After the Flush - Who's in Charge of Sewage Management?

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Bachelor of Arts, University of Western Ontario, 1985

A THESIS SUBMITTED IN PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARTS

in the Department

of

Geography

ACCEPTED
FACULTY OF GRADUATE STUDIES

[redacted]
DEAN

DATE May 20, 1987

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ABSTRACT

The production of wastes is an inevitable consequence of human existence. Water-borne wastes originating from domestic, commercial, institutional and industrial sources must be effectively dealt with in order to protect human health and the quality of the environment. The collection, treatment and disposal of sewage has become an increasingly important process as society has become more urbanized and costs associated with the latter have escalated.

The main responsibilities for sewage management in Canada lie with regional and municipal governments. Under policies and regulations set by senior levels of government, these local agencies must plan, implement and finance systems which transport sewage out of the urban environment. Professional engineers play a critically important role in decision-making processes related to sewage management systems. It is these roles and the characteristics which condition them that are focussed upon in this thesis.

Eleven municipalities and regional districts located on southern Vancouver Island and the lower mainland of British Columbia form the sample communities considered in this thesis. The chief engineers, administrative officers and elected representatives from each of these areas were invited to participate in this study in order to gather information to shed light on the process of sewage management decision- making in the various communities, as well as the role of the engineer in

such matters. In-depth interviews were held with these officials and the findings of the study reported in this thesis.

It is noted that two types of decision-making processes take place with regard to sewage management at the regional and municipal level. Routine decision processes address such matters as regular operation and maintenance of sewage systems and small-scale upgrading activities. Strategic decision processes are concerned with problems such as major upgrading schemes and installation of new treatment facilities. Professional engineers are extremely important in both processes. These engineers ostensibly control routine decisions and heavily influence all stages of strategic processes. The influence of the engineer does, however, vary in accordance with certain factors. These include the size of the community, structure of the decision-making network, breadth of the engineer's role and perception of organizational constraints. The contention that engineers are the most influential actors in sewage management decision-making has several implications, including the tendency for decision processes to focus upon technical matters and the orientation toward structural solutions to problems. In order to ensure efficient allocation of resources and protection of the environment, a multi-disciplinary approach to sewage management involving engineers who possess broad perspectives is suggested.

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ACKNOWLEDGEMENTS

There are several people to whom the author is sincerely grateful for the guidance and support that they provided during the course of this study.

Dr. W.R.Derrick Sewell provided constant support and encouragement throughout the term of this project and has been an intellectual mentor, advisor and friend. Drs. Colin Wood and Terry Morley deserve many thanks for their useful comments and for moral support. In addition, the author wishes to thank Drs. W.M. Ross and T. O'Riordan for their suggestions in the formative stages of this project.

Particular thanks are extended to the various municipal and regional officials who participated in this study. Their enthusiastic co-operation made this a much easier task. Such thanks are also conveyed to the 'Water Mafia', especially Ashley Bansgrove and Scott Anderson, for their help with 'contracts'.

Finally, my most heartfelt thanks go to Susan for making me laugh along the way and helping me to keep things in perspective, and to my family for their confidence and love.

INTRODUCTION

Resource and environmental management problems have become increasingly technical and complex in nature. Institutions located dominantly in the public sector have responded by initiating policy and decision-making processes designed to resolve these problems. Specialized knowledge within institutional bureaucracies is frequently called upon to aid such processes. As a consequence, a group of actors who possess this specialized knowledge - the professionals - have come to command a great deal of influence in policy and decision processes. A variety of professions including law, engineering, medicine and forestry are amongst this influential group. Such professionals may fulfil roles as technical staff, advisors, consultants, administrators and decision- makers. It is also possible that a professional may fulfil more than one of these roles. Regardless of the professional's vantage point vis- a-vis the policy and decision-making processes in resources and environmental management, it is important to question how important those professionals are in relation to other actors involved in such processes.

These generic issues of the professional's role in resources and environmental management are directly applicable to the management of water. More specifically, these issues relate directly to an extremely important aspect of water quality management - sewage. The generation of waste is an inevitable consequence of human existence. The effective management of sewage is especially important

in light of the trend toward urbanization in many developed countries. Sewage management systems are an expensive component of urban infrastructure. If improperly managed, sewage disposal may result in serious impacts upon the environment. Perhaps most crucial is the link between sewage management and human health. It is in policy and decision-making processes regarding sewage that professionals, particularly engineers, have an important role to play.

There are a number of important questions which arise when considering the role of the professional engineer in sewage management. At one level there are questions which relate to the day-to-day operation of sewage management organizations, the latter usually synonymous with local governments. For example, queries may relate to the closing of beaches due to sewage contamination or the harvesting of shellfish from sewage-receiving waters. Further, concerns such as the adequate level of treatment for a community's wastewaters and the possible utility of alternative methods of sewage disposal must be addressed by sewage management organizations. The engineer has an integral role to play in such deliberations.

There are also questions which relate to the more theoretical aspects of the professions. These questions all center around the concern of the professional's relationships with others. First, it is important to examine the professional's relationships with his/her peers, as professional associations are extremely important reference points to their individual members. Second, the relationship between the professional and his/her co-worker is an important consideration, as the professional receives both explicit and implicit signals from his/her co-worker

regarding the nature of the professional's role. A third important relationship is that which exists between the professional and his/her employing organization. The behavioural norms and administrative structure of the organization affects the professional's interaction within that organization. Fourth, the relationship between the profess- ional and groups or organizations other than that with which he/she is employed is an important consideration. The values and perceptions held by the outside group of which the professional is a member may bias the input that the professional will have within his/her employing organization. Finally, it is important to consider the relationship between the professional and the public. A professional's inability to correctly gauge public views may lead to considerable social and economic losses.

The guiding hypothesis underpinning this research is that the engineer is the most influential actor in sewage management decision- making at the community level. The influence which the engineers hold is posited to vary in accordance with a number of factors, however. Such factors include, for example, the size of the community in which the engineer is employed, the engineer's contact with his/her professional association and various dimensions of the engineer's role. These factors are more fully explained later in the study.

The purpose of this research is to shed light on the role and influence of professionals in resources and environmental management policy and decision-making. More specifically, the research aims to accomplish three things. First, a more thorough understanding of the professional's influence in policies and decisions related to resources and environ- mental management is sought. Second, the

research is intended to foster more articulate comprehension of the theoretical aspects of the professionals' relationships with others. As a corollary of the first two aims, this examination seeks to bridge an existing gap in resources and environmental management research. Importantly, this research intends to furnish a better understanding of the professional's role in shaping the environment.

In order to accomplish these aims, the following rationale is utilized. The conceptual foci of the research are policy and decision-making processes within local government organizations. Of particular interest are those processes which relate directly to the environmental problem under consideration - sewage. The engineer involved in sewage policy and decision-making processes at the local level is the focal actor. In addition, however, chief administrative officers and elected officials in local government are considered. A more thorough outline of the study design and a description of the methodology are presented in chapter three.

A series of five chapters follow these brief introductory comments. Chapter two reviews the literature of various disciplines in order to structure the theoretical framework used in this study. The central themes of this review are the definition and characteristics of professionals, the structure and operation of organizations and the process of decision-making in organizations. These general themes are applied to a review of resources and environmental management and, more specifically, water and sewage management. Finally, the topic of organizational policy and decision-making at the community level is considered. The chapter concludes with the formulation of some of the concerns raised in the discussion into a general relationship used to structure the thesis' argument.

The way in which the study was designed forms the basis of the third chapter. Initially, the study's hypotheses and measuring variables are presented. Second, the study communities and sample groups utilized by the study are introduced. Following this, the way in which the data is analyzed is considered. This empirical research focusses upon both structured and unstructured means of collecting data and thus utilizes qualitative and elementary quantitative methods of analysis.

The central concern of this thesis is the role of professionals in sewage management, namely its collection, treatment and disposal. Chapter four takes an historic perspective on the sewage issue, reviews developments and trends in the field of sewage management, discusses contemporary concerns related to this problem and examines the political nature of the issue.

The results emerging from the study are documented in chapter five. It is structured to critically examine the thesis' hypotheses. The conclusions of the study, implications and recommendations for further research are presented in chapter six.

REVIEW OF THE RELEVANT LITERATURE

Definition of Professional

Prior to examining organizational resources and environmental management decision-making, it is necessary to define the term 'professional'. It is useful to introduce this definition by considering two closely related terms - specialist and expert. Barker(1977) sees a specialist as one who devotes themself to one particular branch of a subject or pursuit This is a fairly general definition. An expert has been defined as "a person skilled in some art, trade or science to the extent that he possesses information not within the common knowledge of men"(O'Hara, 1970;566). Taken together, these definitions partially define a professional. In addition, however, a professional must attend an accredited institution to study his/her field, undergo apprenticeship training, become a member of an association composed of his/her brethren and practice under a stated code of ethics which is legally as well as morally binding(Carr-Saunders and Wilson, 1933). Specialists or experts who adhere to these much more rigorous criteria may be considered professionals.

Another important distinction exists between the governed and the self-governing professions. By strict definition, all professions are self-governing in that they look to the executive of the association or institute of which they are a member for support, reinforcement and sanctions(Tuohy and Wolfson, 1978).

Lawyers, medical doctors and engineers are examples. There are, however, many groups in society who prefer to call themselves 'professions', yet are governed by the organizations with whom they are employed. Occupations such as economists, chemists and geographers are illustrative of this distinction. In the latter case, organizations may apply positive or negative sanctions to these employees who, by strict definition, are not professionals.

There are numerous implications of this distinction. The governed 'professional' may comply with organizational wishes which violate his/her personal judgement and not fear retribution from his/her 'professional' peers. Further, the governed 'professional' may use his/her expertise and credentials to add validity and credibility to organizational goals which may result in social and/or environmental deterioration. On the other hand, self-governing professionals must comply with professional standards or face expulsion from their professional association(Liebermann, 1970). If professional standards are violated in order to comply with organizational wishes and, consequently, professional status revoked, the professional may be unable to practice his/her trade in the future. Further, if the governing body of the profession is responsible and objective, the professionals it governs must be ethical, moral and responsible in administering their expertise.

Theory of Organizations

Prior to examining the roles of those which we have defined above as professionals in resources and environmental management organizations, it is necessary to consider the fundamental structure of organizations. An organization may be

defined as a 'systematic arrangement for a definite purpose'(Silverman, 1976;9). This rather ambiguous definition needs further clarification. Three distinguishing elements of organizations will assist in this regard(Silverman, 1976). First, organizations arise at an ascertainable point in time. Second, organizations are characterized by patterns of relationships which are particularly important, especially to the managers of the organization. Finally, organizations pay much attention to changing internal and external social relations and the reasons upon which these changes are based.

It is worthwhile to examine the 'systematic arrangement' component of the above definition of an organization further. All organizations, whether social or natural, must satisfy the requirements of survival and adaptation within the environment through a pattern of interdependence between their parts(Parsons, 1951). Whether one is concerned with an animal, a machine or a social organization, it is useful to consider a system of resource inputs, conversion or throughput and production or output. This successive process of 'input - throughput - output' is known as general systems theory. Talcott Parsons(1951) was one of the first social scientists to note the relevance of general systems theory to organizations. His contentions were based upon the observation that social organizations, like natural systems, are composed of an inter-related series of processes.

Included within the organizational milieu are individuals who are not permanent members of the organization. Rather, these individuals are seconded, either on a regular or periodic basis, to provide needed information to the organization. This process is generally known as consultation(Grove, 1971). Consultation may

take the forms of, for example, advisory boards, special committees, topical conferences or informal, ad hoc discussions. Grove(1971) notes that these forms of consultation are extremely important to the proper conduct of organizational affairs.

While it has been noted that organizations may be viewed as systems under the rubric of general systems theory, there are several ways in which to examine the actual organizational system(Silverman, 1976). One is to view an organization as a closed system in which extra-organizational factors are essentially ignored. While this view does violate the systems perspective, it adheres to a positivist approach which focusses upon the direct influence of organizational factors on human behaviour. A second approach views organizations as partially-open systems which encorporate extra-organizational influences, yet focus principally upon organizational variables as determinants of human behaviour. Third, organizations may be seen as open systems subject to the influence of extra-organizational factors operating in a broader societal context. In light of the relevance of general systems theory to organizational structure, it is preferable to view organizations as open systems which influence, and are influenced by, extra-organizational factors. Further, the retention of consultants inevitably introduces extra-organizational factors into the organizational milieu.

The broader framework of extra-organizational factors within which organizations operate may be termed the 'environment'. There are two general typologies of organizational environments(Katz and Kahn, 1966). One is the environment-input typology, which concentrates upon the influence of external

environmental pressures on organizational function. Second is the environment-output typology which is concerned with the consequences of an organization's contribution to the environment and particularly the impacts upon the rest of society. It is not sufficient to rely solely upon either interpretation of the relationship between an organization and its environment. Rather, it is preferable to consider both of these viewpoints to be valid.

The open organizational system provides many things to an organization. It provides a general social, political, technological and economic framework within which an organization may be structured. It gives individuals employed by the organization broader experiences than those afforded by the organization alone. Finally, the broader environmental system provides the stimulus or impetus to initiate the process of decision-making within an organization.

Bureaucracies as Organizations

The bureaucracy is a special type of organization. Weber(1947) outlined six attributes which characterize the ideal bureaucracy. First, the regular activities required to achieve the goals of the organization are distributed in a fixed way as official duties. Second, the organization of offices follows the principles of hierarchy, with each lower office being under the control and supervision of a higher office. A consistent system of abstract rules is the third characteristic of ideal bureaucracies. The fact that officials undertake the responsibilities of their offices with a spirit of formal impersonality comprises the fourth attribute. Fifth, employment in bureaucratic organizations is based solely upon technical

qualifications and is protected from arbitrary dismissal. Finally, bureaucracies are highly efficient means of achieving organizational goals. While Weber's(1947) model of bureaucracies may be criticized on many grounds, such as its unemotional treatment of people or the fact that many informal networks develop within bureaucracies, it is nevertheless a useful conceptualization of highly-structured organizations. This type of bureaucratic structure has many implications for organizational decision-making. It is the latter topic to which this discussion will now turn.

Organizational Decision-Making Theory

A decision may be defined as a choice taken from a number of alternatives. Scott(1971) identifies four key ingredients involved in the taking of a decision. First, a new goal(s) is sought due to perceived dissatisfaction with the existing goal(s). Second, objectives are formulated in order that the goal(s) may be attained. Third, a number of alternative strategies are selected which more or less fulfil the objectives. Finally, the outcome of each of the alternative strategies is evaluated and a decision taken.

There are a number of differences between decisions taken by individuals and those taken by organizations. Barnard(1971) identifies three key differences. Personal decisions may be deliberate and calculated or unconscious, automatic and habitual. Organizational decisions, on the other hand, virtually always involve logical, conscious processes. Second, responsibilities for personal decisions may not be delegated, whilst organizational decisions almost always involve delegation.

Finally, personal decisions involve limited specialized knowledge; the converse again being true of organizational decisions.

In theory, the activities of organizations are dominated by organizational, not personal, ends(Barnard, 1971). These ends, or goals, of organizations require logical means or processes for achievement. The co-ordination of processes as means to an end results in the logical structure of organizations. Two of the main components of these means or processes required to achieve the goals of the organization are the delegation of authority and responsibility, and specialization. In delegating authority and responsibility to personal actors within an organization and retaining specialized individuals as an integral part of the process of organizational decision-making, the organization is allowing the threat of pursuit of personal ends to emerge.

Downs'(1971) model of the decision-making process in organizations stresses the importance of individuals in this process. It is offered as an alternative to the Barnard(1971) model discussed above. Downs views the decision-making process as an activity prompted by the continual scanning of the environment. Such scanning may result in stimuli to which the decision-making process must respond. In order to respond new goals must be sought, objectives formulated, alternatives generated and evaluated and a decision taken. Downs'(1971) model closely accords with that conceived by Scott(1971), as discussed above. However, Downs contends that decision theory should concentrate "upon individuals rather than upon the bureau as a whole, since individuals are the basic decision-units"(Downs, 1971;67). This focus upon the individual is important for at least two reasons. First, indi-

viduals will screen out information adverse to their personal interests and magnify that according with their interests. Second, undue precedence will be given to those alternatives which the individual feels will draw rapid consensus. These individual biases will have a profound impact upon the entire decision-making process within an organization.

It is worth pausing for a moment to consider the implications of the Barnard(1971) and Downs(1971) models for the individual organizational employees. Interpretation of Barnard's model suggests that the individual may be constrained in his/her actions by organizational norms. Hence, the individual decision-maker may not be able to take a particular decision or advocate a stance although he/she feels that it would be proper to do so. Downs' model, on the other hand, sees the individual as a relatively free actor operating with few organizational constraints. The individual is allowed much latitude in making decisions. The views of Barnard and Downs are felt by this author to represent ends of a continuum upon which individual cases may be located.

Roles in Organizations

Regardless of which interpretation of the relationship between the individual and his/her employing organization is accepted, the actual function or set of functions carried out by the individual is known as a role(Kahn, 1964). Individuals generally maintain a variety of roles ranging, for example, from businessman to father to golf partner. Each of these roles carries with it a set of expectations which are placed upon the role player by those surrounding him/her in a certain

activity. Although this concept was introduced above, it deserves further consideration. The fulfillment of one's role is influenced by two factors. One is the role player's internal forces, such as commitment, dedication and perception of role. Second, forces external to the role player in any given situation must be considered. Where uncertainty toward the role player's responsibilities exists in the mind of the role player or in the minds of those surrounding him/her, role ambiguity may result.

It is possible that the two or more roles taken on by one person may conflict(Handy, 1985). For example, a conservation-minded bureaucrat may be expected to campaign for the forest preservation group of which he is a member whilst allocating forest resources to timber contractors. These tasks clearly conflict. Conflict may also result from role overload, where the number of responsibilities one person must assume simply overwhelm that person. Conversely, underload may result if an assigned role is deemed by an individual to be well below his/her capabilities.

There are three implications arising from the stress produced by role conflict and ambiguity(Handy, 1985). First, an individual may experience tension which may be manifested in physical or mental illness. Second, low organizational morale may result. Finally, lines of communication between individuals and those surrounding them in an organization may deteriorate or be withdrawn. Efficient and productive organizational operation relies upon the proper maintenance of these three factors. Consequently, role conflict or ambiguity may adversely affect the process of organizational decision-making.

Power in Organizations

Power may be identified as "the capacity to affect people, things, situations and decisions", especially the ability which one person has to have others do things they otherwise would not do(Lee and Lawrence, 1985). Five types of organizational power may be identified. Legitimate power is that which is accepted without question by those it is exerted upon. Reward and coercion power involve the application of sanctions by a person of authority. Referrent power is based upon the character and charisma of the person of authority. Finally, expert power is attributed to those who possess knowledge and abilities required by others in the organization.

There are numerous ways of relinquishing power within organizations, one of which is to delegate authority. Silverman(1976) and Handy(1985) both note that in delegating authority, one is essentially allowing others to influence the domain over which he/she once held exclusive control. This argument is supported by Lee and Lawrence(1985), who note that in order to retain the greatest possible power and influence, one should involve others in decisions only when absolutely necessary. Downs'(1967) contention that 'tall' organizations possessing a high degree of delegation of authority also demonstrate greater inequalities of power and prestige than 'flat' organizations further supports the argument that the power and influence held by one decision participant is inversely proportional to the number of actors involved in the decision.

Pelz and Andrews(1966) conducted empirical research on more than one thousand scientists in the United States to determine, amongst other things, how

organizational freedom affected job performance. Their findings led to the conclusion that "high autonomy tended to co-incide with high influence" in regard to professional involvement in organizational decision-making(Pelz and Andrews, 1966; 17). The relationship between the expert, or pundit, to whom authority is delegated, and those who perform administrative duties in organizations is considered by Benveniste(1977). In this case, the pundit views the administrator as an enemy, one who may become involved in the pundit's affairs and thus reduce the pundit's power and influence. Typically, the pundit plays an integral role in organizational decision-making. It is to this point that this discussion will now turn.

Professionals in Organizations

A particularly important group of organizational role-players are the professionals. Professionals are called upon to fulfil roles in organizations essentially for one reason - they have a specialized set of knowledge, skills and talents which are required to satisfy the responsibilities delegated to their particular division of their organization. Sommers(1963) contends that those professionals accorded a higher degree of status within society and, indeed, within organizations, are those who specialize on problems relating to one or more of the following areas: 1) human rights and obligations; 2) development and use of technology; 3) human health; 4) finance. Professionals involved in these areas have crucially important roles to play in organizations dealing with matters related to these concerns.

