authority are one and the same--for example in the case of Crown takings the Minister of Highways might act in both capacities and in municipal takings the council will be its own approving authority.

2) The expropriating authority notifies the owner of its intention to expropriate.

3) If the owner objects his objection is heard by an inquiry officer. The inquiry officer is a person independent of the expropriating authority and he holds a public hearing at which both sides will be represented.

4) The hearing officer makes his recommendation to the approving authority who either approves or refuses to approve the taking.

5) On registration of approval in the Land Titles Office, and not before, title vests in the expropriating authority.

After title has been taken, there must be provision for settling of compensation. The scheme we propose, which is like that in the recent Ontario and Canada Acts, is this. The taker is obliged to furnish an appraisal and to notify the owner of his right to an amount based on the appraisal. The notification we call the proffer. The owner may accept it without prejudice to his right to claim further compensation. The scheme of the Act is to require the different steps to be taken within specified times so that the settling of compensation will not be drawn out.

As a device to procure agreement on the amount of compensation both Canada and Ontario provide for negotiation which is designed to bring the parties together. We do not recommend this formalized procedure. Often the parties will negotiate voluntarily. If one or the other is unreasonable the case will have to go to expropriation anyway and the negotiation procedure will simply consume extra time.

We shall make Recommendations with respect to the date as of which compensation is to be fixed, the taker's right to possession, the owner's right to interest, and the costs of the proceedings.

A last basic procedural Recommendation has to do with the tribunal to fix compensation. We think there should be a single tribunal which would include the Surface Rights Board. It would have comprehensive jurisdiction, though in the case of Crown takings the owner would have an option to have the compensation fixed by the court.

Turning from procedures to principles of compensation the main Recommendations provide for

1) market value as the basic method of assessing the expropriated land;
2) reinstatement as the basis of compensation where the structures on the land do not have a market value;
3) an allowance to the home owner where the cost of equivalent accommodation is above the market value of his expropriated home;
4) damages for injurious affection on a partial taking;
5) compensation for disturbance including business losses where the owner is compelled to move;
6) separate valuation of separate interests in the expropriated land.

The Power to Expropriate

One preliminary question is whether we should attempt to prescribe a formula as to the bodies that should have the power to expropriate. We all are strongly of the opinion that the Legislature should

consider carefully before granting the power to expropriate. We all belive that consideration of present grants might well be undertaken. We agree with the comment of the Honourable Mr. McRuer (Royal Commission Report No. 1, Vol. 3, p. 980):

> It cannot be too strongly emphasized that the Legislature should not confer the power of expropriation on any body or person unless it is clear that the power is inescapably necessary in the interests of government and the adequate controls over its exercise are provided.

However, the majority of our Board are of the opinion that we should not in our present project examine the existing grants of the power to expropriate.

A minority view would make an attempt to restrict the power in terms of the concept of public use. Admittedly this is difficult to do. In the United States the Constitution confines the power of expropriation, called "eminent domain", in federal takings to those "for a public use". The cases show that "public use" has been expanded far beyond the original State prerogative on which it was based. It is clearly too late to take the power away from all private corporations, but one of our members would have made an attempt to formulate a test based on public use.

II. The Meaning of Expropriation

The first party to the procedure is the person who owns the fee simple in land or some lesser estate or interest. We call him the "owner". The other party is the "expropriating authority". "Expropriation" is the taking of the land or an interest therein.

Historically, the power to expropriate land, sometimes called the power of eminent domain, was part of the Crown's prerogative. As to the Crown's obligation to compensate, the law was in doubt. In modern times, the power has been spelled out in statutes and extended from the Crown to municipal and other public bodies and

sometimes to private corporations. In most cases compensation is specifically provided for.

Usually there is no doubt as to whether there has been a "taking". However, a statute sometimes provides for a restriction on an owner's rights over his land without a literal taking--zoning laws and restriction on access to land are examples. In the United States there are decisions which say there may be a taking where a statute operates to render the land valueless; but the general Canadian view is the there is expropriation only where there is a taking. Nevertheless, even under our law there are borderline cases. Examples are: rights of entry under section 22 of the Public Works Act; the right of a municipality to erect poles on private land under the Municipal Telephones Act; the right of the Alberta Research Council to enter upon, take and use land without the consent of the owner; and "replotting" under the Planning Act.

We have collected and analyzed in Appendix A the Alberta statutes which give the power to expropriate or something approaching it.

A general Act such as we propose applies to expropriations but this cannot ensure that the Legislature will always confer the power in explicit terms. We would hope that the Legislature will use the word "expropriate" whenever it intends to confer the power.

This Report will recommend a general Expropriation Act, and it is appropriate at the outset to define "expropriation". The present definition in the Expropriation Procedure Act is "the taking of land without the consent of the owner by an expropriating authority in the exercise of its statutory powers". Ontario's definition is the same, while in the Canada Act, "expropriated" means "taken by the Crown under Part 2". We think the Alberta definition is adequate.

A STUDY OF THE ECONOMIC AND SOCIOLOGICAL IMPACT OF CONSTRUCTION AND INITIAL OPERATION OF THE TRANS ALASKA PIPELINE

Alyeska Pipeline Service Co. Inc., Bellevue, Washington, Sept. 1972

Executive Summary

This study attempts to estimate the socio-economic impact of construction and initial operation of the trans Alaska pipeline. Judgments about potential impacts are made by integrating estimates of future construction activities, econometric model projections of State and regional employment and population, and considerations of social institutions and the services they provide. Impacts are assessed by comparing the differences in employment and population between the situation in which the pipeline construction occurs and the projected normal growth of the Alaskan economy. Given the limitations of the study assumptions and the econometric model, the primary results and conclusions of this study are as follows:

* The most general economic and sociological impact is achievement of a given level of activity two or three years earlier than would be achieved without the construction of the pipeline. Thus a very rapid economic growth during the construction period followed by a few years of minimal growth after the construction has been completed is projected. For example, at peak impact (1975), total employment is expected to be about 15% higher (18,000 jobs) than it would have been without the project. Following this peak, growth in employment will be very slow until it resumes its normal long-term pattern in approximately 1978. Similarly, the total number of doctors, teachers, firement, etc., required with the pipeline project will be greatly increased during construction.