Professionals may be retained by organizations in a variety of capacities(Prandy, 1965). They may be permanently employed as specialists focussing upon relatively narrow problems in the decision-making process, as members of departments or as administrators or managers. The engineering, law and accounting departments of large organizations illustrate these points. Professionals may also be retained on a temporary basis to fulfil organizational functions. Informal contacts, hired consultants, advisors and committee members are examples.

It is also important to consider the sociological relationship between the professional and his/her employing organization. Driver(1972) called the ability of a professional to interact with the goals, strategies and orientation of his/her organization 'socialization'. Further, Driver(1972) provided an interesting distinction between two types of professionals - the local and the cosmopolitan. The 'local' professional is primarily dedicated to his/her employing organization and its goals. Conversely, the 'cosmopolitan' professional expresses a higher degree of loyalty to his/her discipline and is concerned more with basic research. Hall(1973) continued this theme by examining 'bureaucratization', a term used to denote a higher degree of compliance with the organizational dimensions of a bureaucracy. Characteristics of the profession, such as type of training, restrictions of ethical codes and professional association, as well as dimensions of the bureaucracy, such as behavioural norms and administrative arrangement, were found by Gianos(1974) to profoundly affect the professional's ability to 'socialize' and 'bureaucratize'. Rather than viewing the ability to 'socialize' and the inability to do so as a dichotomy, it is preferable to conceptualize the latter as a continuum along which a professional may move during his/her career.

Case Studies

Professionals provide advice to the government of the United States on the matter of national science policy from a range of perspectives within that bureaucratic organization. At one level, eminent scientists are summoned to advise on science policy at the very pinnacle of the American government system - the office of the President(Kriedler, 1964). The periodic advice provided by such professionals is complemented by the regular input of two special bodies - the President's Science Advisory Council and the Federal Council for Science and Technology. Each of these Councils provides professional advice on national security, foreign and domestic policy and all other matters of public policy where scientific factors are relevant. Finally, the Office of Science and Technology is a federal agency, staffed predominantly by professionals, which administers the day-to-day requirements regarding advice on national science policy.

A second case study examining the functions of professionals in organizations involves the intention of the New York State Electric and Gas Corporation(N.Y.S.E.& G.C) to build a nuclear-fuelled electricity generating plant on Cayuga Lake in New York state(Nelkin, 1979). The N.Y.S.E.& G.C. retained a large division of professional engineers on staff, although not relying solely upon their advice in terms of making decisions regarding the nuclear power facility. Two major research contracts were awarded. One went to the Cornell Aeronautical Laboratory, an independent group of engineers contracted to examine the physical effects of thermal discharge on Cayuga Lake. Second, a group of ecologists, biologists and engineers from the Cornell University Water Resources Cen-

tre was hired by the N.Y.S.E.& G.C. to study the ecological impacts of the proposed facility. Finally, the utility retained Dr. Thomas D. Wright, a professional engineer, to act as an impartial observer in the controversy and to ensure that the organizational decision-making process was proceeding in an orderly and objective fashion.

Although structured in a different socio-economic and political environment than that of the western world, organizations in the U.S.S.R. also utilize the expertise of professionals to a large degree(Gustafson, 1979). An examination of environmental planning in the U.S.S.R. illustrates this point. Geographers and hydrologists from the U.S.S.R. Academy of Sciences, a powerful quasi-political body, have traditionally been considerably involved in hydro-electric projects in that country. Government agencies, such as the Ministry of Fishing Industry, retain large numbers of ichthyologists, soil scientists and agronomists on staff. A special body called the Scientific Council on Water Resources Management provides a further channel to specialized information available to decision-makers. Organizations such as these maintain professional, expert and specialized members on staff as well as solicit outside advice on occasion.

Resources and Environmental Management Organizations

Throughout many countries of the world, agencies have arisen within the last twenty years to address problems of resource and environmental management. Such agencies are dominantly located in the public sector. These agencies tend to possess systematic structures, generally in the form of a bureaucratic hier-

archy(White, 1986). Further, there tend to be set patterns of relationships which occur between the components of these organizations, a topic which O'Riordan(1971) notes has been the subject of extensive enquiry. Taken together, these characteristics of resource and environmental agencies satisfy the criteria of emergence at a point in time, systematic structuring and patterned relationships used by Silverman(1976) to define an organization.

An examination of the more concrete aspects of the definition of an organization further support the contention that resource and environmental agencies are indeed organizations. O'Riordan(1971) notes that these agencies are often segmented into departments, each of which possesses a specialized function. Communication occurs between such departments. However, as O'Riordan observes, "information flows are also distorted by organizational structure"(O'Riordan, 1976;244). Resource and environmental organizations may be regarded as being open systems for, as Schiff(1966) notes, they are subject to extra-organizational influence, particularly from conservation groups.

Decision-Making in Resources and Environmental Management

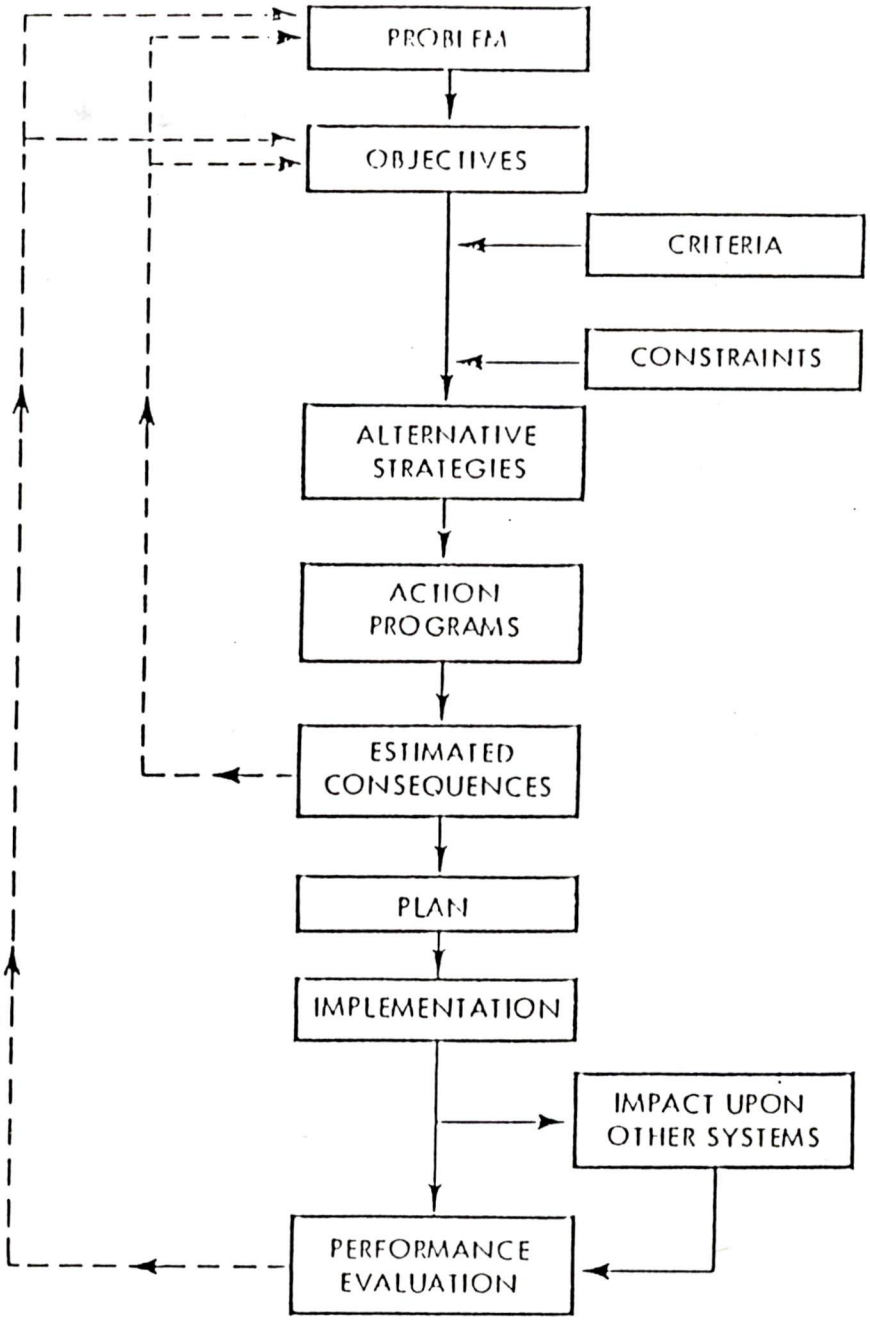
The mechanism used to make decisions on matters of resources and environmental management is to a large degree dependant upon the nature of the problem. Two general types of problems may be identified(Dorcey, 1986; O'Riordan, 1984). The first type are routine problems which are relatively straight-forward and easily resolved. In order to decide upon actions necessary to resolve such problems, those interests with appropriate knowledge and concerns relevant to the

issue need only to be brought together in a suitable process to reach agreement(Dorcey and Martin,1986). The second type of problem is the non-routine or strategic problem. Lack of certainty vis-a-vis technical matters and/or differing value judgements render these problems difficult to resolve. Problems which typically fall into this latter category are those which have not been faced before by the decision-making agency responsible and those which are politically contentious.

Problems which are routine in nature may be resolved through a normative process of decision-making, such as that modelled by Mitchell(1970) (see Figure One). While Mitchell's model is more articulate than the simplified 'define goals - generate alternatives - evaluate alternatives - make decision' framework discussed above, the overall rationale underpinning each model is quite similar. It is this process which conceptualizes "traditional decision-making regarding the allocation of resources via the public sector"(O'Riordan, 1972;5).

Problems in resources and environmental management which are non-routine in nature require different types of decision processes to facilitate resolution. It would be convenient to apply the normative model of decision-making outlined above to such non-routine processes. However, close examination of this model discloses serious limitations. For example, the model does not provide for the inclusion of intangible values - values which have become increasingly important to the management of resources and the environment. A second and related concern is that the role and influence of various interest groups in society in defining and articulating problems in not recognized.

Figure 1: Mitchell's Normative Model of Decision-Making



Kasperson(1969) offers an attractive alternative to the model of decision-making presented by Mitchell(1970). The former adopted a behavioural approach in constructing his model. This approach notes the importance of interplay between interest groups and actors in the decision-making structure (see Figure Two). This model is useful in addressing non-routine problems. According to the model, goals are constantly being altered and updated through inputs from the political system and alternative strategies continuously formulated and evaluated under technological, institutional and psychological constraints. Two criticisms may be levied against this model, however. One is that the 'influencing environment' is defined in relatively narrow physical terms. Second, discreet decisions and the direct results of those decisions are not sufficiently recognized.

O'Riordan's(1972) extension of the Kasperson model encorporates the above considerations into a conceptualization of resources and environmental decision-making (see Figure Three). O'Riordan notes not only the importance of environmental stress, perceptions and the interplay between various groups, but goes on to assert that decisions may result in protest by impacted groups and ultimately a second decision. There have been numerous developments in resources and environmental management theory since O'Riordan assembled this model in 1972, however. These developments are reflected in an up-dated version of the original model (see Figure Four).

There are a number of aspects of the O'Riordan(1986) model which deserve comment. The model postulates three decision tracks. The first track represents resolution of a routine problem. Here, the Mitchell(1970) model appears to be

Figure 2: Kasperson's Behavioural Model of Decision-Making

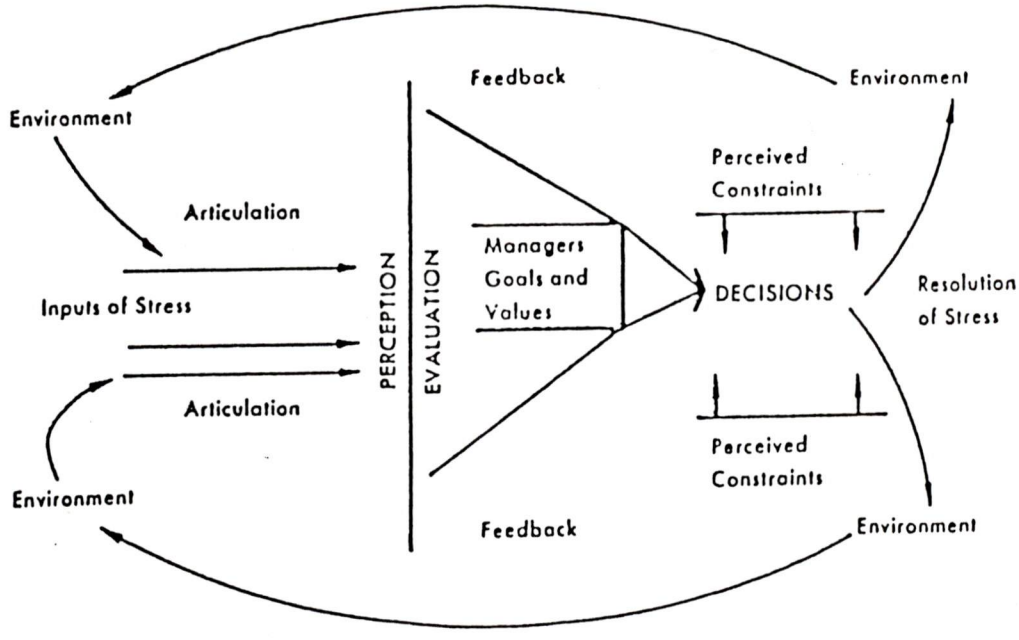
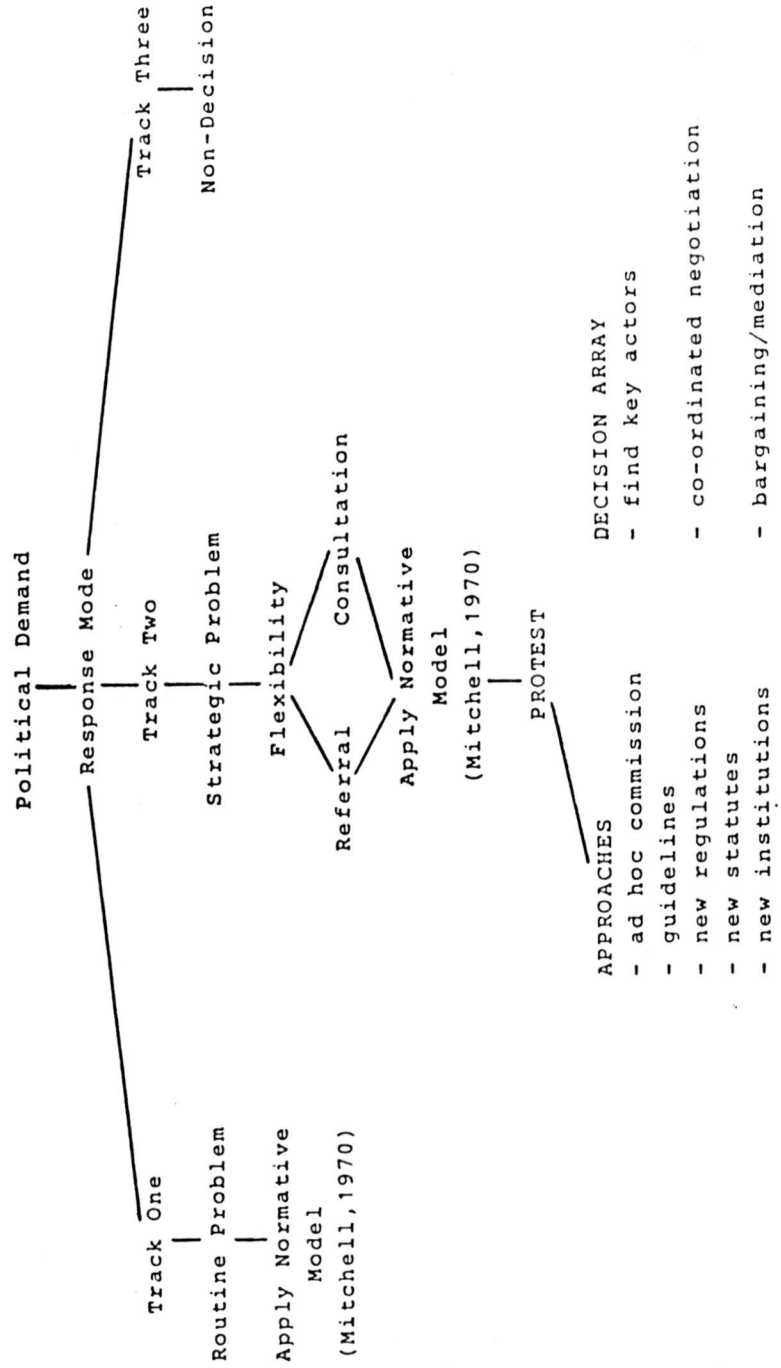


Figure 3: O'Riordan's (1972) Model of Decision-Making

Figure 4: O'Riordan's (1986) Model of Decision-Making



applicable. The second track involves the resolution of non-routine problems. In order to solve such problems, a degree of flexibility must be incorporated into the decision-making process. Such flexibility will allow referrals or consultations to take place. Referrals are formalized means of channeling communication through various actors within government(Dorcey and Martin, 1986). Consultations are generally informal meetings held between small groups of people representing government agencies, private industry, research organizations and interest groups(Dorcey and Martin, 1986). Following the conduct of referrals and/or consultations in which various potentially impacted groups may voice their opinions to decision-makers, the normative process of decision-making as prescribed by Mitchell(1970) may proceed. The third decision track involves a non-decision. Jenkins(1978) identifies non-decisions as issues or problems which are prevented from reaching the political agenda. In a pluralist society, issues may be deflected away from the political agenda by routinising demands through the use of committees or inquiries, or imposing threats of sanctions, amongst other methods. In his study of air pollution, Crenson(1971) notes the importance of industrial presence, the structure of the local political system and the nature of the air pollution issue in the non-decision vis-a-vis that environmental problem. Crenson observes that the importance of the noxious industries to the economic well-being of Gary, Indiana, and the fact that much of the pollution is transported out of the community, are important determinants in the local government's ability to avoid taking a decision on the issue.

It is entirely feasible that decisions taken along any of the three tracks of O'Riordan's(1986) model may result in protest from impacted groups. O'Riordan

identifies five approaches which may be taken to address such protests. Ad hoc commissions may be established, guidelines articulated, new regulations assembled, new legislation invoked or relevant institutions adjusted or established. A combination of these approaches may address or otherwise become involved in the application of a decision array. The search for and identification of key interests involved, co-ordinated processes of formal negotiation and bargaining/mediation involving trade-offs such as compensation for risk are all contemporary strategies couched within this decision array.