* These impacts will not be felt uniformly across the State. Few construction personnel will live in Anchorage, but 50% of the total peak differential increase in the trade and service sectors

is expected to occur there. Due to the large labour base the impact should be relatively minor. Fairbanks will be more directly exposed to construction worker impact, and a peak employment increase of 25% in trade and services is projected. After construction the growth in Fairbanks is projected to be essentially zero for a few years. Fairbanks may become a center for "off-hour recreation" for a large number of construction workers. On the North Slope, Barrow is bound to be impacted strongly by demands generated by the nearby construction activity. Due to the small labor base in Barrow, even small numerical increases will stress the supply of services. The Valdez region will experience a doubling of employment levels, and impacts on medical, school and housing supplies will be significant. The impact in Valdez will be more permanent and will require a more positive planning effort.

* Peak (1975) population impact is projected at 40,000 on a statewide basis (12% higher than without the pipeline). Housing shortages will occur, and the use of mobile homes will be required to respond to local short-term demand. An increase in "victimless crime" (e.g., prostitution, gambling, con games, etc.), can be expected in the Valdez-Fairbanks corridor, resulting in a demand for additional police services. Double shifting of classrooms and teachers will be required in the Valdez area.

* Projected impacts appear relatively insensitive (over reasonable ranges) to their construction activity variables considered: start-up time, Native employment, ratio of resident and nonresident employment, movement of dependents to Alaska, time-off locations. Restricting immigration to the State during the construction period will help to reduce unemployment and will reduce the impact of the project.

* Following the construction period, workers released from the project will have to be prepared to change occupations and residency as they seek employment. Due to the continued growth of the

economy sufficient job opportunities should exist for most workers. Native workers not permanently employed on the pipeline may return to their villages. It is hoped that, given the Native Claims Settlement Act and the activities of the Native corporations, sufficient demand for trained Native corporations, sufficient demand for trained Native workers will exist so that they will not be forced to return to a subsistence economy pattern.

Conclusions

The most significant conclusion of this study is that, despite its magnitude, the trans Alaska Pipeline project will not produce a "boombust" imbalance in the Alaska society. The primary basis for this conclusion is the fact that the pipeline construction occurs against a background of growing economy, paced by continuing petroleum exploration and other natural resource exploitation. The most general impact is the achievement of a given level of activity two to three years earlier than would be achieved without the construction impact in the normal growing economy. Thus the impact is one of rapid short-term growth followed by a static period, until economic demand requires new additions to productive capacity. Taking the impact on the Alaska economy as a whole, this statement is applicable to almost all social and economic aspects of the Asaskan scene.

Thus, for example, it is expected that the pipeline project will produce 18,000 more employed persons in Alaska in 1975 than there would have been without the project. However, this more rapid growth in employment early in the decade is balanced by a slower growth later in the decade, such that the impact of pipeline construction on total employment is expected to be negligible well before the end of the decade.

Similarly, the rate at which physicians will have to be attracted to the State early in the decade will behigher with the pipeline

project than without it. However, there is a balancing reduction in the rate at which physicians will have to be added later in the decade. In both cases, the total number required--60 to 70 over the decade--is the same.

While the generalization "demand or growth is advanced two to three years" has broad applicability, it is important to consider the exceptions to the rule. In the economic sphere, major impacts on specific communities deserve special attention. Because of the large geographical area of the State of Alaska and its few concentrations of industry and population, the economic and sociological impacts projected in the study are not felt uniformly throughout the state. Anchorage receives very little direct construction worker impact; only some administrative support will be located there. But it will enjoy 50% of the total State increase in the trade and service sectors, since it is the principal supplier of the demand for these services throughout the State. The Fairbanks area will be exposed to a more direct impact of construction camps in the vicinity. Trade and service employment will increase by about 25% in Fairbanks at the peak of the construction effort. Fairbanks may also become a center of "off-hour recreation" for a large number of construction workers.

In the Valdez region much of the construction impact is restricted to camp living and much of the services are imported. However, the region does project a growth of trade and services employment of about 100%. More specifically, much of this will occur in the town of Valdez itself which accounts for less than one quarter of the region's population and labor force. Consequently, the impact will be accentuated. It isworth noting that the impacts on the Valdez community have been estimated with the assumption that all terminal construction workers will live in camps. If due to the long term and localized nature of this work the restriction is relaxed, the impact on Valdez could be significantly increased over the present estimates.

Unlike other regions, the Valdez impact will stabilize at a considerably higher level after the completion of the construction because a significant part of the permanent labor force as well as pipeline related activity will be based there. Compared to the State as a whole, the permanent impact is four or five times greater in Valdez. This should result in solid long-term economic growth for the area. In the Northern region, Barrow is likely to play a significant role. Although this region imports most of its goods and services and almost all of the direct construction impact will be camp based, there is bound to be some leakage to the local sector and most of that should occur in Barrow. Thus the model predicts a general increase in Barrow of almost 100% in most sectors of the economy. As a result, the housing supply, which is already in substandard condition in Barrow, will probably become critically short.

In Barrow as in Valdez a critical assumption must be borne in mind. It has been assumed that the road will not be open to public access during the construction period. If the road is opened to the general public upon completion, say after the fifth or sixth quarter, then the economic development of the Northern region (Barrow, in particular) could be significantly accelerated over the present model estimates.

On a statewide basis, the sector of the economy which encounters the most serious impact is that of State and local government. Since the demand for services of this type responds to population growth, our projections show a 4300 employee increase due to the influx of construction workers as well as secondary and indirect effects. It appears from our analysis of the State budget projections that the State may be able to satisfy the demand of the growing economy with the presently projected revenue income and capital utilization. The pipeline project is projected to create a demand beyond current budget projections.

The difficulty of estimating the growth of the State and local sector lies in the question of the demand for services exerted by a construction project which is largely bachelor camp based. As discussed in Section IV and Appendix A, it has been estimated that the demand of a camp worker for State and local government services is only 40% of that of the normal construction worker. Despite this assumption the demand is large (4,300 statewide). Without this reduction, the demand would be more than 50% greater. Whether this assumpton fully accounts for the possible decreased level of services, such a double session in schools in Valdez, is open to question; but the estimate made is our best judgment of the impact.

In the sociological sphere, the same generalization that "demand or growth is advanced three years" applies to most areas. Most of the social services considered will increase according to the population impact. Indications are that the state has already programmed expanding educational facilities sufficient to absorb all the projected Alyeska impact, with the possible exception of Valdez.