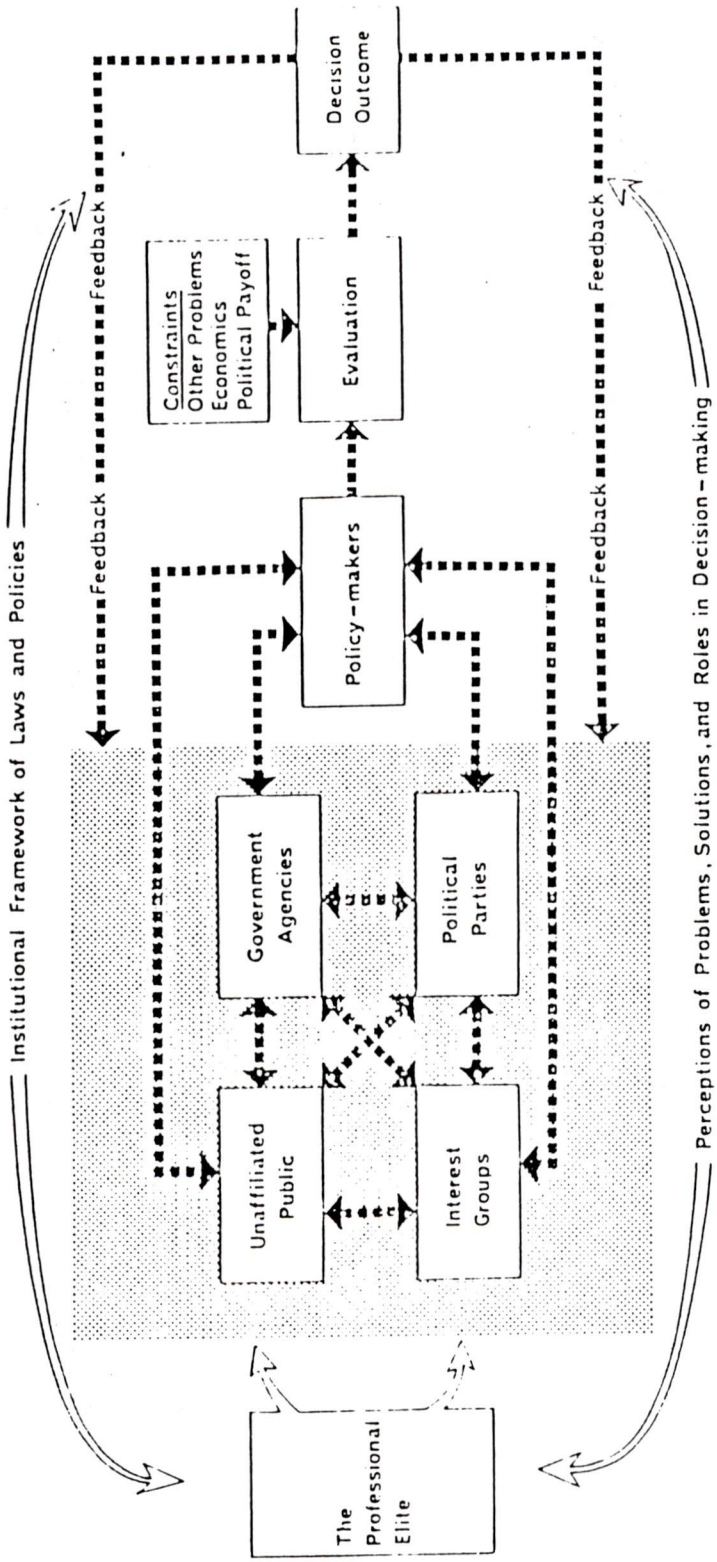
Professionals in Resources and Environmental Decision-Making

Within the last two decades, the importance of professionals to resources and environmental decision-making has come to be recognized. White (1966) was one of the first workers in the field of environmental studies to note this importance, particularly with regard to the attitudes and perceptions held by professional resource managers versus those held by groups within the public. Other workers were quick to recognize the importance of this research theme.

In his study of engineers, Sewell(1971; 38) concluded that "the engineers saw themselves principally as technical advisors", while Sewell(1971) and McMeiken(1972) found that public health officials perceived their roles quite broadly. The latter felt responsible for identifying problems as well as devising and implementing solutions. O'Riordan (1971; 103) observed "professionals play various roles, such as consultants, advisors, planners, supervisors of management programmes, technical staff, administrators and politicians." Hendee and Bultena (1972; 12)

noted that the characteristically broad role which foresters perceived of themselves was the "result of professional socialization, organizational structure and working environment." In her study of student engineers, Barker(1977) observed that this group saw their roles as those of strictly technicians consulted during the planning process. Much of the early work on this theme was conceptualized by Sewell(1974) (see Figure Five). As depicted on this diagram, the professional elite influence all stages of, and inputs from various groups to, the process of decision-making.

Figure 5: Sewell's Model of Professional Involvement in Decision-Making



Case Studies

The conceptual aspects of resources and environmental decision-making noted above may be illustrated through the use of two examples. Reich(1962) thoroughly examined the administrative and legal underpinnings of the process of forest management decision-making in the United States. His thesis clearly places the structure of the U.S. Forest Service in the context on an open-system organization, as input from extra-organizational forces articulated primarily through interest groups is held to be of great importance. In terms of decision-making, Reich notes "the forest agencies have adopted elaborate internal procedures in order to exercise their management, policy and planning functions" (Reich, 1962;418). In addition, Reich notes the critical importance of professionals placed throughout the Forest Service, a topic further researched by Kaufman(1967). These authors feel that while forest management agencies are, in theory, receptive to outside input into decision-making, the professional staff are often reluctant to accept advice on the management of 'their' forests.

The case of the preservation of a wilderness area in south-west Tasmania provides another illustration of decision-making by a resources and environmental management organization(Davis, 1984). Both the Australian Commonwealth and Tasmanian State governments were involved in this issue. Agencies within these governments, each possessing bureaucratic structures open to inputs from industry, conservation and other government groups, attempted to resolve the issue of preservation versus development of this wilderness area. Each agency used a strategy of goal formulation, generation of alternatives, evaluation of alternatives

and decision(Mercer, 1985). For example, the Tasmanian Hydro-Electric Commission(H.E.C.) attempted to pursue its goal of providing a reliable power supply by generating and weighing a number of alternatives prior to taking a decision. A number of professionals, including engineers and economists, were retained by the H.E.C. and others to facilitate the decision-making process(Sewell, 1987). The goal of the Commonwealth government, formulated to a large degree in response to intense political pressure from conservation groups, was one of preservation of the Tasmanian wilderness. This issue generated much debate in Australia as the goals pursued by the Commonwealth and Tasmanian governments were clearly in conflict.

Water Management Organizations

The concepts and examples of organizational decision-making in resources and environmental management outlined above may be applied to the management of specific resources, including water. In most parts of the world, water resource management agencies are located within the public sector. Fox and Craine(1962) identified four characteristics of such agencies. First, they possess a system of values and goals and the attendant requirements for decision-making. Second, physical and economic characteristics of the function of providing water services are present in these organizations. Third, significant relationships exist between component parts of the water provision system. Finally, such agencies are responsive to the general socio-economic environment.

Parker and Penning-Rowsell(1980) argue that water management is only one of a number of planning systems which include community-based planning, social and economic planning and other types of resource- based planning. They note that the water planning system has a management structure manifested in institutions and legislated dominantly through government edict. In theory, these water management institutions interact with segments of society represented by interest groups in order to formulate policies, plans and schemes. The latter are a result of decision-making processes undertaken by these organizations.

Water Management Decision-Making

The resources and environmental decision-making process modelled by O'Riordan(1986) appears to be applicable to the management of water resources. The management of such resources often requires a stimulus - response mechanism to initiate a process of decision-making(Foster and Sewell, 1981). Further, the three decision tracks identified in the O'Riordan model, as well the new approaches to decision-making, have all been utilized in various examples of the management of this resource(see, for example, Dorcey, 1986).

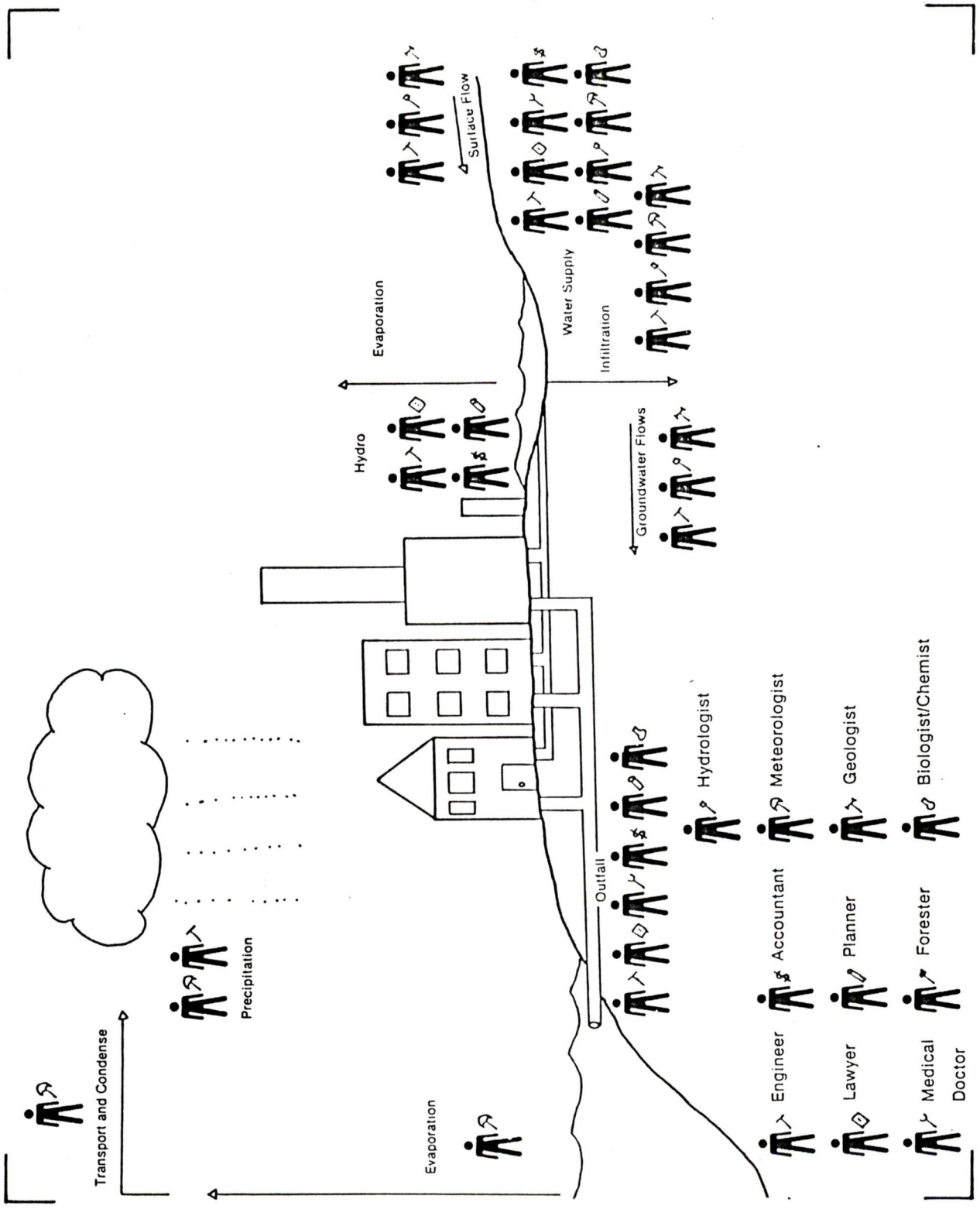
Professionals in Water Management

A variety of professionals are intimately involved in the process of decision-making within water resource management organizations. There are two ways of conceptualizing this professional involvement. One is to examine the points of participation at various stages of the water resources management decision-

making process(see Figure Four). It is apparent from this model that professionals may profoundly influence all stages of the process and, ultimately, the outcome. A second way to conceptualize the involvement of professionals in water resources management is through the use of a model of the hydrologic cycle(see Figure Six).

This model is intended to illustrate, in a simplified way, the importance of various professionals at different stages of the hydrologic cycle. From the diagram, it is obvious that professionals are extensively involved at all stages. It is especially important to note the dominance of engineers in all aspests of water management. A further interesting observation is that professionals appear to be most heavily involved in the stages of the hydrologic cycle that are significantly modified by man. The various professionals depicted in this model may be involved as consultants, advisors, technicians, administrators and decision-makers, or a combination of two or more of these roles, in the management of this resource.

Figure 6: Involvement of Professionals in Water Management



Case Studies

There are numerous examples of professional involvement in water resources management in the literature. One way to place these case studies into context is to examine not only the stages of the decision-making process at which professionals are involved, but also the spatial scales of involvement. The latter context will be considered first. In 1963, a consulting firm of engineers from Los Angeles, Ralph M. Parsons Co., proposed the North American Water and Power Alliance (N.A.W.A.P.A.) scheme(Parsons,R.M., 1967). International in scope, this scheme was conceived to divert water from areas of surplus to those of deficit and to provide benefits throughout North America. At a smaller scale, the U.S. Army Corps of Engineers, which is staffed almost entirely by professional engineers, was closely involved in various diversions from the Colorado River basin, involving the states of Utah, Colorado, Wyoming, New Mexico, Arizona and particularly California(Parsons,R.M., 1967). An examination of the Goldstream controversy in Victoria, British Columbia reveals the involvement of professionals in relatively small-scale decisions(Wood, 1976). In this situation, initial decisions taken by the controlling agency were based almost entirely upon the technical advice provided by the agency's water commissioner - a professional engineer.

Case studies in the literature may also be used to illustrate the contention that professionals are involved at various stages of the water management process. Engineers and economists employed by Manitoba Hydro proceeded with the planning of the South Indian Lake project under what they had defined as being the goal and objectives of that utility - reliable hydro-electric power at the lowest

possible price(Burton, 1974). In terms of generation and evaluation of alternatives, the involvement of accountants, hydrologists, economists and engineers employed by Egypt and the World Bank in planning the Aswan Dam illustrates how professionals may be involved in these stages of the decision-making process(Rycroft and Szyliowicz, 1980). Whilst the ultimate decision of whether or not to construct the dam lay with the Egyptian officials, lawyers, economists and engineers from a host of countries provided input into the process of bargaining and negotiation which resulted in the final decision.

An important case study reflecting the involvement of professional engineers in water management is that of the U.S. Army Corps of Engineers. Maass(1974) emphasizes the power and persuasiveness of the Corps in attaining the water management goals which they set, suggesting that they lobby strongly in Washington to further their cause. Maass (1974) also notes that the Corps is comprised of 'company men', engineers who are fiercely loyal to their organization. In examining the water management goals and strategies which the Corps pursue, Morgan(1971) notes their apparent insensitivity to the environment as well as their tendency to manipulate management tools, such as benefit-cost analyses, to meet particular needs. Similarly, Laycock(1970) criticizes the techniques and policies of the Corps in his examination of several projects, concluding that the term 'diligent destroyers' may be an apt characterization of this organization.

Several other important studies must be noted in the context of professional involvement in water management. Allen(1972; 319) states that "consulting engineers at Anchicaya completed failed to recognize the sediment and debris prob-

lems" inherent in their proposed design for a large hydro-electric project in Columbia. Only after extensive re-evaluation was the project allowed to proceed. Parker and Penning- Rowsell(1980; 48) note that water management institutions in England, Wales and Scotland are "unbalanced in favour of those with engineering backgrounds" and that such a bias may lead to narrow approaches and adherence to established practices which may not necessarily yield the best solution. After evaluating the success of many international civil engineering projects, Kalbermatten and Gunnerson(1977) note that it is the responsibility of the engineer to consider economic, environmental, behavioural and engineering dimensions of problems prior to recommending possible solutions.

Sewage Management Organizations

Decision-making regarding the treatment of liquid wastes produced by domestic, commercial and industrial consumers in urban areas takes place within an organizational framework. This has not always been the case. In fact, the relatively recent trend toward urbanization in developed countries thrust this environmental issue into the organizational milieu. Whilst federal and state governments in various countries do hold interests in liquid effluent management via their involvement in the maintenance of water quality, the main responsibilities are most squarely focussed upon regional and municipal levels of government(Woodrow, 1974). Regional and municipal governments may be regarded as being organizations. They generally maintain divisions which deal with specialized problems such as financing and technical services - two key aspects of liquid effluent management(Plunkett, 1972). Further, Woodrow notes that the "influence

within the community and the role of public awareness of environmental quality issues in municipal decision-making" must not be ignored, suggesting that extra-organizational variables must be accounted for(Woodrow, 1974;218). The structured, specialized and open nature of the liquid effluent management issue places it firmly within the context of organizational decision-making.

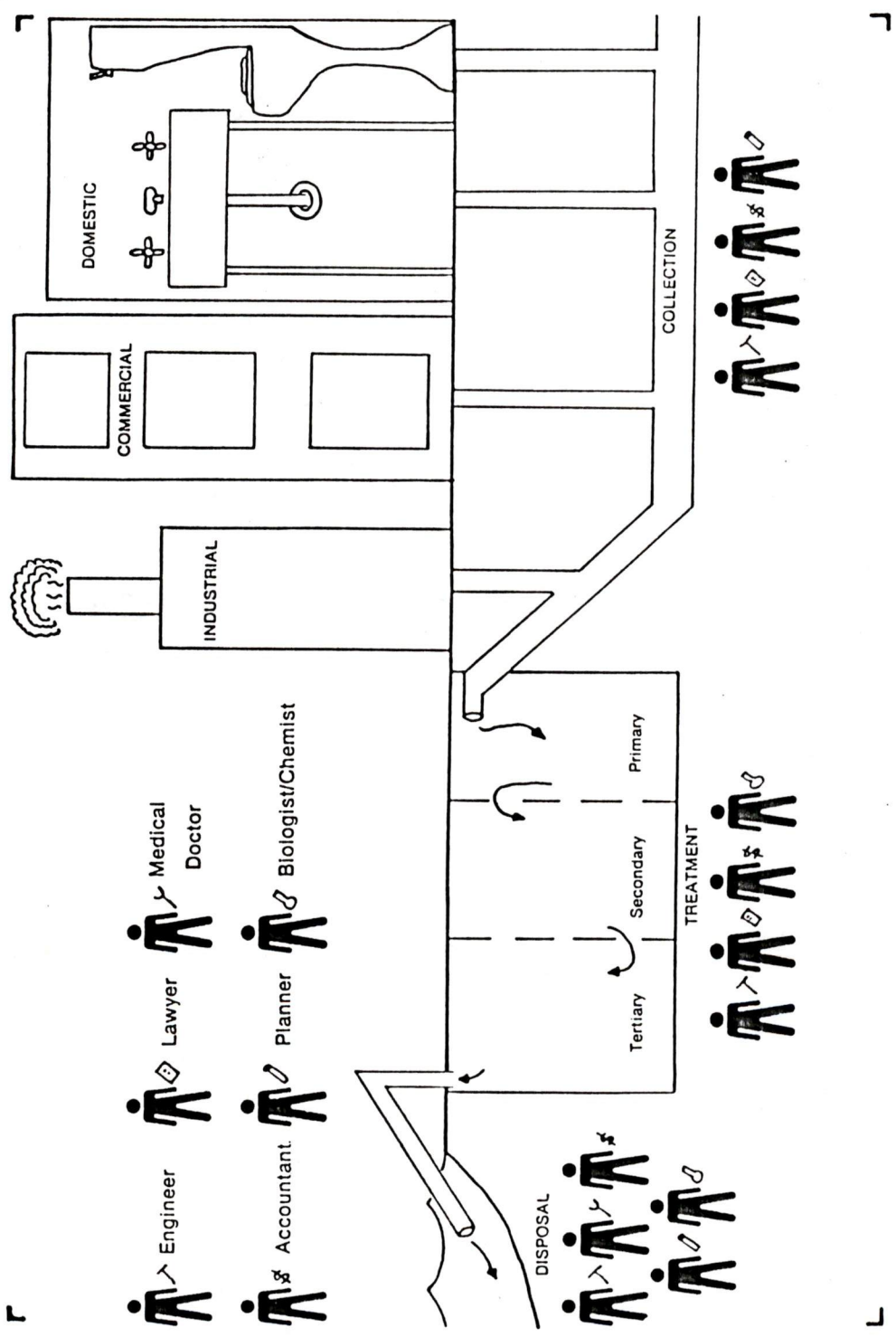
Sewage Management Decision-Making

The collection, treatment and disposal of liquid effluent originating in urban areas falls within the rubric of resources and environmental decision-making. Such effluent is disposed of onto land or into water, both of which are resources valuable to our society. In addition, such disposal may result in serious environmental impacts. O'Riordan's(1986) model represents an attractive means of conceptualizing decision-making vis-a-vis this issue. Schemes proposed or utilized to manage liquid effluent may spur intense political debates to which decision-makers must respond. If the particular issue is routine in nature, such as the need to repair a section of a sewer pipe, the straight-forward process shown in decision-track one may be followed. If the issue is non-routine or problematic in nature, such as the need to construct a new treatment plant, decision-track two may be followed. Although the author is not aware of any examples, it is conceivable that a liquid effluent management issue may be met with non-decision. Finally, the approaches and decision array components of the O'Riordan model are certainly applicable to the management of urban liquid effluent. A recent example of the latter point is the passage of British Columbia's Waste Management Act in 1982, accompanied by the initiation of the Ministry of Environment's (now Environment and Parks) Waste Management Branch.

Professionals in Sewage Management

Professionals fulfil a variety of functions in the process of liquid effluent management decision-making within an organizational framework. In their study of water quality issues in the Okanagan and Shuswap Lakes of British Columbia, the O'Riordans noted that professionals acted as advisors and consultants, as well as being employed in a managerial capacity(O'Riordan, 1972). Woodrow(1974) notes that professionals are employed as technical support staff in municipalities across Canada, as administrators and as member of interest groups in his consideration of municipal sewage treatment in Canada. The types of professionals noted in these works are engineers, public health officials, accountants and economists. The way in which they are involved in liquid effluent management is depicted in Figure Seven.

Figure 7: Professional Involvement in Sewage Management



Case Studies

The involvement of professionals in liquid effluent management decision-making may be further illustrated through the use of two case studies. The first concerns ocean dumping of effluent from New York City(Payton, 1985). The City of New York was accused by the U.S. Environmental Protection Agency of degrading the quality of the water in the New York Bight to a considerable extent through the dumping of sewage. Various professional scientists employed by the Environmental Protection Agency(E.P.A.) and New York City's Department of Environmental Protection(D.E.P.) then undertook massive studies on which to base their respective positions. New York City's D.E.P. also engaged two professional consulting firms, Ecological Analysts Inc. and Seamocean Inc., to conduct impact assessments. Various outside interests, such as researchers from the National Oceanic and Atmospheric Administration, also became involved in this debate. As the two main organizations involved - the City of New York and the E.P.A. - could not reach a decision, the matter was referred to the U.S. District Court for resolution. The Court ruled in favour of the City, concluding that New York's ocean dumping could not be prohibited.

A second interesting example is set in the New Plymouth area of New Zealand. Three groups were involved in the debate over discharge of sewage into the Taranaki Harbour on New Zealand's north island(New Zealand's Commission for the Environment, 1975). Various government agencies provided input to the debate in the form of technical alternative evaluations, environmental impact statements and financial analyses. A broad range of professionals were involved

in compiling such submissions. The second group involved in the debate was the Taranaki Catchment Authority/Regional Water Board. A group of engineers, biologists and oceanographers employed by those agencies considered the technical aspects of their chosen alternative, which was to continue to discharge wastes offshore. Third, groups such as the New Zealand Ecological Society and the New Zealand Institute of Engineers submitted documentation to the debate, generally opposing the ocean dumping of untreated sewage. Whilst the New Zealand Ministry of Works and Development was ultimately responsible for the decision, the input of various other organizations,who themselves relied heavily upon professional advice, was welcomed through the formative stages of the decision-making process.

Decision-Making at the Community Level

The discussion thus far has focussed upon the role and influence of professionals in organizational resources and environmental decision- making and has dealt with only one specific problem - sewage. It is now necessary to narrow the scope of inquiry to deal with decision- making at an appropriate scale - the community. In the context of this study, 'community' can be taken to mean municipal and/or regional levels of government. While mention is made above that the responsibilities for sewage management are predominantly charged to municipal/regional governments in developed countries, the process and structure of community decision-making has been given little attention. It is to this concern that this discussion will now turn.

In his study of water management controversies in ten communities in Massachusetts, Sanders(1961) identified a series of six successive stages which led to community decisions, namely; initiation, preproposal, proposal, community action, decision and aftermath. Initiation involves the informal discussion of the problem involved amongst interested community officials. At the preproposal stage, a plan of action is articulated and broader community support sought, with the resulting strategy being presented to those empowered to take action at the proposal stage. The action stage involves debate between the decision-making body and its opponents, with the actual choice or outcome of this debate being the decision stage. It is quite conceivable that an aftermath stage may result if the decision is controversial. These stages of community decision-making roughly accord with those identified for organizational resources and environmental decision-making.

A number of behavioural aspects of the O'Riordan(1986) model of resources and environmental management decision-making are not noted in Sander's(1961) model. For example, Sanders does not mention the existence of flexibility in the community decision- making system or the importance of power and influence in inter-actor relationships. Crain et al.(1969) explicitly recognize these factors in their study of drinking-water fluoridation decisions in over one thousand communities in the United States. They note that a number of optional strategies are typically available to community decision-makers to facilitate problem resolution, and that the interplay of power, particularly between elected city officials, professionals and private-sector lobbyists, are important factors in shaping decision outcomes. When considered in conjunction with the the model outlined by Sanders(1961), these behavioural aspects of community decision-making provide a framework similar to that outlined by O'Riordan(1986).

The work of Crain et al.(1969) raises an important question about community decision-making which has not yet been addressed - who are the important actors? Although the importance of various actors will differ according to the nature of the issue in question and the structure of the decision-making network, a locus of key individuals may be identified. In their study of decision-making in thirty-two communities in the United States, Davis and Weinbaum(1969) noted the unvarying importance of elected city officials, senior appointed city officials, businessmen and professionals in community decision processes. While senior government or lobby group representatives may be seen as particularly important in certain specific decision, these key actors are important in all community decisions.

The structure of community decision-making processes varies from community to community across the world. In North America, two basic structures of community decision-making may be identified (Crain et al.,1969; Plunkett,1972). The first is the city-manager system, in which the city manager is responsible for administration and direction of departments and employees. The second is the council - committee system, in which the mayor acts as a link between various committees and council and also serves as a chief administrator. The structure of the community decision-making system affects the distribution of responsibility and power within the system as well as conditions which actors may take part in decision processes.

A simple example may be used to illustrate the distinction between the city-manager and council-committee forms of local government. Under the city-manager system, if a concerned citizen writes to the municipality with a sewage

management problem, the city manager will direct the concern to the head of the engineering department, who will in turn report back to the city manager with a proposed solution. If the problem is particularly contentious or requires substantial funding, the city manager may take the issue to council and, in addition, play a role in the making of a decision. The council-committee system operates quite differently. Here, the concern is directed by the mayor to the head of the engineering department as well as to a committee initiated to deal with such problems. This committee, which generally is known as a 'sanitation and water' or 'public works' committee, typically consults with the head of the engineering department. The mayor then co-ordinates the inputs from the engineering department and the relevant committee to council, and also participates in the final decision. The mayor in the latter case therefore acts as an administrative officer. As Bish(1986) notes, this clear distinction between the two decision-making systems may become muddled if special committees are established under the former system or strong administrative officers are present in the latter.

Summary

The management of liquid effluent generated in urban environments takes place within what have been defined as organizations. Such organizations are characterized by internal delegation of authority, specialized divisions and channels of information flow both within, and from outside, the formal structure. In Canada, the United States and many other countries of the world, the organizations which perform the functions associated with the management of urban effluent may be more specifically termed bureaucracies, as they are governing bodies characterized by hierarchical administrative structures.

Decision-making takes place within such organizations. It has been noted that normative models of resources and environmental management decision-making do not adequately portray the process of municipal effluent management. Rather, a behavioural approach which accounts for the input of extra-organizational values into decision-making, perceptions and attitudes of the various actors involved and the interplay between such actors appears to be more appropriate. Such behavioural models do encorporate decision-points where the more normative processes of decision-making may apply.

Of all of the groups involved in decision-making processes for resources and environmental management, the professionals are one of the most important. The latter not only staff the organizations in which decisions are made but are also involved in consultancy firms, advisory boards and interest groups to whom organizations may turn for advice. It is indeed conceivable that a given professional may be involved in two or more of these activities. Regardless of the nature of their involvement, they are accorded a high degree of status in decision-making as they provide critical input into issues involving human rights and obligations, the development and use of technology, human health and finance.

A number of questions arise out of this discussion. Among the most important of these is what conditions the role and influence of professionals, notably engineers, in sewage management decision-making at the community level? Of the host of possible factors, four are postulated to be of critical importance. These are the tradition of leaving technical and complex matters of resources and environmental management to those assumed to know best how to solve them; the size

of the community decision-making network; the structure of the community decision-making network; and the professional's own characteristics. It is the aim of this thesis to shed light on these factors in order to foster a better understanding of professional involvement in resources and environmental management.

STUDY DESIGN

Introduction and Hypotheses

From a review of the relevant literature, discussions with academics, consultation with persons working in the field of sewage management, the above general relationship concerning the role of the engineer in sewage management was formulated. In order to test this relationship, the study will examine a series of hypotheses. These hypotheses are:

1) The engineer is more likely to exert a greater degree of influence on the outcome of sewage management decision processes than other actors involved in such processes.

2) The engineer in a larger community is more likely to exert a greater degree of influence on the outcome of sewage management decision processes than the engineer in a smaller community, and thus play a more important role.

3) The engineer in a city manager system of community decision-making is more likely to have a greater degree of influence and play a more important role in the outcome of sewage management decision processes than the engineer in a council-committee system of community decision-making.

4) Engineers' perceptions of their roles can vary. The engineer who perceives a broad role for him/herself in sewage management is more likely to exert a

greater degree of influence on the outcome of sewage management decision processes than the engineer who perceives a narrow role for him/herself.

5) Engineers' perceptions of others' roles can vary. The engineer who perceives others' roles in sewage management as being distinct from the technical aspects of engineering is more likely to have a greater degree of influence on the outcome of sewage management decisions than the engineer who perceives others' roles to be aligned solely with the technical aspects of engineering.

6) Organizational norms can act to constrain a professional employee's activities. The engineer who does not feel constrained by organizational norms is more likely to exert a greater degree of influence on the outcome of sewage management decision processes than the engineer who feels constrained by organizational norms.

7) It is argued that there is an association between professional characteristics such as contact with one's profession, years of professional experience, level of education and degree of influence. The engineer who exhibits a greater degree of expertise as measured by these professional characteristics is more likely to have a greater degree of influence on the outcome of sewage management decisions processes than the engineer with less expertise.

Variables

In order to test these hypotheses, a number of key variables must be extracted and encorporated into a research instrument. These key variables are: the actual role of the engineer; the perceived role of the engineer; the engineers' perception of his/her level of expertise; the engineers' actual level of expertise as measured by his/her professional characteristics; the size of the community; the structure of the community decision-making process; the role of other actors in sewage management decision-making at the community level; organizational norms and constraints and, finally, influence. The research instrument which encorporates these variables is appended (see Appendix One).

Measurement

This study is not intended to be a rigorous examination of the factors affecting the role and influence of the professional engineer in sewage management. The sample size is small, levels of measurement weak and control of the situation in which the subjects respond to examination non-existent. Through in-depth interviews, the study is simply attempting to shed light upon the relationships postulated to shape the professional engineer's decision-making environment and, consequently, his/her influence within that environment. It is hoped nevertheless that other workers will benefit from this preliminary review in designing and constructing future research, using larger size samples and more refined research tools.

Study Communities

The three geographic areas investigated by this study are the community of Ganges on Salt Spring Island, the Greater Victoria region and the Greater Vancouver region. Municipalities and Regional Districts within these three areas were chosen for examination as these levels of government fulfil two important criteria. First, they are the levels at which important sewage management decisions are taken. Second, these levels of government employ the groups of actors who will be the foci of this study, as outlined below. The rationale used to choose specific municipalities/regions within these three study areas may be outlined as follows.

The relationships postulated to exist between the variables of professional engineers' characteristics, the perceptions of professional engineers and other actors, organizational constraints and the role and influence of the professional engineer may be studied in virtually any setting. Therefore, the variables of structure of the community decision-making network and community size were used to select study communities. In the three study areas noted above, Victoria and Burnaby are large municipalities which possess the city-manager system of decision-making. Each of these was chosen for study. Vancouver is a large municipality which operates under a council-committee system of government, and was also chosen for study. There are no municipalities in the study areas which have a city-manager system of government and a population of less than 50,000 - the arbitrary size used to distinguish small from large municipalities. Esquimalt, Oak Bay and North Saanich were chosen for study as they are small municipalities in the study areas, each operating under the council-committee system. The Capital and Greater Vancouver Regional Districts were included in

the sample as they retain significant responsibilities for sewage management in the study areas. Finally, the municipality of Nanaimo and the Comox-Strathcona Regional District were included as checks to determine if any idiosyncrasies existed in the lower B.C. mainland or southern Vancouver Island regions.

Sample Groups

Three groups of actors were chosen for examination in these ten study communities. The first consists of chief municipal/regional engineers - engineering being the focal profession of this study. The second group comprises the municipal/regional chief administrative officers(C.A.O.'s). C.A.O.'s direct the functions of the municipality or region, maintain contact with department heads and elected officials and act as liaisons between the latter two groups. They are extremely knowledgeable in regard to the functioning of municipal/regional government. The third group are the elected officials. The latter are responsible for setting policy within their jurisdiction and are ultimately responsible for any decision taken. They therefore exert broad influence on decision processes in municipalities/regions. Representatives from these groups were chosen through consulting newspaper articles, published literature, government documents and persons familiar with sewage management decision-making in the communities under investigation.

Analysis

Three types of data will be generated using this research design. Graphic data will be produced by having respondents sketch the decision-making structure in their community. Relatively unstructured data will result from responses to open-ended questions and the scenario. Third, scaled data will be generated by having municipal/regional actors respond to more structured questions. All of the data will be used to shed light on the variables posited to affect the engineers' influence on municipal/regional sewage management decision-making. In most cases, the variables will be qualitatively assessed. Spearman's rank correlation, a non-parametric statistical test appropriate for use with the nominal and ordinal data generated by this study, will also be used to test relationships between variables. As noted,limitations of this study will not allow extensive reliance upon quantitative methods of assessment. Such methods will, however, be used to supplement qualitative analyses in order to correlate variables to test the hypotheses used in this study.

THE SEWAGE ISSUE

Introduction

The production of wastes is an inevitable consequence of human existence. Accordingly, man has had to devise methods of dealing with them, either as an individual or group effort. This chapter will consider the evolution of the issue of sewage collection, treatment and disposal. Initially, an historic perspective on the issue will be taken, noting especially the various methods of collection, treatment and disposal which have been utilized and the reasons why more complex and technologically-advanced methods have been adopted in many countries. Second, some contemporary concerns of sewage management will be noted. Third, the special concern which relates to the reluctance of many people to have any aspect of the sewage management process located in their area. Finally, the political nature of the sewage management issue will be examined. Whilst focussing mainly upon sewage management in developed countries, the problems faced by developing countries will also be noted, as they represent cases from which we in developed countries have, to a large extent, evolved. Prior to initiating this discussion, however, it is necessary to define what sewage is.

Sewage is the effluent resulting from the use of water in domestic dwellings, institutions and industries. Domestic sewage is primarily water which typically contains less than one percent solid matter(Barnes and Wilson, 1976). The three

major sources of domestic sewage are washing, food preparation and human excrement. Organic and inorganic compounds may be found in domestic sewage. Institutional sewage, which originates in hospitals, schools, laboratories and the like, is also predominantly water. Such sewage tends to contain a higher concentration and larger variety of solvents, dyes and other inorganic chemicals than does domestic sewage, as well as a significant amount of human excreta(Imhoff et al., 1971). Industrial sewage originating in manufacturing, processing and trade establishments typically contains a host of inorganic chemicals, some of which are toxic, and a relatively small amount of human excreta(Imhoff et al., 1971). The relative proportions of domestic, institutional and industrial effluent in a given volume of sewage will substantially affect decisions on how to deal with that sewage. It is the domestic component of sewage which will form the basis of this discussion.

The management of sewage is primarily a matter of environmental health and sanitation. Water-borne wastes are typically disposed of in surface waters, groundwater streams or reservoirs(Wolman, 1980). Such water bodies often serve a variety of purposes other than merely recipients of wastes. For example, a lake may provide a community's water supply, support a recreational fishery, act as a source of industrial process-waters and possess a high aesthetic value, as well as receive doses of sewage. Consequently, human, animal and vegetative life forms can come into contact with sewage. If improperly disposed of, the organic and inorganic components of sewage may produce serious nuisances such as malodors, corrosion and fish kills(Pike and Gameson, 1970). Toxic and carcinogenic elements in sewage constitute a threat to human health, as do other viruses, bacteria and

organisms specifically dangerous to man. As Imhoff et al. (1971) assert; "from the point of view of public health and general sanitation in any communal area, proper treatment and disposal of water-borne wastes is practically essential"(p. 3).

An Historic Perspective

A convenient way in which to view historic developments in the field of sewage management is to consider them in five sections - pre-collection, collection,treatment and disposal systems and alternative methods. The first section considers sewage management at an individual or small group level. One of the earliest references to the management of human excreta may be found in the biblical Book of Deuteronomy, which refers to the customs of the ancient Hebrews.

> Thou shalt have a place also without a camp, whither thou shalt go forth abroad: And thou shalt have a paddle upon thy weapon; and it shall be, when thou wilt ease thyself abroad, thou shalt dig therewith, and shalt turn back and cover that which cometh from thee(Deuteronomy, xxiii; 12,13).

This rather crude method of disposing of human wastes was common in areas of low population concentrations through the nineteenth century and, indeed, is still practiced in many developing countries today(Krepp, 1867; Okun and Ponghis, 1975).

As societies began to develop, more elaborate means of disposing of human wastes were sought. Among these was the outside toilet or, as it is popularly known in Canada, the 'privy'. There are three basic types of 'privies'(Health and Welfare Canada, 1968). The pit privy is a toilet constructed over an excavation large enough to handle several years of waste(see Fig. 8a). The excavation is

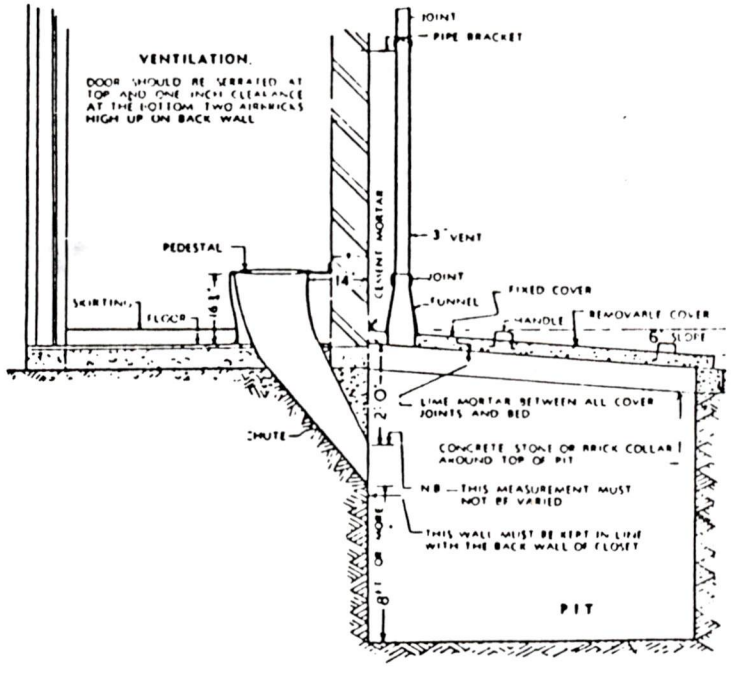
located above the water table to avoid contamination of nearby water supplies. The chemical privy is similar to the pit privy, but uses a chemical such as caustic soda to dissolve solid wastes. The septic privy uses a small water-filled tank to convey wastes to a disposal or leeching pit. Although somewhat obsolete, privy toilets may still be found in rural areas of developed countries.

A more advanced method of dealing with domestic wastes at the individual or small group level is the use of a septic tank(see Fig. 8b). These are water-tight chambers installed in the ground and designed to retain sewage for at least a twenty-four hour period(Barnes and Wilson, 1976). Such tanks facilitate primary settlement and grit separation, with liquid effluent being discharged into porous substrata. The tank's anaerobic environment allows some digestion of the settled solids. Accumulated sludge must be removed on a regular basis. This system of sewage management still enjoys much use in rural areas.

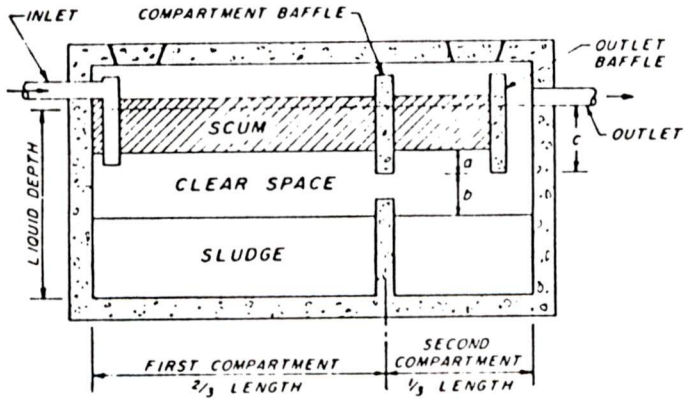
The invention of the water closet in England in the 1800's spawned extensive development of that which is the focus of this second section - sewage collection systems(Krepp, 1867). There were at least two major implications of the widespread adoption of this means of carrying sewage from the home. First, freshwater resources, which constitute the medium in which sewage is borne, became inextricably linked to the process of sewage management. Second, large-scale collection systems were required to convey water-borne wastes from numerous sources in settled areas.