The demand for welfare services may not rise as fast as the population because, in Alaska, a significant fraction of the welfare load involves the Native population and this should not change; in fact, both the pipeline employment and the Native Claims Act could decrease this load to some extent. Also, the type of population which is historically a heavy welfare consumer is least likely to immigrate to Alaska.

The increase in victimless crimes expected, particularly in the Valdez-Fairbanks corridor and Anchorage, is diffiuclt to quantify. It is likely that the increase will result in a need for police services that will be over and above what normal population growth would require in those regions.

Housing demand is proportional to employment and population.

However, because of the capital requirements and long lead-times associated with this industry (as well as the short time of the construction period which discourages investment in housing projects), a substantial housing shortage should be expected during the construction period. A deficit of 8,400 units is projected. The housing industry would likely be straining to keep up with the long-term economy trend, without reacting to the construction impact. It is probable that much of the local, short-term demand for housing due to pipeline construction will not be satisfied by the construction of permanent homes or other structures.

With respect to the Native population it should be kept in mind that the goal of 2,200 trained Natives is a large fraction (estimated at almost 20%) of the presently available unemployed Native labor force. Native hires in these numbers must be sought by cooperative efforts involving the Native leadership throughout the State including many small communities. In these communities the impact of a small number of men departing to work on the pipeline can have a serious impact. When considering the interaction of Alyeska and the Native Community, the existence of the twelve regional corporations and their current budgets and operating plans must be recognized. Whereas the true economic benefits of the Native Claims Settlement will probably not occur until after the pipeline construction has been completed, the Alyeska hiring will occur in competition with the regional corporations' organizational efforts and may compete for the best Native talents.

These conclusions relate essentially to the Base Case selected for study and analysis. However, the Base Case projections appear relatively insensitive to changes in the input variable over the ranges tested.* Changes in the variables beyond the ranges selected

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* It has been suggested that some of the camp living and dependency assumptions should be varied on a local basis. Some of these are discussed in the community impact section.

as reasonable would be required to change the economic and social impacts indicated. In general, a linear relationship exists between construction employment and impact. Thus, where a given category is changed by given percentage, impacts are easy to estimate. This is not the case when some isolated change is made in the plan or policy variables. Where employment is significantly different than what is projected here, significantly different impacts can be expected.

It is interesting to note that increasing the number of non-Native Alaskans hired (Alaska Hire Legislation) to work on the project causes an increase in employment and demand for services (due to the model assumption that each Alyeska construction worker hire is replaced in his former job by an immigrant). The benefit of restricting immigration to Alaska from the lower 48 is demonstrated by the case in which only 50% (rather than 100%) of non-Native Alaskans hired to work on the pipeline are replaced in their former position by immigrants. The other 50% are replaced from the unemployed pool. A significant drop in unemployment and a slower population growth resulted. Some recent experience with immigration into Alaska as a result of pipeline publicity leads one to believe that alternative assumptions about immigration might be of interest.

In terms of total impact, several assumptions of the model bear some discussion. It is assumed that approximately 90% of the Alyeska workers are housed in camps and exert only 40% of the demand for State and local government services that any other Alaskan would exert. Policy decisions, whether on the part of Alyeska or the State, which change this 40% factor could cause significant influences on the economy.

It is also assumed that all non-Native Alaskan construction workers who go to work on the pipeline are replaced in their construction jobs by non-Alaskan immigrants. If either a significant number of

these workers comes out of the Alaskan unemployment pool (as was discussed above) or if the construction industry actually slows down due to the shortage of skilled workers, significant changes of the impact could occur.

Finally, it is worthwhile to consider the post-construction period. The Alyeska project primarily generates new construction workers whereas the overall growth of the economy demands a variety of skills. The model assumes a completely elastic supply of labor and, consequently, that workers transfer smoothly from one industry to another. In reality, Native Alaskan hires of Alyeska will presumably return to their villages trained in construction trades and converted to a cash economy philosophy and may have problems adjusting. The rate of progress of the economic advances due to the Native Claims Settlement and the resultant opportunities to the Natives will be an important factor in facilitating this adjustment.

Non-Native Alaskan construction workers, some 2,000 strong, may return to their former locations and reenter the local construction industry where employment is projected to grow from 6,500 in 1971 to 9,800 in 1980. There will be competition between these workers and the new immigrants who replaced them in their construction jobs when they left to work on the pipeline.

The availability of alternative job opportunities will also have considerable effect on the Alyeska workers' reentry program. It has already been stated that the growing economy should make alternate opportunities available for most workers. Other significant economic developments are not within the capability of an impact model to predict.

However, it is obvious that the potential of such projects as Champion Paper in the Juneau area and possible gas and oil pipeline

construction projects elsewhere in the Artic would create additional employment opportunities in the construction industry labor market. If unemployment is high in the rest of the United States, workers will be less likely to leave Alaska. On the other hand, if employment is high, particularly in the Pacific Northwest, the excess construction workers will likely be drawn out of Alaska. In this case, a real industry-wide need may exist in Alaska, and unemployment may fall well below the projected levels.

MULTIPLE USE OF RIGHTS-OF-WAY The Electric Utility View

Edward P. Gueth, Jr., Assistant Secretary and General Attorney - Western Division Niagara Mohawk Power Corporation

May 15, 1973

When I began to review the items which might be included in my discussion with you today, I came up with a small list - only twenty-five items in all - which reflected some of the areas of concern on the part of electric utilities today which arise in a consideration of multiple use of rights-of-way. Discretion being the better part of valor, however, I have narrowed the field to four general areas to which I will direct my remarks, namely,

The needs of the electric utility;

The needs of other utilities, public and private;

The needs of abutting property owners and the protection of their property rights; and

The needs of environmental groups.

I have referred to these categories in terms of needs, for each category does, in fact, have needs which are unique to themselves. The order in which I have referred to them, however, may be seen in terms of the priorities which I have given to these needs. That is, the needs of the electric utility in the use of its own lands is more important to the electric utility than the needs of other utilities, abutting property owners or environmentally-oriented groups.

Needs of the Electric Utility

We realized that it was possible for additional uses to be made of our bulk transmission rights-of-way, which would allow us to continue to provide adequate safeguards to our equipment and systems. I should point out, however, that it is still necessary to review all multiple uses - and decide in our own favor - if there is any serious potential for disruption of our system. Each request for a multiple use must be examined on its own merits. Any "carte blanche" approach to multiple uses is simply not practical and will not, to my mind, ever work.