The installation of systems of sewerage was thus necessitated. Sewerage may be defined as a system of pipes and associated appurtenances which convey

Figure 8: Two Fundamental Methods of Sewage Treatment



(a) The Pit Privy



(b) The Septic Tank

Adapted from Rybczynski, et al., 1978.

water-borne wastes. Sewerage was introduced long before the invention of the water closet. For example, the Roman Cloaca Maxima, built during the rule of King Priscus about 600 B.C., was an extensive sewerage system which discharged into the Tiber River(Krepp, 1867). Although somewhat more sophisticated, modern sewerage systems operate under the same basic principle of collecting wastewaters from occupied areas and carrying them to a point of disposal(Steel and McGhee, 1979). There are two main components of any system of sewerage. One is the sanitary sewer which originates at the sanitary outfalls of homes, businesses and institutions. The second is the storm sewer which carries ground run-off and street-wash generated by precipitation and/or snowmelt events. Present-day construction of sewerage systems stresses separate sanitary and storm sewers. However, combined sanitary/storm systems exist in many communities which installed sewerage many years ago(Okun and Ponghis, 1975).

Prior to discharging sewage into a receiving environment, sewerage systems generally incorporate some form of treatment. Four forms of treatment are considered in this section of the historic perspective on sewage management. The first is the lagoon system. Lagoon ponds, which have been in use since Roman times, are large shallow basins underlain by semi-permeable material(Bolton and Klein, 1971). A continuous flow of raw sewage enters the pond and is subjected to a minimum detention time of one month. During this period, aerobic stabilization takes place first in the presence of bacteria, then of algae. Treated waters leave the pond through evaporation, seepage and surface run-off.

A wide range of more complex systems of sewage treatment are available. As the type of treatment becomes more advanced, the quality of the emerging effluent becomes more pure. Preliminary treatment systems involve one or more of a series of racks and screens, comminutors which chop or grind solids, grit and grease removers and pre-aeration devices(Steel and McGhee, 1979). The purpose of preliminary treatment is to remove large particles from the sewage and allow subsequent stages to operate more efficiently and/or to provide rudimentary purification of wastewaters. Primary treatment systems facilitate settlement and clarification of wastewaters, generally through the use of large settling tanks, flocculents which bind smaller particles together and aerating mechanisms. The purpose of this level of treatment is to remove suspended organic solids, augment the oxygen content of wastewaters and reduce the biochemical oxygen demand (B.O.D.) associated with wastewaters. Primary treatment alone is utilized in many parts of the world, especially where large water bodies with extensive assimilative capacities are present to act as receiving environments (Ferguson, 1980).

Secondary and further advanced methods of sewage treatment involve complex processes and are usually preceded by preliminary and/or primary treatment. Communities requiring such advanced forms of treatment are often able to purchase commercially manufactured and patented units which are then custom-fit to satisfy their particular needs(Barnes and Wilson, 1976). Secondary treatment removes soluble and colloidal organic matter remaining after initial treatment. In general, there are two ways in which secondary treatment operates(Steel and McGhee, 1979). The first involves the use of filters which promote a high degree of biological growth and activity in their interstices. The active biological popu-

lations present in the latter consume the organic matter passing through the filter. The second general class, activated sludge mechanisms, constitutes a generally favoured process. It is based on the principle that bacteriologically-active and aerated sludge, which possesses relatively high-order bacteria, is capable of consuming the relatively low-order bacteria contained in organic matter in incoming wastewaters(Bolton and Klein, 1971). Such secondary processes reduce the number of dangerous coliform bacteria in wastewaters as well as decrease B.O.D. Beyond this, there are numerous methods of advanced wastewater treatment. These include the use of chemical neutralizers, electrodialysis and carbon adsorption, are intended to remove excess nitrogen, phosphorous or dissolved organics from treated sewage(Steel and McGhee, 1979). In order to demonstrate the effectiveness of these processes, their proponents can often be seen consuming the effluent resulting from such advanced forms of treatment.

The final stage of the sewerage system involves some form of disposal of treated wastewaters and accumulated solid matter. In many instances, effluent is discharged into fresh-water streams and lakes. The ability of these water bodies to assimilate the wastes hinges upon many factors, including the quality and quantity of effluent and the self-purifying ability of the receiving environment(Wolman, 1980). In coastal areas, treated sewage is typically discharged via ocean outfalls. Due to the assumed enormous capacity of the world's oceans to assimilate wastes, sewage is very often discharged with little or no treatment. The ability of the oceans to assimilate wastes is contingent upon many factors, such as the character of the effluent, nature of the aquatic environment adjacent to the point of discharge and water circulation patterns in the disposal

region(Imhoff et al., 1971). In response to mounting public concern vis-a-vis the practice of ocean disposal, Ferguson (1980; 3) quotes Dr. Isaacs, a noted sewage management expert from California.

> Many countries bordering on the sea are planning these extremely expensive and highly advanced municipal waste treatment plants, ostensibly to avoid 'polluting' the sea with organic materials and nutrients. Such plans reflect a serious misunderstanding of science.

Solid organic and inorganic matter accumulates with any form of sewage treatment. Septic tanks must be emptied regularly, screens and comminutors cleaned and biologically-dead sludge disposed of. Typically, a disposal site is chosen according to the criteria of rates of infiltration and percolation, distance from freshwater supplies and proximity to source of wastes(Steel and McGhee, 1979). As will be demonstrated later, however, various other dimensions of the site selection problem must be considered. Once chosen and prepared, a site is infilled with accumulated wastes. If poorly treated, such wastes may introduce pathogenic bacteria to the soil system and generate malodors. If treated by secondary or advanced methods, these wastes are generally innocuous.

Numerous alternative methods of treating sewage have been designed in recent years. For example, incinerating toilets that reduce body wastes to sterile ash have been popularized in Australia, New Zealand and Japan, while biological toilets which use enzymes and bacteria to convert body wastes into water have gained some acceptance in the United States(Leich, 1975). A unique household collection system which carries wastes, which are discharged directly into tightly-sealed containers, via trucks to land disposal sights has been initiated in England(Leich, 1975). Spray systems which broadcast wastewaters on to forest,

agricultural or un-used land have been utilized throughout the world(Glysson, 1985). Similarly, concentrated sludge may be applied to land as a fertilizer, as it is rich in nitrogen, phosphorous and potassium(Licht and Johnson, 1986). The addition of sludge to mulch to produce compost may also produce an organic fertilizer. While these methods appear to be attractive alternative means of disposing of human wastes and, indeed, converting such wastes into resources, they have yet to gain widespread acceptance by scientific, engineering or medical communities.

Summary of Trends

A number of changes in the way in which man has dealt with sewage may be discerned from the above discussion. These changes constitute four trends. The first trend involves moving from individual to collective methods of disposal. The invention of the water closet initiated this trend and introduced the notion of sewage, which has been defined as water-borne human wastes. More than three-fourths of the population of the developed world now utilize this method of disposal(Leich, 1975). A second trend is the regionalization of sewage management(Bolton and Klein, 1971). Rather than have each local authority treat the sewage produced within its boundaries, regional bodies are established to manage sewage drawn from areas defined by geographic, not political, boundaries. A third trend has involved the movement towards more advanced forms of sewage treatment. Increasingly, urban areas are installing more effective systems of treatment intended to clean up receiving waters from which, in many cases, they draw their water supply. The final tendency is a movement toward the consideration of

alternatives. The work of Veal(1927) attests to the fact that alternatives such as composting and spray irrigation have been contemplated for at least sixty years. Although such alternatives have not yet enjoyed broad support, they may represent a coming trend in the management of sewage.

It is important to pause for a moment to consider the plight of developing countries. In their report to the World Health Organization, Okun and Ponghis(1975) explain the problems arising in developing countries as a result of unsatisfactory disposal methods on a large scale. Water supplies become contaminated and transmit diseases such as cholera, typhoid, infectious hepatitis and dysentery. In addition, environments polluted by direct excretion provide breeding grounds for schistosomiasis, filariasis and worm infestations. The consequence of poor sewage treatment and disposal methods is a hundred-fold greater incidence of transmitable diseases in developing countries than is the case in developed countries.

Stimulants to Change

Obviously, such health concerns provided one impetus for the changing trends in sewage management in developed countries. There are at least three other factors which contributed to the initiation of these trends. Urbanization has been, and continues to be, a profoundly influential factor. In fact, the concentration of people in settlements necessitated the invention of sewerage. In Canada, the United States and other developed countries, the urbanization trend evident over the last century has been paralleled by a trend toward collective systems of sew-

age management(Woodrow, 1974). A third factor in sewage management is technological and scientific innovation. As man came to understand better the chemical and biological interactions which take place in sewage, he found himself better able to prescribe treatment(Bolton and Klein, 1971). A better understanding of receiving environment characteristics allowed the formulation of water quality standards(Wolman, 1968). Further, mechanical innovations have allowed the design of more efficient and effective sewerage systems(Steel and McGhee, 1979). The fourth factor is environmental consciousness. Such consciousness has played a particularly significant role in the pressures felt by many decision-makers to improve treatment methods and look to alternatives(Licht and Johnson, 1986).

Contemporary Concerns

Despite the widespread adoption of treatment and disposal methods and other innovations in the field of sewage management, there remain numerous concerns about the management of liquid human wastes. These may be broadly grouped into human health, environmental, aesthetic and financial concerns. While most of the latter relate to the disposal of sewage into receiving waters, they also apply to various aspects of the sewerage system and to alternative disposal methods.

Human health remains the most critical question vis-a-vis sewage management. Various workers have noted the important relationship between water quality and human health(see, for example, Flynn and Thistlethwayte, 1965; Wolman, 1968,1980). While evidence has long been available to establish the relation-

ships between unsanitary water conditions, infection and human health, there is a paucity of information on the inter-actions between introduced contaminants in water and their relationship with human health. The relationship between bathing in sewage-receiving environments and human health is also a topic of concern. Fecal coliforms, bacteria which are present in all human feces, are used as indicators of bathing water quality(Waldichuk, 1984). If fecal coliforms are present in concentrations exceeding two hundred per one hundred millilitres of water, there is a risk that bathers in such waters may contract an infectious disease, notably one affecting the eyes, ears, nose or throat(Pike and Gameson, 1970). Therefore, sewage poses a danger to human health either through ingestion of, or contact with, contaminated receiving waters.

There is also concern for pollution of the environment resulting from the discharge of sewage, particularly that which has received little treatment. Parsons(1984) and Waldichuk(1984) comment on a number of problems related to sewage disposal. These include excessive biochemical oxygen demand (B.O.D.), nutrient loading and acute toxicity. B.O.D. results from respiration by the multitude of bacteria required to decompose organic matter, such as human excreta, in water. Hence, higher concentrations of sewage lead to greater competition for available dissolved oxygen by other marine life. In extreme cases, anaerobic conditions may result. A second concern relates to nutrient loading. An abundance of fecal matter in an area may favour higher-order consumers and, as a result, disrupt the entire food chain. If humans ingest these higher-order consumers, such as bivalves and mollusks, they may acquire diseases such as typhoid or hepatitis. Further, essential nutrients such as phosphorous, potassium and nitrogen contained

in sewage effluent may lead to eutrophic conditions in receiving waters. As a consequence, the receiving waters' ecosystem will be drastically altered. Finally, toxic chemicals in sewage are ingested by marine life, particularly bivalves, and may bio-accumulate through the food chain.

Sewage management is not an aesthetically-pleasing process. Thus, aesthetic concerns often form the bases of objections(Pike and Gameson, 1970). In many cases these criticisms are well founded due to the presence of feces, contraceptives, sanitary napkins and other plastic matter near effluent outfalls. The presence of such offensive matter is related to many factors, including dispersion capacity of the receiving environment and degree of treatment. Sewage management also produces olfactory nuisances. Malodors are generated by gases such as methane which are present at treatment and disposal sites. Such aesthetic concerns may lead to the perception that, although sewage may be adequately treated and disposed of, environmental and human health problems still persist.

The high cost of sewage management is also a contemporary concern. Municipalities must typically generate tens of millions of dollars of capital through tax revenue and supplemental external funds when contemplating construction of a sewerage system. Although not as expensive, maintenance and upgrading also represent significant costs. The need for sewerage systems must also compete with other capital-intensive needs in an urban environment(Woodrow, 1974). Further, this is taking place at a time of escalating costs and heavy pressures on municipal finances. Whilst regionalisation of sewage management has provided economies of scale and increased borrowing power for management authorities,

this trend is not without its complications. Most notable is the complexity of designing and implementing cost-sharing formulae to which numerous municipalities, each of which being cost-conscious, can agree.

Sewage management remains a contentious issue throughout much of the world. This is especially the case where inadequate treatment is provided. People continue to fear for the integrity and aesthetic quality of the environment and, in extreme cases, for their health. Where adequate treatment is provided, perceptions held by groups within the community lead them to utilize the media to make their concerns known and to lobby decision-makers. Regardless of how sewage is managed, it is an offensive issue which people would prefer to be able to forget about after they flush their water closet.

The 'Not-In-My-Back-Yard' (N.I.M.B.Y.) Syndrome

In an urban environment, it is currently impractical to deal with wastes at an individual scale. Collective disposal of liquid human wastes requires land for sewerage pipes, pumping stations, treatment plants and land disposal sites. In addition, a body of water adjacent to inhabited areas is generally utilized as a receiving environment. Consequently, those living near such components of a sewage management system are not able to ignore the sewage problem 'after the flush'. When faced with the possibility of having one of these components located near to them, people aware of the contemporary concerns of sewage management often exclaim 'N.I.M.B.Y.'.

The N.I.M.B.Y. syndrome, alternatively referred to as the L.U.L.U.(locally unwanted land use) syndrome, is not confined to sewage management. Any activity which humans perceive as potentially noxious may be subject to the N.I.M.B.Y. syndrome. Caplice(1983) provides an interesting argument on the underpinnings of the N.I.M.B.Y. syndrome. He suggests that Maslow's hierarchy of human needs may shed some light upon why people are offended by certain land, or water, uses. Maslow placed human needs in an ascending order from basic needs such as food, shelter and security at the lower end of the hierarchy through less tangible requirements such as self-esteem and self-actualization at the higher end. The higher level needs tend to be the main concerns in day-to-day life in our society. However, certain stimuli may cause us to abandon these high-level needs in defence of lower-level needs. Foci of the N.I.M.B.Y. syndrome provide such stimuli. The natural human response to such stimuli is to oppose the antagonist.

Promoters of land and water-use schemes related to the siting of noxious facilities tend to place technical merit as a high priority in location decisions. The technical approach to such decision-making involves five steps(Parrott, 1983). The nature and characteristics of the waste are defined, disposal site and associated technical criteria outlined, site and technology selected, wastes disposed of and, finally, the disposal process monitored. This normative, rational approach to waste disposal was utilized by the Ontario Ministry of the Environment in proposing a liquid industrial waste disposal site at South Cayuga, Ontario(Parrott, 1983). After outlining what type of wastes would be disposed of, the Environment Ministry chose South Cayuga as the disposal site. The Ministry then proposed to bring in technology from Germany to facilitate safe and proper disposal. The apparent

rationality of this procedure was severely criticized by the people of South Cayuga, who felt that less rational factors had intervened in a process into which they had had virtually no input.

One factor which intervenes into what may otherwise be rational, normative processes of hazardous waste disposal is uncertainty. In its active form, uncertainty may be referred to as risk. Uncertainty results from the inability of decision-makers to properly and fully project the consequences of their decisions(Grima, 1986). If the decision is taken and implemented in the face of uncertainty, the environment may be at risk. Professionals are frequently called upon to provide their expert judgement in order to reduce uncertainty. In many cases, however, such professionals are only able to state that there is a low probability that the unwanted consequences will occur. This translates into the notion of 'acceptable risk'. People opposed to the idea of potentially hazardous activities being carried out in their back-yards are unwilling to tolerate such 'acceptable risks'.

There are also economic aspects of the N.I.M.B.Y. syndrome. Whilst it may be technically possible to dispose of wastes far from inhabited areas of the earth or, as has been suggested, outside the earth's atmosphere, such options are generally economically infeasible due to exorbitant transport costs. Therefore, disposal sites close to the point of waste generation are favoured. In chosing such sites, the question of economic incentives to compensate for community disruption often arises. Wolpert(1976) notes that noxious public facilities are common in some urban areas, yet absent in others. As location of noxious facilities tends to

correlate directly with socio-economic status, Wolpert posits that less advantaged areas represent more easily and less expensively compensated sites for such facilities. However, should economics play such an important role in locating potentially hazardous sites and facilities?

In order to shed further light upon this and other aspects of the N.I.M.B.Y. syndrome, the moral and ethical dimensions of the controversy must be considered. The concept of benefit-cost analysis is instructive in this regard. The beneficiaries of waste disposal are all those who generate such wastes(Chant, 1983). On the cost side of the ledger, much broader dimensions than simple primary capital costs must be considered. There are social costs, such as an increase in levels of stress and disruption of community life, involved in siting noxious facilities. Questions such as 'who should bear the costs' and 'is it moral and ethical to impose intensive costs on a few for the benefit of many' must be addressed. Further, how can mechanisms for direct and meaningful public participation, especially by those bearing the brunt of the costs, be designed and utilized to ensure a democratic process of decision-making? These moral and ethical dimensions of the N.I.M.B.Y. syndrome are not easily dealt with.

The above discussion demonstrates the fact that the N.I.M.B.Y. syndrome is not wholly a technical, economic or social problem. Rather, it is a complex mixture of these elements. The highly contentious nature of this complex issue often results in its placement on the political agenda(Randall, 1983). Political actors and institutions at all levels of government must then grapple with waste disposal siting decisions. Such actors and institutions endeavor to make decision processes

appear as technically sound and democratic as possible. In cases such as the South Cayuga controversy, however, less rational factors intervene. Citizens of the South Cayuga area charged that political expediency and the fact that the area was outside of the boundaries of mainstream Progressive Conservative support in Ontario were mitigating factors in the Ontario Conservative's decision to locate the waste facility there(Hayes, 1983). Further, the technical integrity of the decision came under question. This is well illustrated by a newspaper photo of then Ontario Conservative Premier William Davis standing beside a flooded field which was proposed as a disposal site due, in part, to its location off the Cayuga River floodplain. Events such as this have made potentially impacted individuals and groups even more wary of allowing waste disposal facilities to locate in their back-yards.

This discussion of the N.I.M.B.Y. syndrome was introduced through a brief examination of the potentially noxious components of a sewage management system. It is now necessary to re-examine the relationship between the N.I.M.B.Y. syndrome and sewage management. The collection, treatment and disposal of sewage represents a potentially hazardous problem which requires technical solutions. As it is often difficult to project fully the consequences of a specific sewage management initiative, particularly those which relate to final disposal, sewage management involves uncertainty and risk. The economic aspects of sewage management, such as what capital investments must be made and who should be compensated and to what extent, must be considered. Moral and ethical factors must also be taken into account. Therefore, the technical, economic and moral conundrums characteristic of the N.I.M.B.Y. syndrome certainly apply to sewage

management. The question remains, however, whether sewage management is a political issue.

Sewage Management as a Political Process

A political process may be defined as a shrewd and calculating means of achieving an end(Lee and Lawrence, 1985). Although such a process may occur in any group setting, it is most commonly associated with the workings of government and with actors in government bureaucracies. This is not to be interpreted to suggest that political processes dominate the day-to-day activities of these bureaucracies. However, influential policy and decision-makers in government may engage in political manoeuvreing(Downs, 1967). It is the association of the political process with government responsibilities for sewage management that will form the basis of the following discussion.

There are at least three perspectives which may be taken in evaluating the political nature of sewage management. The first considers sewage management per se as a government responsibility. As noted above, the design and installation of sewage management systems are generally the responsibilities of municipal/regional governments in developed countries. Regulation of sewage management, particularly effluent quality standards, is usually performed by senior levels of government. The responsibilities of the B.C. Waste Management Branch of the Ministry of Environment and Parks, U.S. Environmental Protection Agency and New Zealand Soil and Water Conservation Conservation Authority are illustrative of this latter point(B.C. Ministry of Environment, 1982; Payton, 1985; Ryan, 1985).

Second, it is instructive to look to attendant concerns of sewage management, such as financing, environmental management and human health in evaluating such management as a political process. Although primarily a municipal concern, financing of sewage management is typically overseen by a senior government agency, such as the B.C. Ministry of Municipal Affairs(B.C. Ministry of Environment, 1982). Environmental management is also a responsibility of senior government agencies such as New York's Department of Environmental Protection or the Canadian Department of Fisheries and Oceans(Payton, 1985). Finally, human health is a concern related to sewage management which is dealt with by agencies ranging from local public health offices to national bodies such as New Zealand's Department of Health(New Zealand Commission for the Environment, 1975).