Needs of Other Utilities, Both Public and Private

When we look to the needs of other utilities, it appears that many factors must be considered. In our metropolitan areas, the rapid spread of suburban living which appears to be continuing in most areas of the United States and Canada, has created a continuing and growing problem. For example, the growth of new subdivisions has mandated the installation of large water and sewage systems to service the needs of the residents. Since most of these systems are installed by municipal operations, they have often looked to the use of transmission rights-of-way as an easier and less expensive route for their systems. This eliminates the problem of tearing up major highways which is often so expensive that it makes the project impractical without large additional taxes.

I think that where adequate safeguards against washouts can be provided, there is no need to deny a permit or easement for such uses. Of course, as a practical matter, the choice of granting or denying such a request may be academic in many states, since the power of condemnation exists for the water or sewer agency involved. I have always felt that, given these set of circumstances, it is much better to negotiate a grant rather than run the risk of a judgment

in condemnation which may fix a route that is not to our liking. In my experience with Niagara Mohawk, we have followed such a policy and have been satisfied with the results. It is especially noteworthy that we have not had one instance where a sewer or water agency has refused to comply with all of our requests relating to routing, depth of excavation, and the many other conditions mandated by these requests. I emphasize this to indicate the importance of not using a hard-nosed attitude in dealing with these uses of rights-of-way.

A different problem is presented when the proposal comes from another utility to use your right-of-way. The most common uses that come to mind are for pipelines for natural gas, gasoline or any bulk products carried by pipeline common carriers. Here, there are other considerations that must be looked at. First, the hazards incidental to fires and explosions must be examined in greater detail. As part of this examination, the trends of recent years in the pipeline business to carry commodities at greater pressures mandates even greater care in reviewing the proposed uses. Pipeline technology has kept up with the increased pressures being used today, and the pipeline industry has the equipment which permits safe use of our lands. Yet, we must look carefully to greater protective measurers to minimize exposures from hazards as previously described.

As an aside, in those cases where petroleum products are being transported through pipelines, it is imperative to establish one person within the pipeline company who will take immediate responsibility for clean-up operations in the event of a break, however small, in the line. It is my recommendation that a statement be prepared by the pipeline company, using the name of an appropriate official, that can be given to the press, radio and television stations which will explain affirmatively what steps are being taken. The purpose of such a statement is two-fold: First, the citizens and particularly those whose property might be affected by an oil spill realize it is a problem to be solved by the pipeline company. Secondly,

the electric utility will not be placed in a position of having to remedy a situation in which it might not have the expert knowledge required to cope with the problem. This sort of problem has become rather sensitive in the past 5 or 6 years due to the intense publicity that has followed oil spills of any kind. In most instances the question was not whose failure caused the problem but rather how fast the spills which occurred could be cleaned up. When pipeline breaks do occur, a little common sense and prompt handling of the spill are the greatest tools to common acceptance of future pipeline construction.

One problem that keeps facing a electric utility in multiple use of rights-of-way involves the importance of bulk transmission systems. Any given electric company must look at its bulk transmission system - generally with voltages of 230 Kv or higher - not only from the point of view of the needs within its own service territories, but also with a view towards its continuing obligation to power pools and regional electrical grids serving a much wider area. I must admit that the relative importance of the transmission line in question often has to be the sole criterion for approval or disapproval of requests to use the property. We must always look at each request with an understanding of how we would handle our electrical needs if we lost our system in any given area due to whatever catastrophe might occur. If there is no suitable alternate to back up our transmission system, then the request will have to be denied. Our industry cannot today allow any conditions which create a spectrum of mass outages, since this would inevitably lead to further legislation and control by appropriate elements of government, as had happended following the Black Tuesday blackout of November 9th, 1965. I believe our motto is and should be that "we'll help when we can."

Abutting Property Owners - Their Rights and Privileges

In our zeal to work our problems relating to multiple use of rights-of-way, and to satisfy the demands of various groups claiming to have

an interest in our properties, we should never forget the one group from whom we very rarely have any organized opposition - the abutting property owners. I think that a strong obligation exists to let him quietly enjoy his property. In urban and suburban areas, group recreational actibities, such as snowmobiling, horseback riding, and motorcycle racing are inconsistent with the rights of abutting owners and should be discouraged. In rural and sparsely populated areas, consideration can be given to such activities. The use of rights of way for snowmobiling and motorcycle racing should only be allowed under exceptional circumstances because of obstructions, ruts and holes that inevitably occur on rights-of-way. The hazards inherent in this type of activity are such that only the rare case will be acceptable to all parties who are involved. I think that the approach used with such requests is important. When a group inquires, a request should be made for a detailed proposal as to what activity will be engaged in and the exact method they will use to accomplish their purposes. My experience has taught that it is wise at the first meeting to communicate the fact that there is no such thing as an automatic approval. In any event, it should be made clear that there will be no major rearrangement of facilities solely to accommodate a use for recreational purposes by another party. This again gets back to the idea that we will help - where we can.

Needs of Environmental Groups

The final area to which will direct my remarks today involves the needs of environmental groups. The electric industry is faced with a continually evolving challenge from groups which have come to be known as environmental groups. The large acreages we own throughout the country are sought for uses such as hiking trails, bicycle trails, horseback trails and bird sanctuaries. While in many

instances the proposals have merit, there seems to be one compelling and continuing problem with such uses. Many groups that wish to make such use of rights-of-way are not organized - in the sense that they are not an organization which, by their formal structure, are capable of obtaining and maintaining liability insurance for their projects. These people often request use of lands without realizing that this use would involve an assumption of responsibility on their part. I stress this point because if you are not careful about which groups you allow to use your lands, you will not only have to take on an added maintenance burden but an increased public liability burden as well.

It is important to remember that an electric utility cannot just grant requests to any group, solely for the sake of being a good guy. Some corporate responsibility must be exercized. Probably the best way to handle this is to establish general guidleines as to what uses will be permitted on electric rights-of-way generally. This presents two specific advantages. First, for those companies that cover large areas, the problem of one manager granting a request and another denying a similar request will be avoided. Second, when the area involved is particularly crucial to your operations, or where there is a great liability exposure, a polite explanation may be provided why the request must be declined.

Again, it seems to me that an affirmative posture of assisting groups with bike trails, hiking trails, bird sanctuaries and similar projects is more desirable in the long run. I feel that if the industry does not concur in this policy, regulations will come forth from federal and state government regulatory agencies, often as a direct result of pressure from environmental groups.

We can see this trend developing in proceedings where it is necessary to obtain a certificate of necessity, which incorporates the concept of environmental compatibility, for a transmission line or

generating station. I will not get into any specifics since in some states these proceedings are already in existence and in some they are only proposed. It does appear, however, that they will become a standard part of our business within the next five years. Probably the one item that stands out in these proceedings is the protection of the environment. The burden of satisfying the conflicting elements represented in such hearings rests solely with the utility. Nor is it an eary burden to bear. We no longer can buld the least expensive line or the minimal generating stations. We, in the industry, must be able to justify the facilities and then go about explaining the way we affirmatively, and I emphasize affirmatively, will protect the environment.

Perhaps it is important to stress that in such proceedings the environmental consultants retained by the utility have a critical role to plan. They must be able to verify that the routes or sites picked by the utility are environmentally compatible, and be willing to admit of other uses of the right-of-way. I make a point of this because it seems to me that unless certain uses of rights-of-way are conceded, the necessary approvals for construction will not be obtained.

Another facet of the environmental question facing utilities today involves multiple use of distribution system rights-of-way in build-up areas. As you know, many state regulatory commissions have adopted rules relating to underground residential distribution (URD) in new subdivision construction. Although in most states there is no jurisdiction by a commission over all of the various services needed for a residence, the commisssions have been urging those utilities within their jurisdiction to "cooperate" as much as possible to get as many services as possible within a single corridor. This is just one further evidence of a change in philosophy. We are getting away from the "I'll go my way, you go your way" school of utility construction. While this particular multiple use is in no way as critical as multiple uses of transmission rights-of-way,

it is a practice that will continue to become more common as URD systems are developed throughtout the country.

In reviewing our industry, we see that multiple use, as a new phenomenon in our industry, is here to stay. If we realize this, I think that in the long run we shall be able to work towards a better environment and still be able to provide for the energy needs of our customers. This, after all, is still the reason that we are in business.

Before closing, I would like to make one brief mention of a facet of this entire question which is most complicated. This relates to the ownership of the utility corridors. While it is not possible to set a hard and fast rule, I feel that the electric industry would prefer to have the ownership of the lands where transmission rights-of-way are located. Our reliability becomes a problem of continuing concern to us. We don't want another blackout, and we feel that the integrity of our system must be maintained. For this reason, we would tend to discourage a multiple or joint ownership of major rights-of-way. I am hopeful that the future deliberations of the International Utilities Committee of the American Right-of-Way Association will help us toward a national policy on this subject.

Thank you for letting me speak to you today on a subject which is much a part of our business today.

From Report by Intercontinental Engineering of Alberta, March, 1973

ENVIRONMENTAL MATRIX

The interrelationship between the tar sands technology and environmental impacts is of such complexity that an organized format is required to analyze and present the subject. In the search for

a suitable means of correlating and presenting the voluminous data, the procedure prescribed by the U.S. Environmental Protection Agency was examined. It requires consideration on the following principal topics:

Description of the proposal

Description of the environment

The environmental impact of the proposed action

Mitigating measures included in the proposed action,

Any adverse effects which cannot be avoided should the proposal be implemented

The relationship between local short-term use of man's environment, and the maintenance and enhancement of long-term productivity,

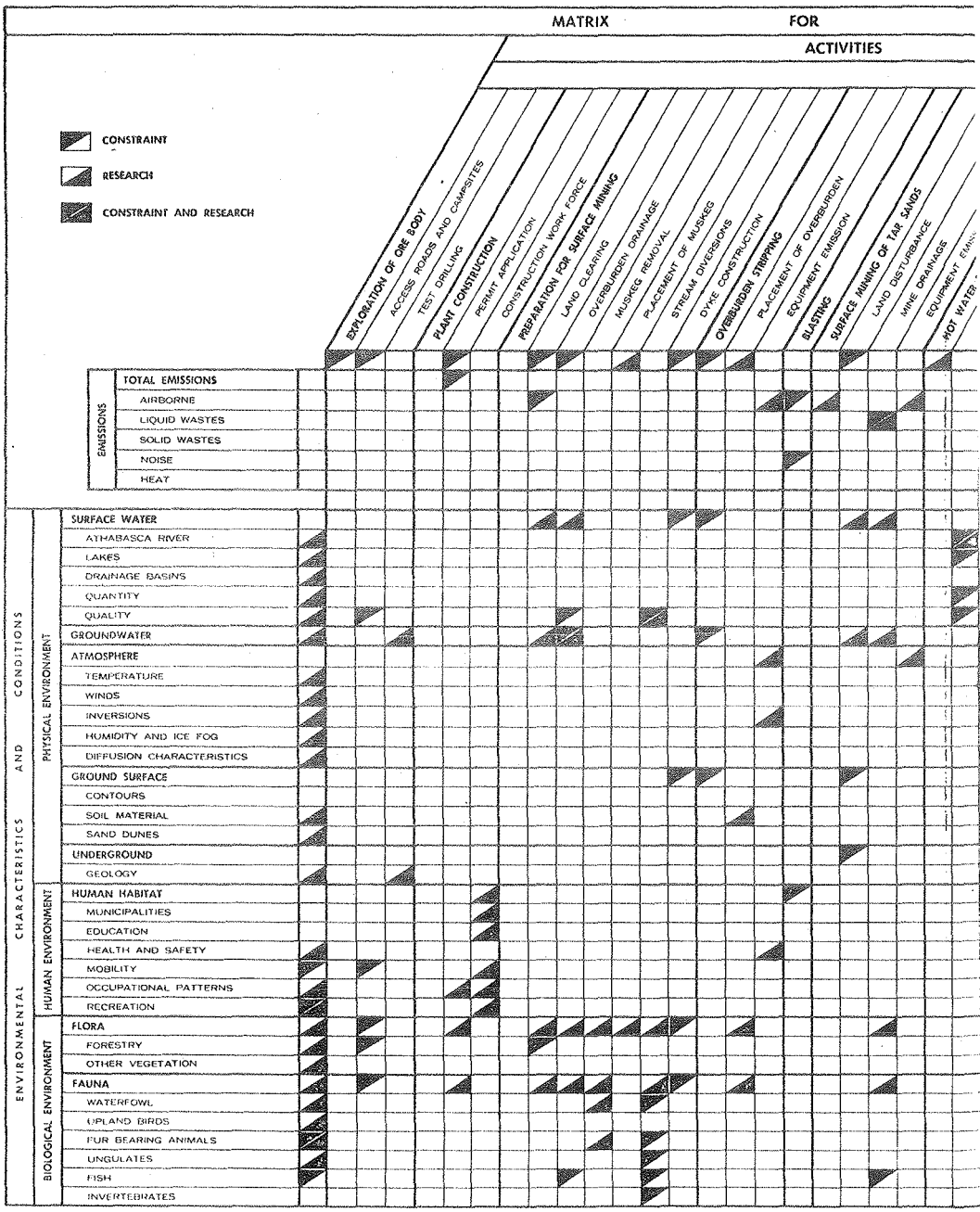
Any irreversible and irretrievable commitments of resources which would be involved in the proposed actions hould it be implemented,