Third, it is interesting to examine sewage as a 'scapegoat' issue used to camouflage other political concerns. Keenan(1984) presents a very persuasive argument in this regard. During his career as Director of the Pollution Control Branch of the B.C. Ministry of Environment, Keenan found that opposition to expansion of sewerage facilities was often based on the desire to prevent community expansion and development, not on the merits of the sewage project. Regardless of the exact nature of that which was at issue, the debate was squarely set in the political arena.

It has been demonstrated that sewage is very much a government responsibility and, consequently, may become a political issue. Politicians, however, tend to look to the electorate in defining a political issue. Sewage management has been the concern of many electorates and, as a result, has formed a plank in many

political platforms. For example, the fate of the Clover Point outfall in Victoria, B.C. was a high profile issue in the Victoria municipal election in November of 1979(Colonist, 4 Nov., 1979). If considered in conjunction with government responsibilities for sewage management and the political nature of the N.I.M.B.Y. syndrome, examples such as this lead one to conclude that sewage management is very much a political process.

STUDY RESULTS

Introduction

The preceding chapters have reviewed the role of the professional in resources and environmental management decision-making, outlined the study design and examined the general question of sewage management. From discussions with officials in each of the study areas, several observations may be made. This chapter will present and analyze these observations. First, municipal and regional models of sewage management decision-making are examined. Second, the important actors participating in these decision-making processes are identified. Third, the engineer is focussed upon, as he/she is an extremely important actor in such decision-making, and is also the focus of this study. An assessment of the study's hypotheses is then presented in order to determine what factors may condition an engineer's influence in sewage management and also to enhance understanding of the engineer's influence in the latter process.

Throughout this discussion, emphasis will be placed upon qualitative assessment of information gained during in-depth interviews. As noted in Chapter 3, limitations of the study's design do not permit exclusive reliance upon quantitative methods. Eleven of the one hundred and seventy-two municipalities and regional districts in the province of British Columbia were examined, while eleven engineers, ten administrators and ten elected officials of the hundreds of actors in

each of those positions were interviewed (see Table 1). Sample size is therefore one of the limitations of this study. The inability to make assumptions about several characteristics of the actors interviewed, such as the variance of their perceptions toward sewage management problems, and the relatively low level of data measurement further limit options vis-a-vis data analysis. However, Spearman's Rank Correlation, a non-parametric statistical test appropriate for use with small samples and ordinal data, is useful in the context of this study. The statistics emerging from the application of this test are presented in tabular form throughout the text in order to supplement the qualitative analyses of the study's hypothesis.

Table 1: Study Communities and Actors Interviewed

Community	Engineer	Admin.	Politician
Vancouver	1	1	1
Burnaby	1	1	0
Victoria	1	1	1
Nanaimo	1	1	0
Oak Bay	1	1	1
Esquimalt	1	1	2
C. Saanich	1	1	1
N. Saanich	1	0	2
G.V.R.D.	1	1	1
C.R.D.	1	1	1
C.S.R.D.	1	1	0

The former 8 are municipalities, the latter 3 regional districts

Sewage Management Decision-Making at the Community Level

It can be argued that two types of decision processes dominate the process of managing sewage at the community level. Routine decision, which are relatively straight-forward, do not require extensive outside consultation and are provided for in annual sewerage budgets, are made constantly. Examples of the above include the maintenance of existing sewer lines, pumping stations and treatment facilities, allocation of resources to undertake small-scale upgrading activities or relatively inexpensive repairs. The second major type of sewage management decision process at the community level is the strategic decision process. Strategic decisions tend to be shrouded in uncertainty and often involve value judgements. Further, such decisions generally require outside consultation and are politically contentious. Strategic decisions are made much less frequently than routine decisions. Examples of strategic sewage management decisions include major upgrading schemes, installation of new treatment facilities and utilization of new disposal techniques.

Prior to examining routine and strategic sewage management decisions more fully, two special types of decisions must be mentioned. Budgetary decisions which allocate funds to the various departments in municipal governments are taken annually. While these decisions are strategic deliberations, they involve a different locus of actors than do strategic sewage decisions. Therefore, such decisions will not be focussed upon. The second special type of decision is the catastrophic decision. Such decisions must be taken in an instance where, for example, a treatment facility malfunctions and begins to discharge large volumes

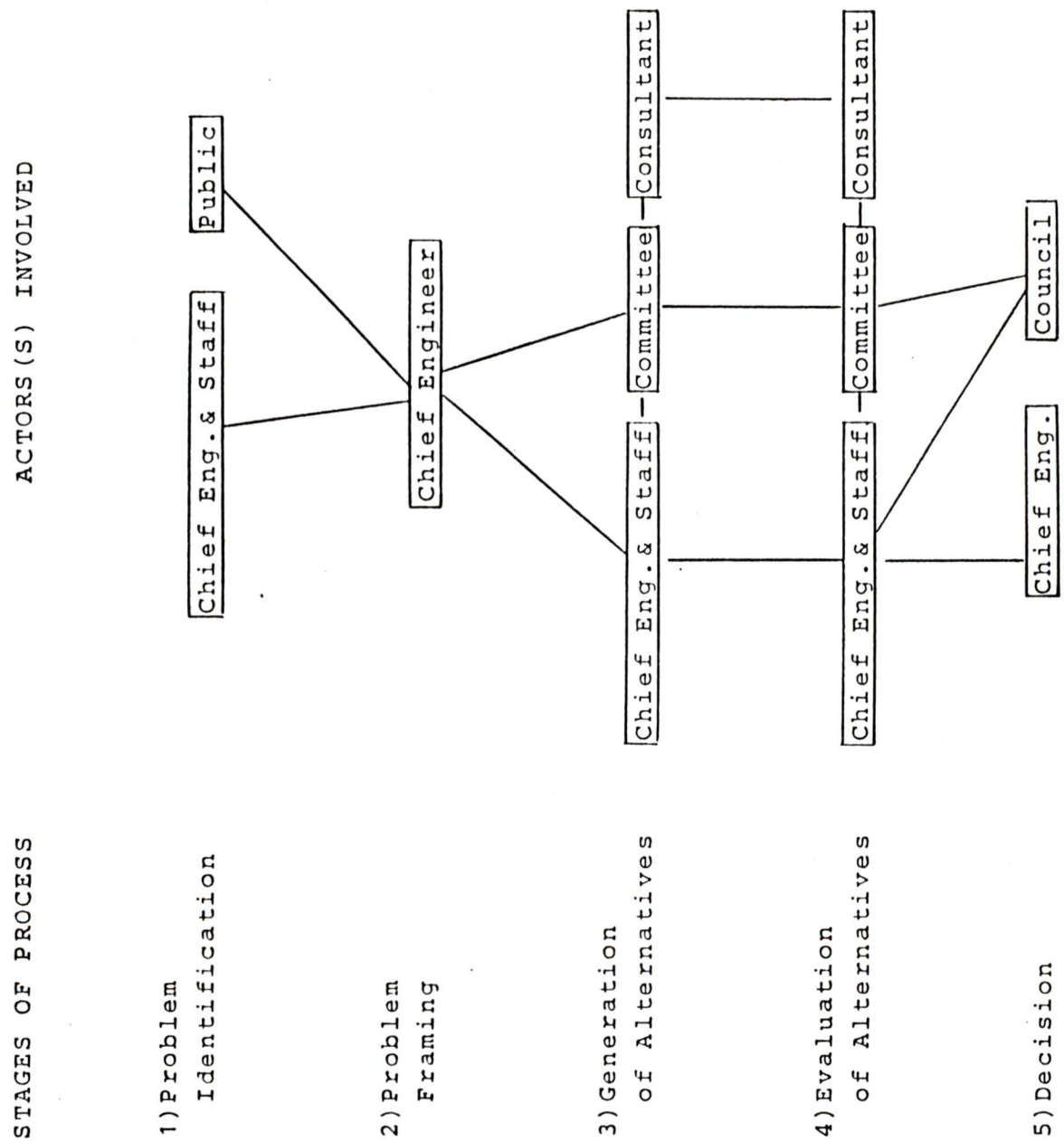
of raw sewage. Such scenarios are uncommon and involve a process of decision-making which may be likened to response to natural disasters. As catastrophic decision processes represent a radical departure from routine and strategic decisions, they will not be discussed further.

A normative model of community sewage management decision-making is used in this discussion as it affords clarity and consistency of analysis. In reality, the five steps of the process are not rigidly defined and tend to overlap with one another. This simplified abstraction of reality is based upon information gathered in the interviews. The process begins with the identification of a problem, such as a broken sewer connection, faulty collection pipe or presence of offensive debris in the receiving water body. Once conveyed to the agency responsible, the problem is framed and articulated. This stage involves pinpointing the source of the problem, calculating its magnitude and expressing the various dimensions involved in solving the problem. Third, alternative means of resolving the problem are generated. These may range from doing nothing to providing a stop-gap solution to installing an entirely new collection, treatment and disposal system. The fourth stage involves evaluating the various alternatives generated in the third stage based upon their technical, economic, social and political merit. Finally, the decision stage involves the selection of one alternative as a means to solve the problem. Although seldom mentioned, a sixth stage does exist. Monitoring of decisions is very much a part of sewage management and often leads to the identification of problems which in turn initiate the process once again.

Routine Municipal Decisions

Routine sewage management decisions at the municipal level are usually initiated by the municipality's engineering and operations staff who encounter problems during routine operations and maintenance activities (see Figure 9). Occasionally, the public may identify problems and either go directly to the municipality's staff or bring them to the attention of an elected official. Regardless of who identifies the problem, the municipality's chief engineer is responsible for framing and articulating the problem. The chief engineer and his/her staff then, in many cases, generate and evaluate alternative solutions. If a municipal standing Committee which deals with sewage matters is in place, it may be involved in the latter stages of the process. Further, consultants may be retained to deal with specific aspects of the problem. Finally, a decision is taken either by the chief engineer or the municipal Council.

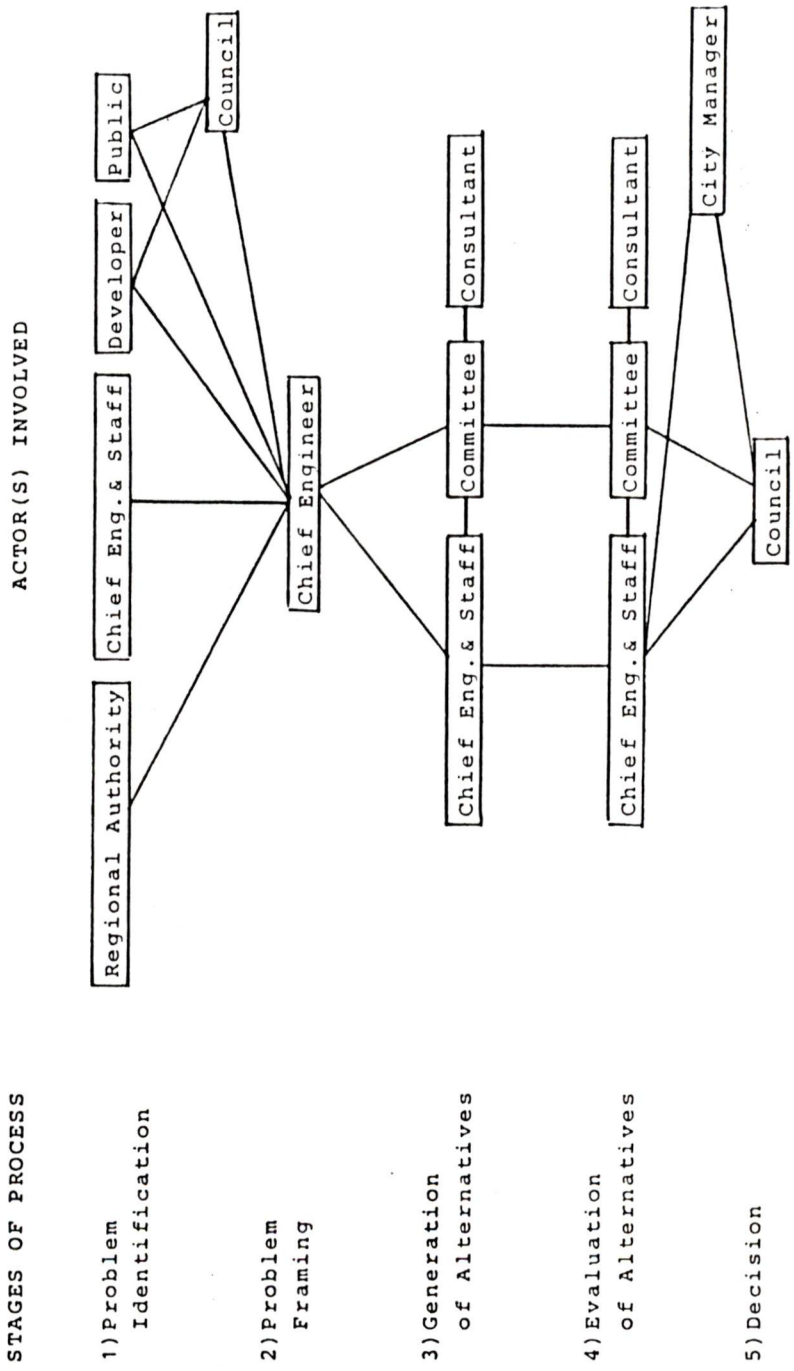
Figure 9: Routine Municipal Decisions



Strategic Municipal Decisions

The problems dealt with in strategic municipal decisions may be identified by a variety of actors or groups (see Figure 10). Regional sewage management authorities, the municipality's engineering and operations staff, private land developers and the public are all involved in problem identification. The latter two groups tend to channel the strategic problem through the municipality's Council. The municipality's chief engineer is solely responsible for the framing and articulation of strategic problems. He/she may then pass the problem on to his/her staff, the appropriate municipal standing Committee and/or an outside consultant. The involvement of actors other than the chief engineer is dependant upon the exact nature of the problem and, in the cases of engineering staff or standing Committee involvement, the simple question of presence. The recommended alternative emerging from this process is then taken to the municipality's Council for final decision. If the municipality operates under the city manager system of local government, the city manager may, in consultation with the city treasurer, examine the recommended alternative prior to the municipal Council taking its final decision.

Figure 10: Strategic Municipal Decisions



Routine Regional Decisions

Routine sewage management problems at the regional level are typically identified by the region's engineering and operations staff or the public, the latter either dealing directly with the regional engineer or bringing the problem to the attention of the elected official in his/her municipality (see Figure 11). Once identified, the problem is then framed and articulated by the regional engineer. The regional engineer then delegates the authority for generation of alternative solutions to the regional engineering staff. The regional engineering staff subsequently present a range of alternatives to the regional engineer who, in conjunction with the regional standing Committee responsible for sewage, evaluates the alternatives. A final decision is then taken either by the regional engineer or by the regional Board of Directors.

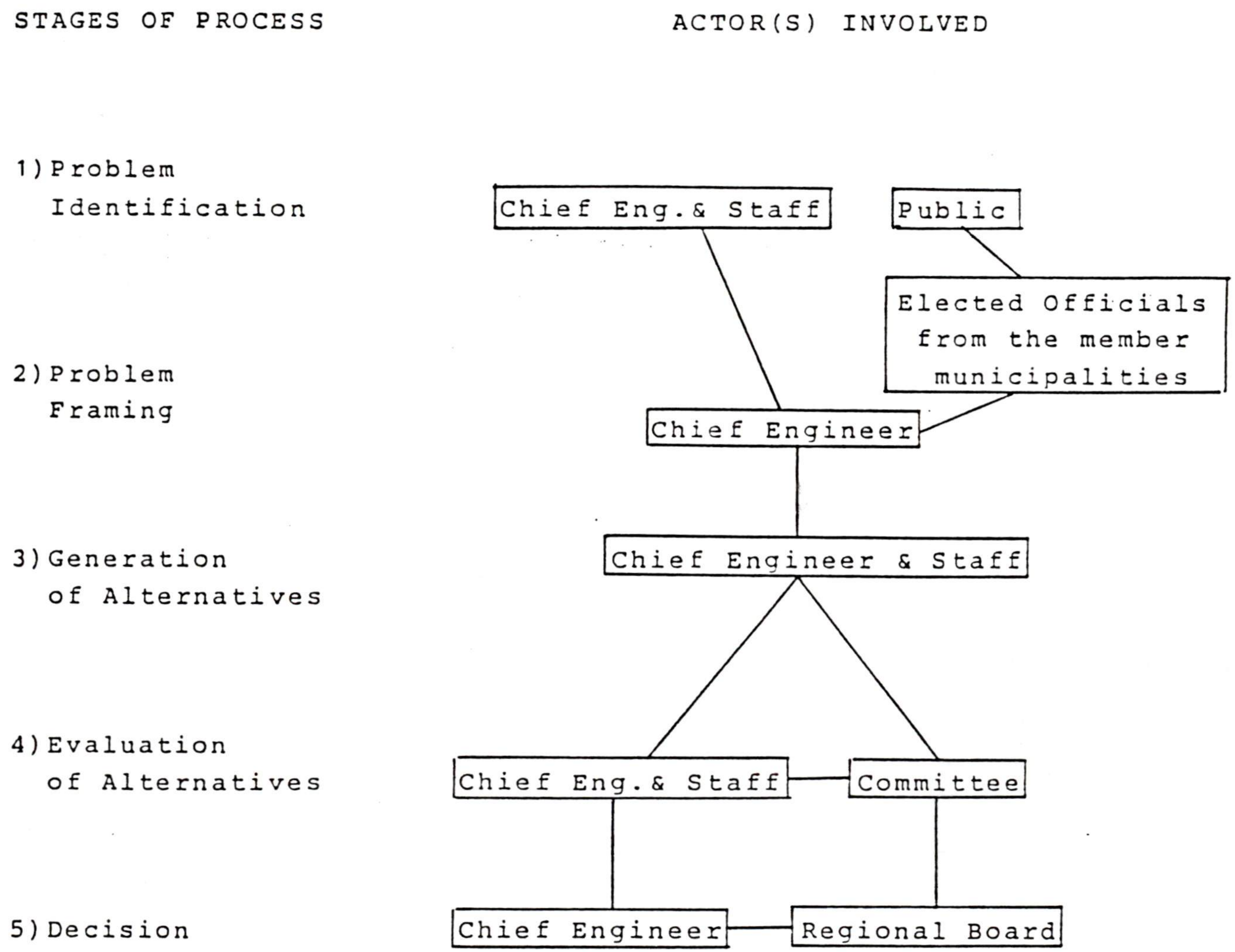
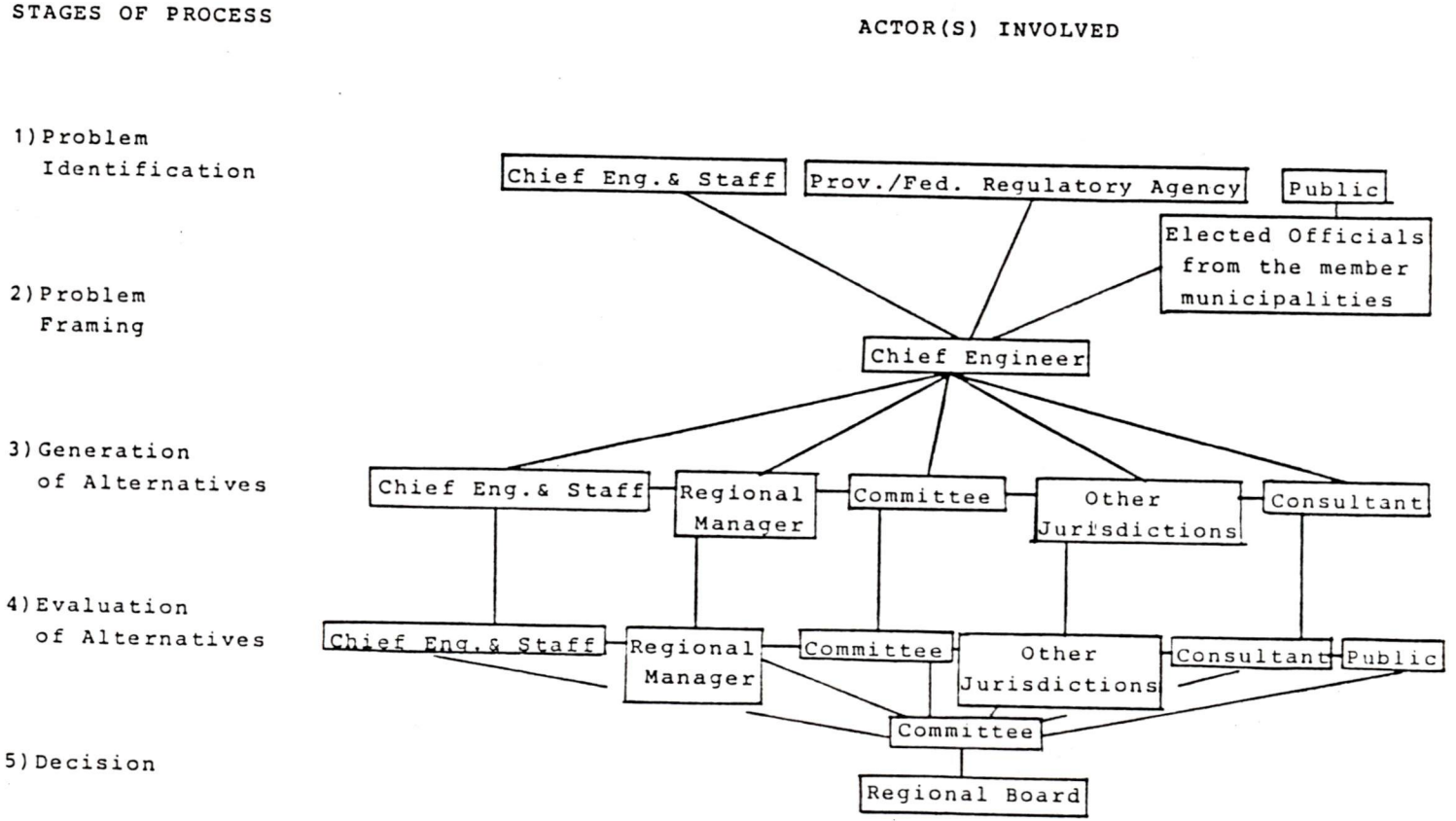


Figure 11: Routine Regional Decisions

Strategic Regional Decisions

The resolution of strategic sewage management problems at the regional level is a very complex process (see Figure 12). Problems may be identified by a number of groups, including regulatory agencies from other jurisdictions. The regional engineer is ultimately responsible for framing and articulating the problem brought to his/her attention. A wide variety of actors/groups are then involved in generating alternative solutions to the problem presented to them by the regional engineer. A similarly large range of actors/groups are then involved in evaluating these alternatives. A select number of potential solutions emerge from these initial three steps and undergo further scrutiny from the regional standing Committee which deals with sewage. The recommendation of this committee is then passed on to the regional Board for final decision.