Alternatives to the proposed action.

Another reference used was the "Procedure for Evaluating Environmental Impact" published as Geological Survey Circular 645. Utilizing the applicable portions of these two systems, an environmental matrix with descriptive text was devised specifically for the tar sands industry.

The characteristics and consitions of the Area are tabulated on the vertical axis. These are classified into: physical, human, and biological environments.

The activities which may cause environmental impacts are listed across the horizontal axis. These are specific to the tar sands industry. Most of them relate to conventional technology, i.e. methods approved for commercial operation. The balance of the activities pertain to probable new technology. Provision was made also to identify sources and types of emissions since these are often intermediary effects between an activity and an environmental impact.


MATRIX FOR
ACTIVITIES
CONSTRAINT
RESEARCH
CONSTRAINT AND RESEARCH
EXPLORATION OF ORE BODY
ACCESS ROADS AND CAMPSITES
TEST DRILLING
PLANT CONSTRUCTION
PERMIT APPLICATION
CONSTRUCTION WORK FORCE
PREPARATION FOR SURFACE MINING
LAND CLEARING
OVERBURDEN DRAINAGE
MUSKEG REMOVAL
PLACEMENT OF MUSKEG
STREAM DIVERSIONS
DYKE CONSTRUCTION
OVERBURDEN STRIPPING
PLACEMENT OF OVERBURDEN
EQUIPMENT EMISSION
BLASTING
SURFACE MINING OF TAR SANDS
LAND DISTURBANCE
MINE DRAINAGE
EQUIPMENT EMIS
HOT WATER
ENVIRONMENTAL CHARACTERISTICS AND CONDITIONS
EMISSIONS
TOTAL EMISSIONS
AIRBORNE
LIQUID WASTES
SOLID WASTES
NOISE
HEAT
PHYSICAL ENVIRONMENT
SURFACE WATER
ATHABASCA RIVER
LAKES
DRAINAGE BASINS
QUANTITY
QUALITY
GROUNDWATER
ATMOSPHERE
TEMPERATURE
WINDS
INVERSIONS
HUMIDITY AND ICE FOG
DIFFUSION CHARACTERISTICS
GROUND SURFACE
CONTOURS
SOIL MATERIAL
SAND DUNES
UNDERGROUND
GEOLOGY
HUMAN ENVIRONMENT
HUMAN HABITAT
MUNICIPALITIES
EDUCATION
HEALTH AND SAFETY
MOBILITY
OCCUPATIONAL PATTERNS
RECREATION
BIOLOGICAL ENVIRONMENT
FLORA
FORESTRY
OTHER VEGETATION
FAUNA
WATERFOWL
UPLAND BIRDS
FUR BEARING ANIMALS
UNGULATES
FISH
INVERTEBRATES

ENVIRONMENTAL STUDY OF THE

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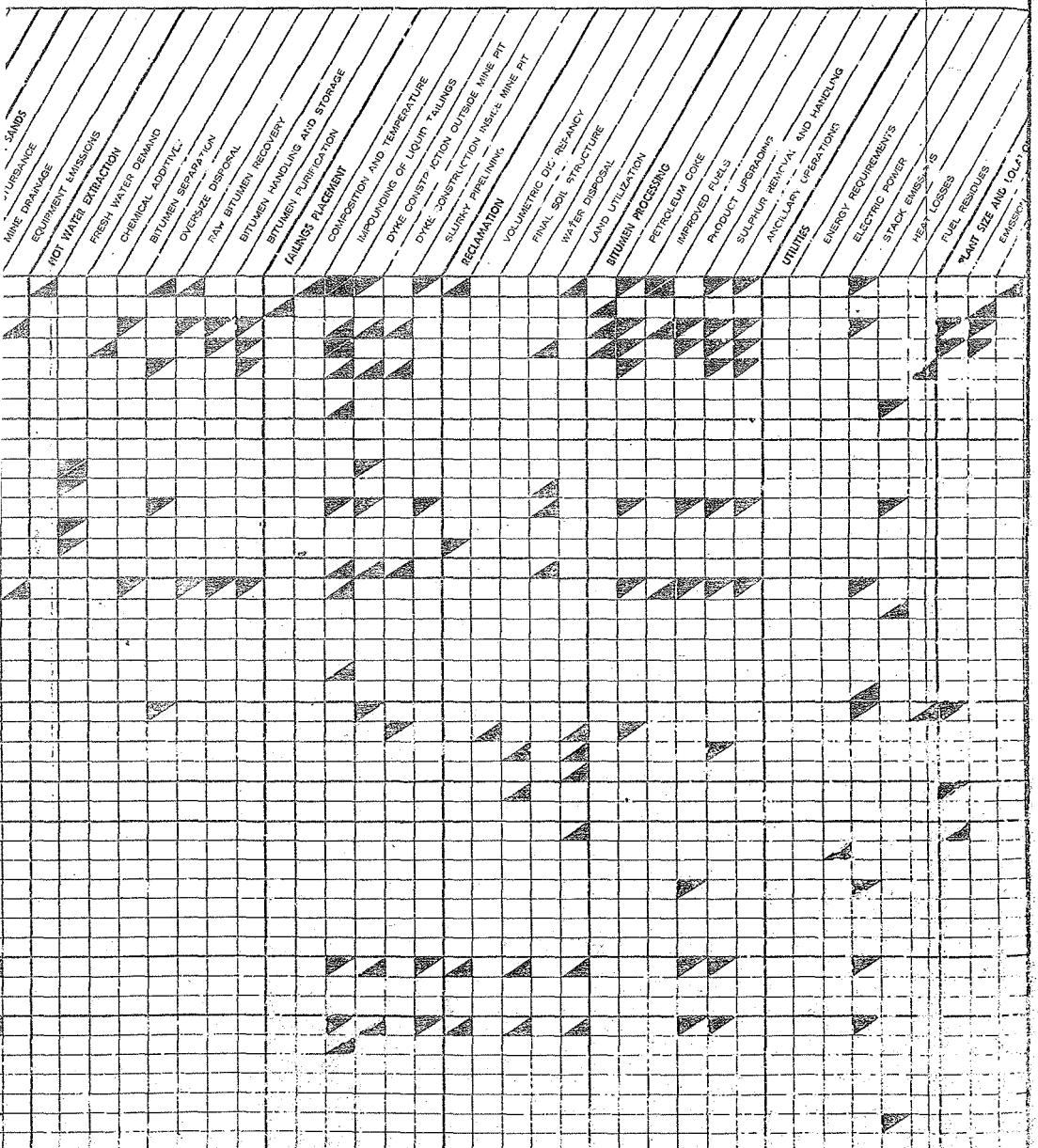

An Environmental Study of the Athabasca Tar Sands

prepared for

Alberta ENVIRONMENT

by

integ Intercontinental Engineering of Alberta Ltd.

The matrix was used as a check list to correlate the imputs of the project team and the ecological survey group. Recommended constraints and research priorities are designated on the matrix by a simple code. The relative magnitude and importance of the environmental impacts are set forth in the text and summary of recommendations. This matrix format could be expanded as additional data becomes available and could serve as a useful guide for future environmental impact analyses.

COPING WITH NOISE

Remarks by Harter M. Rupert, P.E., Office of Environmental Policy Federal Highway Administration delivered at the American Right-of-Way Association 19th Annual International Educational Seminar May 16, 1973, Pheonix, Arizona

Effect of Recent Noise Activity on Highway Projects

The promulgation of FHWA's noise standards will have an effect on the programs and activities of State highway agencies. The standards will affect the work of highway planners and designers, and the appraisers responsible for acquisition of highway rights-of-way. Noise studies and analyses will have to be made during the location and design phases. This will require manpower and sound level measuring equipment. Right-of-way acquisition will be affected by the need for buffer zones, "soundproofing" of certain public buildings, and the payment of noise damages as severance in certain instances when there are partial takes. The combination of all these circumstances will make it more difficult, time consuming and more frustrating to advance a highway project to completion. Hopefully, however, the end result will be a highway which will more nearly meet all the needs of all the people.

Effect of Recent Noise Activity on Future Land Development

The recent noise activity will make future development of noisy vacant land more difficult and more expensive. Many leading institutions pattern their lending policies on HUD/FHA policy. The obvious result of HUD's noise policy will be parcels and tracts of land where residential development will either be very difficult, or where additional money will have to be spent to reduce noise effects. Some developers have already been required to construct noise barriers to "soundproof" residential developments.

The Federal Highway Administration standards accentuate this trend by the requirement for States to coordinate with local officials. States must provide information on projected future noise levels in vacant lands together with some of the types of controls that the locality could take to assure future compatibility. The combined actions of FHWA, HUD and local officials may result in situations where land developers are required to design soundproofing into their buildings, provide open space as a buffer, or construct noise barriers. This, of course, would mean that such future land development (in noisy areas) would be more difficult and more expensive.

Effect of Recent Noise Activity on Property Values

It should be obvious by now that all of this noise activity is going to affect property values. If government insured loans are not permitted in highway level areas, if private lending sources are not available, or if premiums (in the form soundproofing, buffer areas, and noise barriers) must be paid to develop noisy land, it follows that vacant "noisy" land will generally be less valuable than "quiet" land. In addition, as the public becomes more aware and informed, resales of improved "noisy" properties will not likely

command as high a price as similarly improved "quiet" properties.

Control of Noise at the Source

Practically no discussion of highway traffic noise can ever be concluded without dealing with the issue of source control. This is an area where important and significant improvements are needed and can be achieved. It should be recognized, however, that the entire problem cannot be corrected at the source. There is little likelihood that noise from most automobile will be substantially reduced. There are, of course, exceptions such as hot rods, some types of sport cars, and other intentionally noisy vehicles. Most trucks and motorcycles can be quietened considerably. We should all realize that there are limits on the amount of improvement that can be obtained. It now appears that a 10 decibel decrease is about all we can reasonably expect to get from the most dilient source control efforts.

What's in Store for the Future?

You have heard a great deal about current and recent activity concerning traffic noise, and you have gotten a glimpse of the probable resultant effects. I would now like to share with you some personal observations (not necessarily those of FHWA) concerning the future. Noise has already been recognized as compensable (as a form of severance damage) when there is a partial taking. Many informed experts believe that noise will someday be recognized as compensable regardless of whether there is any physical taking.

This recognition, together with other recent activity, will probably lead to the need for acquiring noise easements. We will all probably see the day when some properties and their improvements are acquired in fee because of expected high noise levels. (This is already being done on the approach paths of several major airports).

We are about to see the day when highway agencies will return to completed highways for the sole purpose of constructing noise barriers and providing other noise abatement devices. The 92nd Congress wrote a highway bill (which failed passage on the last day of the session for lack of a quorum) which contained a provision which would have authorized FHWA to develop Federal guidelines for such measures. Both the Senate and House versions of the 1973 highway bill contain these provisions. The Federal Highway Administration may soon be hard at work on these guidelines.

I hope you can see from this presentation that the public, the Congress, and Federal agencies are concerned about the environment in general and noise in particular. I think you can see that recent activity is going to affect operations of highway agencies, utilities, and those in the private sector. It is going to affect the engineers, designers, and those involved in land acquisition.

ALASKA TRANSPORTATION CORRIDOR STUDY April, 1972
Conducted for the United States Department of Transportation and the State of Alsaka - By Tudor-Kelly-Shannon, Alaska Transportation Corridor Consultants.

Environmental Considerations

The preservation of the Alaskan environment was a major consideration in this study.

It must be stressed that this wans an engineering feasibility study including an estimate of the costs to construct, maintain, and operate typical transportation facilities. The prime effort was not directed to the in-depth environmental effects.