STAGES OF PROCESS
ACTOR(S) INVOLVED
1) Problem Identification
2) Problem Framing
3) Generation of Alternatives
4) Evaluation of Alternatives
5) Decision
Chief Eng.& Staff
Prov./Fed. Regulatory Agency
Public
Elected Officials from the member municipalities
Chief Engineer
Chief Eng.& Staff
Regional Manager
Committee
Other Jurisdictions
Consultant
Chief Eng.& Staff
Regional Manager
Committee
Other Jurisdictions
Consultant
Public
Committee
Regional Board

Factors Which Influence Decision-Making Processes

There are four key factors which influence the sewage management decision-making process at the community level. The first is the magnitude and expense of the problem in question. Regardless of the type of problem or level at which it is dealt with, large and expensive decisions require approval by elected officials. Conversely, smaller and less expensive decisions may be made by the director of the engineering department. As one engineer noted, "if the money is in place and approved, we go to work." Another respondent summed up the situation in the following way. "The person responsible for decisions is a matter of the scale of the problem - small problems are solved by the city engineer and larger problems by the engineer and Council."

The second factor influencing these decision-making processes is the size of the community. Smaller communities employ fewer engineers on staff and, consequently, contract work out to consultants more frequently. Further, elected officials in smaller communities tend to become much more involved in all aspects of sewage management than is the case in larger communities. This is especially evident at the 'decision' stage of routine sewage management decision processes, where the Councils in smaller communities make such final decisions. As the engineer from one of the smaller municipalities considered by this study noted, "Council comes to me with the problem and I provide the information so that they can make the decision." In contrast to the situation in smaller communities, larger communities retain more engineers on staff, contract out less work and show relatively less involvement of elected officials in sewage management. In refer-

ring to routine decisions made within the engineering department in his community, one engineer from a larger municipality noted "if our department doesn't wish Council to find out, they won't unless the public at large brings the problem to Council." Therefore, the size of the community appears to have considerable impact upon who is involved in sewage management decision processes and how those actors are involved.

A third important factor is the presence of a standing Committee dealing with sewage management. If such a Committee is in place, it tends to be considerably involved in the generation and evaluation of alternative means of problem resolution. Some members of such Committees are professional engineers, biologists, medical doctors and the like, and therefore possess the expertise to deal with the more complex aspects of sewage management. The recommendations of such Committees are generally approved by the community's decision-making body. One respondent observed "the (sewage) Committee is really a recommending Committee who evaluate options on technical terms and make recommendations to the Board, who generally accept those recommendations." In instances such as this, the role of the chief engineer is to provide data and information to the Committee. If such a Committee is not in place, the other actors involved in the decision-making process assume relatively more importance.

A fourth important factor is one which is germane to any type of organizational activity - the personalities involved. Strong personalities in any position of the decision-making process will affect the operation of that process. In terms of sewage management, such personalities are particularly important in offering

alternative solutions to problems, evaluating those alternatives and influencing the opinions of others involved in the decision-making process. One respondent summarized this view in the following way: "Strong personalities often interfere with the smooth operation of decision processes."

The Engineer in Sewage Management Decision-Making

A locus of key individuals are involved in sewage management decision-making at the community level. This group includes appointed officials, elected officials on Committees, Councils and Boards, consultants and the public. These actors gravitate in and out of decision processes according to the nature and scale of the issue in question and the characteristics of the community in which the issue arises. Only one group - the engineers - are intimately involved in all processes.

Analysis of the frequencies with which various actors participate in the five stages of the sewage management decision-making process described above is illustrative of the extent of engineers' involvement(see Tab. 2) In terms of problem identification, half of the problems are identified by engineering and operations staff, 30 percent by the public and 10 percent by both the chief engineer and elected officials. Fully 90 percent of these problems are then framed and articulated by the chief engineer, with the remaining 10 percent being the responsiblity of Committees. The generation of alternative means of resolving problems is conducted almost entirely by engineers, as standing Committees accept only 12 percent of this responsibility. The engineers are somewhat less

involved in evaluating these alternatives, as 40 percent of this responsibility falls to elected officials on standing Committees or Councils. While municipal Councils and regional Boards are ultimately responsible for all decisions taken within their jurisdictions, a substantial number of sewage management decisions are made by the chief engineer, particularly those which relate to routine problems. This analysis of the frequency with which engineers participate in decisions demonstrates the critical importance of these actors in sewage management.

Table 2: Engineer Participation in General Sewage Decision-making

Stages of Process	Extent of Engineers' Partic.
Problem Identification	50%
Problem Framing	90%
Alternative Generation	88%
Alternative Evaluation	60%
Decision Making	see text

Problem Identification may be by engineer or his/her staff

It is not surprising that the engineer is such an important actor in sewage management. Sewage is a somewhat unique component of municipal/regional activity. It is unlike park planning, land-use zoning and housing, for example, in that the lay-public and elected officials are generally unable to comprehend the technical intricacies of its management. In stating "the engineers are the most important group in these (sewage management) matters as they have the knowledge and abilities", one administrative officer supports the contention that the engineer is extremely influential in sewage management.

The influence of the engineer does, however, vary in accordance with certain factors. These factors were formulated into the hypotheses presented in Chapter 3 of this thesis. Rather than considering all engineers involved in sewage management, the hypotheses pertain to one group of focal actors - the chief municipal/regional engineer. It is to the examination of these hypotheses that this discussion will now turn.

It is difficult to categorically accept or reject the hypothesis that the engineer is the most influential actor in sewage management decision-making processes. Acceptance or rejection hinges upon whether the most influential person is that person who makes the ultimate decision or that person who controls the preceding steps in the decision-making process. In the former instance, the Council of Board of elected officials is, collectively, the most influential. In the latter case, the chief engineer is the most influential.

The information gathered during the course of this study demonstrate that the engineer is the most influential actor in sewage management. In a general sense, the data presented in Table 2 show the critical importance of the engineer in all stages of decision-making, particularly the formative stages of the process. Engineers are virtually solely responsible for framing problems and generating alternative solutions, steps which determine the nature and content of successive stages in the process. Further, engineers are heavily involved in evaluating the options which they, to a large extent, have generated. Responsibility for the final decision varies considerably according to the nature of the problem. Engineers generally make the final decisions in routine decision processes, prompting one

elected official to state "the city engineer is the real power." While municipal Councils and/or regional Boards are responsible for making the final decisions regarding strategic problems, the importance of engineers in this type of decision is clearly shown by the remark of one engineer, who noted "we wouldn't send anything to Council that they wouldn't approve."

In addition to their direct involvement in all steps of the sewage management decision-making process, engineers provide indirect inputs. Such inputs take the form of advice and information provided to other participants in the decision. This is an important consideration as any orientation or bias which the engineer may possess will then be passed on to other actors. The extent to which such consultation takes place is illustrated by the remark of an elected official:

> Literally, it works like this. I receive a phonecall, complaint or report which I then courier over to (the engineer's) office. He reads it, writes down his suggestions and recommendations and gets them back to me. I then act on his recommendation.

In conjunction with the evidence given above, this statement leads to the conclusion that the engineer is the most influential actor in sewage management at the community level. Therefore, the first hypothesis is accepted.

The study's results show great variation in the amount of influence held by engineers according to the size of the city in which they work. In smaller communities, elected officials and administrative officers tend to be more heavily involved in sewage management, and consultants are utilized more frequently. Although the engineer is involved in providing advice, supplying information and hiring consultants in sewage decisions in these smaller communities, the extensive involvement of other actors tends to decrease the amount of direct influence

which the engineer exerts in such processes. In contrast, larger communities show relatively less involvement of elected officials, little input from administrative officers and more 'in-house' engineering under the direction of the chief engineer. This increased direct involvement of engineers in sewage management in larger communities correlates with greater influence of those engineers. If other variables are held constant, therefore, the engineer in the larger community is relatively more influential than his/her peer in a smaller community.

This argument is illustrated by the results of statistical analyses(see Table 3). Positive correlations exist between the frequency with which the engineer is an advisor, administrator, technician and decision-maker in sewage management processes and city size. It is especially important to note that a significant relationship exists between the size of the city and the frequency with which the engineer plays a technical role in sewage management. In contrast, weaker and in some cases negative correlations exist between administrators and elected officials in each of these roles and city size. A very important correlation is that which exists between the elected official as decision-maker and city size. This statistic suggests that as the size of the community increases, politicians become relatively less influential in sewage management. In conjunction with the argument given above, these statistics support acceptance of the hypothesis that the engineer in a larger community is more likely to exert a greater degree of influence on the outcome of sewage management decision processes than the engineer in a smaller community.

Table 3: Correlations Between Actors' Roles and City Size

ACTOR	Advisor	Admin.	Tech.	Dec.-Maker
Engineer	0.23	0.05	0.71[a]	0.30
Admin.	-0.03	0.03	-0.03	0.10
Politician	-0.63	-0.26	-0.64	-0.73[a]

Values from Spearman Correlation-'a' denotes statistical significance.

An interesting relationship exists between the structure of the community's decision-making network and the influence engineers have on sewage management. In a city manager system of local government, the engineer retains considerably more responsibility at all stages of the decision-making process. This is particularly the case at the stages of generation and evaluation of alternative problem solutions. Under this system of decision-making, it appears that the city manager is the only appointed or elected official who may alter the recommendation of the engineer prior to taking that recommendation to Council. As one city manager noted, "I act like a University Dean who takes the recommendations of the Department Heads to the Senate."

The Council-Committee system of local government operates quite differently in terms of sewage management. In this situation, members of Council and, particularly, elected officials on special standing Committees dealing with sewage management, are quite involved in most facets of the decision-making process. This is especially evident at the stages of generation and evaluation of alternatives. In such deliberations, as one elected official stated, "the chief engineer

assists the Committee in formulating recommendations and providing technical advice." Further, much more day-to-day consultation takes place between elected officials and the engineer under this system of government. Such contact prompted one engineer to state "they (elected officials on sewage Committee) consult with me, but never get past the 6th floor (to his subordinates)." With the increased involvement of elected officials, each of whom may alter or question a recommendation put forward by the engineer, under this style of government, the engineer becomes relatively less influential. In conjunction with the argument above, this factor leads to the acceptance of the hypothesis that the engineer in a city manager system of community decision-making is more influential in sewage management processes than the engineer operating under a Council-Committee system of local government.

All of the engineers considered in this study play broad roles. In other words, each of the engineers is involved in sewage management as an advisor, administrator, technician and decision-maker. There is, however, variation in how broad their various roles are. Those engineers who act as advisors, administrators, technicians and decision-makers more frequently and therefore play broader roles tend to be more influential in sewage management processes. This observation is based upon two premises. First, those engineers who play more narrow roles are called upon less frequently to contribute to decision-making processes, particularly in important advisory and decision-making capacities. Second, instances where the engineer plays a relatively narrow role correspond with situations in which other actors in the decision-making process are relatively more important.

The statistics which relate to the relationship between the breadth of the engineer's role and his/her influence in decision-making show an interesting trend(see Table 4). First, the breadth of the engineer's role correlates positively with all aspects of the engineer's involvement in decision-making, particularly with respect to his/her role as an advisor and decision-maker. In the latter cases, statistically significant relationships are evident. These statistics suggest that the engineer who plays a broader role is called upon more frequently to contribute advice to sewage management decisions as well as to make such decisions. Second, much weaker and, in the cases of the elected official as advisor, administrator and decision-maker, negative correlations result from the tests of relationship between the breadth of the engineer's role and those of other actors. These results are important as they show that as the engineer contributes more frequently to decision processes, other actors, especially politicians, become relatively less involved. In conjunction with the qualitative assessment presented above, these data support the assertion that the engineer who plays a broader role in sewage management is more likely to influence the outcome of such processes than the engineer who plays a more narrow role. The study's fourth hypothesis is therefore accepted.

The fifth relationship under consideration is that postulated to exist between the engineers' perceptions of others as technicians and the influence of engineers in sewage management. In very few instances did an engineer perceive either the chief administrative officer or elected officials in his/her community to be technicians. In fact, 77 percent of the engineers interviewed stated that chief administrative officers never provide technical input to decisions, while nearly 90 per-

Table 4: Correlations Between Breadth of Engineers' Roles and Their Influence

ACTOR	Advisor	Admin.	Tech.	Dec.-Maker
Engineer	0.89[a]	0.41	0.62	0.74[a]
Admin.	0.48	0.12	0.16	0.63
Politician	-0.09	-0.24	0.38	-0.34

Values from Spearman Correlation-'a'denotes statistical significance.

cent stated elected officials never acted as technicians. There is a situation in one of the communities considered where both certain members of the Council as well as the city manager have considerable experience and expertise in the technical matters of sewage management, yet the engineer is quite influential in all facets of sewage decision-making. Conversely, numerous situations exist in which elected and appointed officials have little or no technical expertise, yet the engineer holds relatively little influence. It would appear from this that the engineers' perceptions of others as technicians has little bearing upon the formers' influence in sewage management.

This argument may be further illustrated through an examination of the statistics(see Table 5). Weak positive and negative correlations exist between the engineers' perceptions of chief administrative officers and elected officials as technicians and the formers' influence in sewage management. In fact, correlations of '0' resulted from the tests of relationship between the engineers' perception of elected officials as technicians and the engineer as an administrator of

decision-maker. These data, in addition to the observations documented above, do not support the study's fifth hypothesis. Therefore, the statement that the engineer who perceives others' roles in sewage management as being distinct from the technical aspects of engineering is more likely to have a greater degree of influence on sewage management than the engineer who perceives others' roles to be aligned with the technical aspects of engineering must be rejected.

Table 5: Engineers' Perceptions of Others' Roles and Influence

	Advisor	Admin.	Tech.	Dec.-Maker
Admin. as Technician	0.39	-0.33	0.26	-0.19
Politician as Tech.	0.43	0.00	-0.08	0.00

Values from Spearman Correlation-'a' denotes statistical significance

Organizational norms can act to prevent an engineer from practicing applied engineering skills, conducting pure forms of research to find solutions to problems and drawing upon his/her knowledge to propose alternative solutions. As one engineer noted, "I do a lot of report writing - a true engineer should be out looking at holes in the ground and doing sketch designs." In cases where the engineer feels constrained by organizational norms, he/she is relatively less influential in sewage management decision-making. This is due, in part, to the fact that organizations which constrain the engineer's actions place more emphasis upon proven, well-known methods. In such instances, the other actors in the decision-making process are more aware of alternative methods and therefore may exert more influence

upon sewage management decisions. The converse of the above is also true. If the engineer is allowed to develop and implement less conventional methods of sewage management, he/she holds more influence in the decision-making process by virtue of exclusive knowledge.

The data gathered during this study appear to support this contention(see Table 6). In instances where the engineer is satisfied with the amount of time he/she is able to spend practicing engineering skills, he/she exerts greater influence in all facets of sewage management decision- making. This is especially evident vis-a-vis the engineer's role as an advisor and technician. One would expect this to be the case as an engineer dissatisfied with the amount of time he/she was able to spend practicing engineering skills would presumably be more involved in other organizational functions, such as administration. Freedom to generate alternatives also correlates positively with all aspects of an engineer's involvement in sewage management, notably as a decision-maker. The latter statistic, although not statistically significant, suggests that engineers who are free to construct alternative solutions to problems also decide which of these options will ultimately be adopted. If other tasks interfere with the engineer's ability to practice his/her craft, negative correlations exist vis-a-vis this actor's influence in decision-making. This is particularly the case in the engineer's role as an advisor on sewage management matters. If these factors of satisfaction with time spent practicing engineering skills, freedom to generate alternatives and interference of other tasks are considered along with the qualitative arguments stated above, the study's sixth hypothesis is supported. The engineer who does not feel constrained by organizational norms is therefore more likely to exert a greater degree of

influence on the outcome of sewage management processes than the engineer who does feel constrained by organizational norms.

Table 6: Correlations Between Organizational Norms and Engineers' Influence

ORGAN. NORMS	Advisor	Admin.	Tech.	Dec.-Maker
Time	0.64	0.11	0.61	0.17
Freedom	0.06	0.12	0.06	0.52
Interference	-0.76[a]	-0.19	-0.50	-0.33

Values from Spearman Correlation-'a' denotes statistical significance

Complex relationships exist between a variety of professional characteristics and the influence the engineer has upon sewage management processes. For the sake of clarity, the examination of the final hypothesis will be structured into three sections. First, the aspects of contact with the engineering profession will be considered. Second, the impact of years of professional experience will be examined. Finally, the relationship between level of education and influence in sewage management processes will be analyzed.

The first consideration is the relationship posited to exist between formal and informal contact with one's profession and degree of influence in sewage management processes. The degree of attendance at meetings of the British Columbia Association of Professional Engineers and giving presentations at such meetings varied considerably among respondents, with some influential engineers attending and presenting frequently and others not at all. As one engineer noted, "The more

time I spend at conferences, the less time I spend in my office doing my job." All of the engineers interviewed responded that they maintained informal contact with other engineers at least occasionally, with nearly 60 percent stating that they are in constant contact. Therefore, there does not appear to be any correlation between degree of formal and informal contact and influence in sewage management.

The statistics further support this argument(see Table 7). These data suggest that those engineers who attend conferences of the B.C. Association of Professional Engineers more frequently are in fact less involved in all facets of sewage management decision-making, notably as advisors. However, as none of these relationships are significant, conclusions cannot be drawn from the data. Weak positive relationships exist between the frequency with which the engineers interviewed gave conference presentations and their influence in decision-making. Again, it would be inappropriate to draw inferences from these data. Similarly, no statistically significant relationships exist between frequency of of informal contact with one's peers, a factor in which there was little variation throughout the sample, and influence. From this analysis and the qualitative argument presented above, it appears that formal and informal contact between engineers has little impact upon their influence in decision-making. This component of the hypothesis may therefore be rejected.

There appears to be a definite correlation between the number of years an engineer has practiced and the degree of influence he/she exerts in sewage management processes. This contention is supported by the following observations.