Nevertheless, insofar as environmental processes in the corridor areas are now known, they were treated as factors of major importance and as significant cost considerations.

Preservation of the Land -

Both the location of the recommended routes and the preliminary design of roadbeds were governed by their impact upon the land and its natural inhabitants.

Routes were selected to avoid, as much as possible, the kind of soils which might deteriorate if distrubed. Where feasible, routes were situated along rivers, in flood plains which provide the most stable soils, but above the natural flood stages.

Rivers were particularly scrutinized for crossing sites where the structure could be carried over natural flows and channelization would not be required. Also, bridges were designed with a nimimum number of spans, to avoid midstream pier construction and resulting stream siltation.

Over the course of approximately 900 miles of corridors for the proposed railroad and highway, it would not be possible to avoid scarring the land-scape. But by thoughtful location, the impact could be minimized.

Design of roadbeds would require the same careful attention, particularly through areas of ice-rich permafrost. Some of the problems anticipated in constructing rail and highway roadbeds across these unstable materials are described in the section "Cost Estimates."

It is generally recommended that long stretches be placed on embankments which could serve as permanent insultation. This design would reduce the threat of permafrost thaw and its consequences to both the landscape and the roadways.

Such embankments would require large quantities of materials from "borrow pits" off the alinement. However, these temporary disfigurations could be eliminated by grading and restoration.

One other construction requirement seems imperative: Specifications should prohibit the obtaining of gravel from live stream beds. Such a measure would be necessary (1) to prevent siltation of the streams, (2) to avoid destruction of natural channels, and (3) to preserve the natural biological regime of the stream.

Most of the gravel required for embankments could be taken from terraces above the active flood plain. Where terrace gravels are not available, other sources such as moraines, dunes, eskers and rock quarries could be tapped. A considerable part of the location effort was devoted to pinpointing sufficient rock and gravel supplies off the alinement.

Protection of Wildlife -

The impact of the proposed transportation facilities on wildlife is not easily predictable. It would vary from species to species and from season to season. Nevertheless, an attempt was made to anticipate the major effects.

Consultants from the University of Alaska played a vital role here - identifying potential environmental problems, reviewing proposed routes, inspecting sensitive areas, and recommending safeguards which would minimize the initial impact.

As for fish and bird life, two precautions are paramount:
(1) Lines should be located to avoid the resting and nesting areas of migratory birds, and
(2) Construction practices which will prevent harm to fish should be employed.

Small wildlife could be expected to abandon the immediate roadway initially, but it is common experience that many birds and small mammals are not easily distrubed by rail or highway traffic.

As for large animals, the study identified areas where the alinement might conflict with migrations, and appropriate changes were made. The possibility of carrying the transportation corridor over the Anaktuvuk Pass, for example, was eliminated, in part because the Pass is used heavily by migrating caribou. Dietrich Pass, the recommended alternative, is relatively free of such movement. It should be noted that the proposed Alyeska pipeline and service road, if approved, would utilize the same pass, thus keeping all transportation facilities across the Brooks Range in a common corridor.

It will not be so easy to deal with the east-west caribou migration across the Arctic Plain north of the Brooks Range. The movement

is dispersed over so wide an area that it would be difficult to avoid in any north-south rail alinement. The number of animals involved and their routes are not established, but further study may produce a solution.

The moose problem is more serious. These large mammals range all over central Alaska in large numbers, but do not follow well-defined routes. Because of their strength and agility, it is diffiuclt to fence them off a railroad or highway right-of-way.

In summary, the Transportation Corridor Study did address itself to some of the major foreseeable effects of railroad and highway location on the peculiear land and wildlife characteristics of the Alaska site. It anticipated that there would be problems in maintaining soil stability and in preventing deterioration of permafrost areas, and it recommended solutions in terms of where the routes should lie, how the roadbeds should be designed, and what construction practices should be followed.

The study investigated some of the obvious potential effects on wildlife, also, and suggested possible solutions.

The preliminary conclusion was that, with relatively simple precautions, there would be no damage to fish habitat and very little to the nesting and feeding places of resident or migratory birds. Small mammals would adjust easily to the completed transportation facilities. Large animals pose a greater problem, but the recommended corridors would avoid the major caribou migration patterns, except across the northern Arctic Plain.

Such conclusions were developed only to the extent necessary to complete the scope of this assignment. Additional study may become desirable, in time, to explore these and other environmental problems more comprehensively.

Summary of Findings

It is feasible, from an engineering standpoint, to construct and maintain both railroad and highway facilities through corridors developed in the course of this study.

The best corridor for a north-south rail line would begin at Nenana on the existing Alaska Railroad and, proceeding northerly, would cross the Yukon River and the Brooks Range to the North Slope. It would terminate at the Deadhorse Airstrip near Prudhoe Bay. Length: 581 miles.

The best corridor for and east-west highway would begin at Prospect Creek, on the proposed Alyeska pipeline service road, move overland via Bettles to the Alatna River and thereafter follow the same corridor as the railroad to the Dahl Creek Airstrip. Length: 187 miles.

The best corridor for an east-west railroad would begin at a connection with the north-south line at Alatna and follow the Alatna and Kobuk Rivers westward, terminating at the Dahl Creek Airstrip near Kobuk. Length: 139 miles.

It would cost an estimated $1.37 billion to design and construct a basic, low-tonage railroad from Nenana to Deadhorse; and $298 million from Alatna to the Dahl Creek Airstrip near Kobuk.

It would cost an estimated $6.6 million annually to maintain such a railroad.

It would cost an estimated $186 million to design and construct a two-land highway from Prospect Creek to Dahl Creek Airstrip.

It would cost an estimated $285,000 annually to maintain such a highway.

It is technically feasible to transport 1¼ million barrels a day of crude oil over a single-track railroad from Deadhorse on the North Slope to Bear Valley near Whittier.

It would cost an estimated $1.61 billion to construct the oil-haul railroad from Nenana to Deadhorse, and $171 million to upgrade the existing Alaska Railroad from the vicinity of Whittier to Nenana. Systemwide fixed facilities would cost $189 million. Rolling stock and miscellaneous equipment would cost $408 million for an estimated total cost of $2.38 billion.

It would cost annually an estimated $85 million to operate and $176 million to maintain such an oil-carrying railroad and pay associated general expense.

A railroad within the recommended corridors could be designed and constructed within a five-year period. A highway could be designed and constructed within a four-year period.

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