Table 7: Correlations Between Engineers' Contact With Peers and Influence

	Advisor	Admin.	Tech.	Dec.-Maker
Attendance	-0.69	-0.15	-0.29	-0.27
Presentation	0.25	0.47	0.13	0.28
Informal Cont.	0.22	0.19	0.27	0.55

Values from Spearman Correlation-'a' denotes statistical significance

First, those engineers with more years of experience tend to be placed in higher organizational positions from which they may have more influence. Second, those engineers with more experience also tend to work in larger communities where, as noted above, engineers are relatively more influential. A third important factor is that engineers who have more experience tend to have a more extensive network of contacts, both within and outside their organization, and possess more in-depth knowledge of how decision-making operates. As one engineer noted, "engineers just out of University do not have a decision-making background." In short, those engineers who are better able to 'play the game' are more influential in sewage management decision-making.

A particularly interesting statistic which is related to an engineer's experience and his/her influence in decision-making is that which expresses the relationship between the size of the community and number of years of experience. A Spearman Rank Correlation value of 0.98 with a significance value of 0.0001 resulted from a test of relationship between years of professional experience and

city size. This suggests that more experienced engineers tend to work in larger cities. As seen in Table 8, positive correlations exist between the number of years an engineer has practiced and his/her influence in all aspects of sewage management decision-making, notably the technical aspects. A note of caution must be added here, however. As demonstrated above, more experienced engineers tend to work in larger communities where engineers have been shown to be more influential. It is therefore possible that the relationship between an engineer's experience and degree of influence is spurious. Negative correlations exist between the number of years an engineer has practiced and the influence which administrators and elected officials have in all facets of decision- making, with the exception of the administrator as a decision-maker. The relative unimportance of elected officials as advisors and decision- makers in sewage management in communities where the engineer is highly experienced is shown by the statistically significant relationships on the bottom row of Table 8. These observations strengthen the argument that as the engineer becomes more experienced, he/she becomes increasingly important in sewage decisions. This component of the final hypothesis is therefore accepted.

There appears to be little relationship between the level of education which an engineer receives and his/her influence in sewage management decision-making. For example, one respondent who possessed a graduate degree in engineering had little influence within his community, while another respondent with vocational training was quite influential in all facets of decision-making. Two reasons are offered in explanation of this trend. First, those engineers with graduate degrees tended to be younger and less experienced and also worked in smaller

Table 8: Correlations Between Actors' Influence and Engineers' Experience

ACTOR	Advisor	Admin.	Tech.	Dec.-Maker
Engineer	0.31	0.19	0.74	0.38
Admin.	-0.06	-0.09	-0.08	0.08
Politician	-0.69[a]	-0.35	-0.64	-0.73[a]

Values from Spearman Correlation-'a' denotes statistical significance

communities. In contrast, those engineers with vocational or bachelors training tended to be older, more experienced and located in larger communities. This situation is, however, changing. As one engineer noted, " a lot of the old guys with practical training are now moving out and being replaced with professional engineers." With the present situation, however, this component of the final hypothesis may be rejected.

In summary, the professional characteristics selected for study seem to have little bearing on the influence an engineer has in sewage management decision-making processes. Only one variable - the number of years of experience - shows any relationship with influence. Experience is, however, only one of a host of elements which characterizes a professional engineer. The other characteristics considered have little of no bearing on an engineer's influence in sewage management. On the whole, therefore, the hypothesis that an engineer who exhibits a greater degree of expertise as measured by the selected professional characteristics is more likely to have a greater degree of influence on sewage management than an engineer with less experience is rejected.

Summary

The management of sewage in the communities in B.C. considered in this study is not a simple process. A variety of actors and agencies gravitate in and out of the decision process, each attempting to influence the outcome of the deliberations. Routine decision processes are relatively straight-forward and involve only actors from within the community and local government in question, perhaps aided by consultants. Strategic decision processes are much more complex. The latter involve a myriad of actors and agencies drawn from within and outside the community and local government, each of whom may represent different jurisdictions and interests. In both strategic and routine decision processes which address sewage management problems, the engineer is the most important and influential actor.

As demonstrated in this chapter, the engineer controls three of the five steps in the decision-making process. He/she is responsible for delineating the dimensions of the problem to be dealt with, providing alternative solutions to the problem and, to a great extent, evaluating those options. The engineer may then actually make the decision if the problem is routine in nature. With strategic problems, the alternative(s) presented to the municipal Council or regional Board for decision is/are shaped and defined by the engineer. Further, the votes which elected officials cast are, in a very real way, conditioned by advice and information received from the engineer. It is therefore clear that the engineer is the most influential actor in sewage management.

Following this analysis, one is able to sketch alternative scenarios which demonstrate the relationships between those factors postulated to condition an engineer's influence in sewage management decision-making and the actual influence which engineers have in such processes. The very influential engineer has considerable experience, works in a relatively large community which operates under the city manager style of local government, plays a broad role and does not perceive that organizational norms constrain his/her activities. In contrast, a less influential engineer is relatively inexperienced, is employed in a smaller community which functions under the Council-Committee system of local government, plays a relatively narrow role and feels that organizational norms constrain his/her activity. These situations represent opposite ends of a continuum, with most cases lying somewhere in between. Regardless of the degree to which these various factors condition the engineer's involvement and role in sewage management decision-making processes, these professionals are, as a group, the most influential actors in such activities.

SUMMARY AND CONCLUSIONS

Summary

This study is intended as an investigation of the role of the engineer in sewage management decision processes at the community level. Water-borne human wastes generated in urban areas must be dealt with effectively in order to ensure the maintenance of human health and quality of the environment. Decision-making processes addressing these and other issues in resources and environmental management are dominated by professionals of all kinds. In the field of water management, engineers are particularly important. Education and training, relationships with other actors, organizational constraints and various dimensions of the profession were all posited to influence not only the extent of the engineers' importance in sewage management, but the outcome of related decision processes.

Literature from several fields was drawn upon in order to provide the conceptual framework for this study. The theories of organizations, decision-making within the latter and the roles and power held by individuals within such organizations were drawn form the fields of sociology, political science and psychology. Further, the important role of the professional in organizational decision-making was focussed upon. These general concepts were then placed in the context of resources and environmental management and, more specifically, water and sewage management. Finally, this review of the literature considered decision-making at the scale of enquiry used in this study - the community.

The general relationships vis-a-vis the professional and his/her role in sewage management were formulated into a series of hypotheses and presented in the section considering the design of the study. From these hypotheses a number of variables were isolated, and formed into questions. The latter were then administered to engineers, administrative officers and elected officials in a number of communities on southern Vancouver Island and the lower mainland of B.C. The data and information generated from over thirty in-depth interviews were then analyzed using both qualitative and quantitative methods. The small sample size, inability to make assumptions about the population and low level of data measurement would not permit more rigorous quantitative analysis.

Sewage is a problem with which man has had to deal for many centuries. Following an examination of the evolution of the sewage issue, a number of conventional and alternative forms of treatment were considered. It is apparent that a number of trends, such as urbanization, have impacted upon the evolution of sewage management. These trends have been prompted by various stimulants, such as escalating costs and increasing concern for the quality of the environment. Following an analysis of these latter two aspects of sewage management, this issue is then placed into the context of the N.I.M.B.Y. syndrome, a situation which often leads to the placement of sewage matters on the political agenda.

The results of this study show that there are two types of problems which must be addressed by sewage management processes. Routine problems do not require extensive funding, are not especially contentious and are typically easily resolved. Strategic problems, however, require considerable funding, are general-

ly contentious and cannot be resolved on wholly rational grounds. Within both of these processes the engineer was found to be the most important actor. His/her influence was, however, found to vary in accordance with several factors, such as the size of the community and the structure of the decision-making network. These results will now be placed into context and commented upon more thoroughly.

Conclusions - Introduction

Atop an office building in downtown Sewageville sits the Chief Engineer of that municipality. Years of courses at one of the country's engineering schools, an arduous apprenticeship period, membership in the Professional Engineer's Association and a wealth of experience were all necessary prerequisites for this post. He is an important man, more important than his peers who preside over smaller empires. There are many aspects of his job which not only please him, but allow him considerable influence over affairs which fall within his scope of responsibility. He reports to one person only and therefore is not troubled with the requests of all those in the Sewageville municipal government who might otherwise call upon his expertise. A day in the office is never boring, as his position calls for him to make calculations and designs to solve tough technical problems, provide advice to his employer on the pros and cons of options being considered, perform various administrative functions and make decisions on issues as varied as what size pipe would be most appropriate or which treatment system would best meet the needs of Sewageville. His perception that no-one else in the Sewageville government is able to perform the technical tasks he undertakes make him feel like

an essential cog in the organizational machine. Mr. Chief Engineer also likes the freedom and autonomy his position affords. He is not only free to do as he will within the municipality, but is also able to attend engineering conferences frequently and get together with his professional peers at least once a week for business lunches. Taken together, these characteristics make Mr. Chief Engineer of the municipality of Sewageville that community's most influential actor in sewage management processes.

This scenario illustrates factors derived from the literature which constitute the foundation of this thesis. A series of hypotheses related to these factors were erected earlier in the study and subjected to empirical testing. The results of this research must now be placed back into context with the literature.

It is interesting to note that many of the engineers considered in this study were not 'professionals' in the strict definition of the term. The literature suggests that attendance at an accredited training institution, period of apprenticeship, membership in a professional association and adherence to a code of ethics are all criteria which define a 'professional'(see, for example, Carr-Saunders and Wilson, 1933; Driver, 1972). More than one-third of the engineers considered in this study had not received University training, although two of the latter were members of the prestigious Institute of Civil Engineers in the U.K. While membership in the B.C. Association of Professional Engineers is mandatory for all practicing engineers in this Province, it is looked upon simply as a requirement. The engineers considered had little or no on-going contact with their professional body. There was, however, evidence of adherence to the Code of Ethics governing

engineers in this Province. When asked if he altered the design-work done by his subordinates, one chief engineer replied "we are all professional engineers in this department", implying that they are closely guided by Section One of their Code of Ethics, which states their work will be of "the highest standards of integrity" (Engineer's Act, 1979).

All of the engineers considered in this study were 'governed'. Stated another way, each of these engineers worked for an organization rather than independently. Further, this group appeared quite selfless in the sense that they worked for the good of the organization. Statement such as "I supply the advice and information to help make the best decision" and "I look out for the good of the community" exemplify this unselfish attitude. Maass (1974) noted that engineers tend to be 'company men' whose sole interests are to serve the organization for whom they work. In fact, the selection and training of engineers emphasize this characteristic. The findings of this study appear to be congruent with those of Maass(1974).

Turning now to an examination of the municipal and regional government bodies considered in this study, it is evident that these bodies are indeed 'organizations' as defined by the literature. These agencies are inter-connected systems designed for a specific purpose(s), such as the management of sewage. They therefore fall within what Parsons (1951) described as the general systems theory of organizations. The patterned activities, hierarchical structure and other characteristics of these organizations accord with the general model of a bureaucracy as outlined by Weber(1947). Finally, municipal and regional governments are open to stimuli from outside their organizational boundaries and also make decisions

which impact upon the environment outside of their framework. These agencies are therefore clearly open organizations as defined by Silverman(1976) and demonstrate characteristics of both environment-input and environment-output typologies, discussed by Katz and Kahn(1966).

As noted above, it is within these bureaucratic organizations that the engineers considered in this study are employed. These engineers played a variety of discreet roles, ranging from administrators to technicians to advisors to decision-makers. The results of this study may be interpreted to suggest that the actual 'role' of the engineer is composed of a number of discreet bits, as all of these actors possessed this broad range of responsibilities. These observations are in agreement with those of some other workers (Handy, 1985; O'Riordan, 1971), but are discordant with studies done by others (Sewell, 1971; Barker, 1977). This study's findings show that a degree of stress exists vis-a-vis the roles of some engineers, principally due to the interference of other tasks with what they perceive to be their occupational responsibilities. The result of this scenario is what Kahn (1964) defined as role ambiguity. In one instance it was apparent that this stress and ambiguity resulted not only in disenchantment on the part of the engineer but in negative impacts upon the operation of the organization. Finally in relation to engineer's roles within organizations, it is difficult to infer whether the engineer's perceptions of others' roles caused stress for the former, as none of the engineers considered regarded other actors in their organization as capable of performing complex technical tasks.

This study's results show that engineers hold what Lee and Lawrence (1985), amongst others, defined as 'expert' power. These actors clearly possessed knowledge and abilities which were required by others in their organization. The reasons why they held such power may be summarized as follows, in order of importance. First, they dealt with technologically-complex matters. Second, the engineers concerned themselves with the financial aspects of sewage management. Third, their responsibilities were closely related to the maintenance of human and environmental health. The engineers clearly dealt with matters which Sommers (1963) contends result in the accordance of a high degree of power and status.

The degree of power and influence which the engineers held was found to vary with a number of organizational factors, however. This study's results agree with those of Benveniste (1977) in that the influence which one actor may have in an organizational decision is inversely proportional to the number of people directly involved in that decision. Further, Downs' (1967) contention that 'tall' organizations demonstrate greater inequalities of power than 'short' organizations is borne out in this study's results. Finally, the degree of freedom and autonomy which the engineer possessed was found to effect the amount of influence that actor held, a result which is congruent with that of Pelz and Andrews (1966).

One of the factors postulated to determine the ability of the professional to socialize within his/her organization is the frequency of contact with his/her profession(Driver, 1972; Hall, 1973). This study's results show some degree of variation in the degree of contact with the B.C. Association of Professional Engineers,

with some engineers attending conferences and making presentations frequently and others not at all. This study did not, however, focus upon the degree to which the engineers were socialized within their organizations. It would therefore not be appropriate to comment upon the relationship between professionalization and socialization.

Two interesting results that emerge out of this research have received little attention in previous work on professionals in organizations. First, the number of years of professional experience which the engineers considered by this study possessed correlated directly with the influence they held within their organizations. Second, the breadth of the role which the engineer perceived he/she played also correlated positively with degree of influence. As these appear to be isolated observations, they warrant attention by future researchers.

An extensive literature exists on the topic of organizational decision- making. In terms of the actual process, the general model developed by this study is like that outlined by Scott(1971). Each consists of a series of steps beginning with identification of a problem and ending with a decision being made. Further, the process is calculated and involves specialization. It is apparent that both organizational and personal ends are sought within the decision-making process, thus demonstrating components of both Barnard's (1971) and Downs' (1971) models. On one hand, engineers contribute to the decision-making process for the good of the organization and that of the community. On the other hand, there appears to be bias towards intrinsic personal gain, such as the satisfaction realized when one's solution to the problem is utilized, involved in engineers' contributions to decision-making processes. This latter observation will be expanded upon below.

The conclusions reached by this study regarding decision-making at the community level also agree with much of the research conducted previously on this topic. The responsibilities for sewage management are placed squarely in the hands of municipal and regional governments, which retain specialized divisions to deal with various aspects of this problem and also respond to stimulants from the public, characteristics noted by O'Riordan (1972) and Woodrow (1974). Second, the responses to such problems involve a series of steps which articulate the problem, generate and evaluate alternatives and make decisions. This process is similar to that suggested by Sanders (1961). Third, a locus of key actors, including elected and appointed officials and professionals, are involved in the decision-making process. An important departure from other models of community decision-making, however, is the absence of private sector interests (see, for example, Crain et al., 1969; Davis and Weinbaum, 1969). The observations that sewage collection, treatment and disposal is historically seen as a public service and that sewage management in urban areas offers little opportunity for financial gain are offered in explanation of this latter fact.

Finally, it is necessary to compare the results of this research with work done on the process of decision-making in resources and environmental management. The first consideration is the routine sewage management decision-making process conducted at the municipal or regional level. A normative process of decision-making appears to be in operation here. Once a problem has been identified, the process continues along a well-defined series of steps, each of which is the responsibility of a pre-determined actor(s). Further, the dimensions of the problem are typically easy to define and the process operates in an environment of

ample knowledge and information. Therefore, the models of routine sewage management decisions developed in this study are in agreement with the normative models of resources and environmental decision-making proposed by earlier workers(see, for example, Mitchell , 1970).

Strategic sewage management decisions at the municipal and regional levels, however, must also be considered. Such decision-making processes are extremely complex and may be characterized by the following factors. First, decision participants must react to political and social stress emerging from the environment around them. Second, these participants operate in an environment of imperfect information and thus cannot generate all possible alternative solutions. As a corollary of the above two, decisions which are taken must be value-laden. Finally, while problem resolution does involve a series of steps, these steps are neither well-defined nor are the responsibility of a particular actor(s). Therefore, the strategic decision-making models developed in this study are similar to the behavioural models developed by other workers in the field of resources and environmental management, notably Kasperson (1969) and O'Riordan (1986).

Having placed the results of this research into context with previous work to which aspects of this study relate, it is necessary to return to the characterization of the Chief Engineer of Sewageville presented earlier. We have seen that experience and association membership are important pre-requisites for his position, although University training is not. The Sewageville Chief Engineer is indeed more influential within his organization than are his peers who reside over smaller empires. Several other characteristics of his situation enhance the influence

which he possesses within the organization. These include the fact that he must report to only one person, the breadth of his occupational role and the freedom and autonomy which his position affords. His perception of the degree to which other members of the organization are able to perform technical tasks and his attendance at professional symposia appear to have little impact upon his importance, however. One the whole, the Chief Engineer in Sewageville and his counterparts elsewhere are clearly the most influential actors in sewage management in their respective communities.

The overall thesis of this study is therefore proven. In addition, a number of the factors postulated to condition the extent of the engineer's influence in sewage management have been verified. This is not the case with certain characteristics of the engineer's status as a professional nor his/her perceptions of others as technical experts, however. This study's findings have implications for both policy and research. It is an examination of these repercussions to which this discussion will now turn.

Implications

The results of this research show that engineers are the most influential group in sewage management processes at the community level. In order to fully appreciate the implications of this finding, the latter must be placed into context with other work done on professionals in resources and environmental management, as well as in other fields of enquiry. The works cited in the relevant sections of the review of literature are especially important in this regard.

Past research has shown that engineers favour structural solutions to problems. As engineers dominate the process of sewage management, it follows that construction of collection, treatment and disposal systems will continue to dominate the process of dealing with liquid human wastes. This fact has at least two major repercussions. First, attendant concerns of sewage management, such as the social impacts of proposed projects, may be given little consideration by those dominating the decision-making process. Second, source control will receive little attention, especially as it relates to domestic inputs.

A recent decision by the Capital Regional District (C.R.D.) does not support the assertions made above(Times-Colonist, 5 Dec., 1986). The beaches of Victoria extending from Albert Head to Cadboro Bay on the Strait of Juan de Fuca are littered with feminine hygiene products, prophylactics and other offensive material. In 1984, the C.R.D. undertook a study designed to generate options on how to deal with this problem(C.R.D., 1984b). The authors of the study, themselves engineers, devised four options: 1) lobby tampon manufacturers to utilize biodegradable materials; 2) embark upon a public education programme to discourage the use of particular products; 3) remove debris from the beaches manually and; 4) install finer screens on the outfalls. The authors recommended a package solution which encompassed the first three options. The C.R.D. chose the fourth. This decision illustrates not only a willingness on the part of the engineers to utilize alternative, non- structural solutions to problems, but also an instance where elected officials did not heed their engineers' advice.

The results of this and other research may also have implications for resources and environmental management in general. Previous studies have shown that engineers tend to take fragmented views of problems which emphasize their physical aspects. In addition, engineers and many other professionals are skeptical about including the public in decision-making processes which address complicated environmental issues. If professionals who possess these two characteristics hold as much influence in resources and environmental management as is suggested by this research, problems may be exacerbated rather than solved.

The 20 year controversy over the Ganges sewage management system on Saltspring Island, B.C., is illustrative of the above. The C.R.D. and Provincial Pollution Control Branch both saw Ganges' problems as easily resolved with technical solutions(Lucey, W.P., J.W. Dumbrell, C. Laviolette et al., 1986). A system which collected and treated Ganges' wastes and disposed of the effluent through a long ocean outfall was envisioned (Stanley and Associates, 1981). However, various other dimensions of the problem came to bear. The residents of Ganges became concerned with the social and economic development implications they felt would stem from the installation of sewers. The issue also became highly politicized, requiring mediation in B.C.'s Supreme Court. Throughout much of the controversy the Director of the Pollution Control Branch, himself an engineer, lamented the public participation process(Keenan, 1984). He felt that the latter was the result of the attrition of democratic principles within our society.

This research also has implications for organizational decision-making. Specialization in a particular field of study is synonymous with the adoption of par-

ticular perceptions and attitudes. Hence, problem-solving by professionals in organizations is approached from particular perspectives which, in order to afford clarity and focus, tend to ignore many stimuli present in the organizational environment. This is particularly the case when the problem being addressed by the organization is strategic in nature. If professionals are dominant in organizational decision-making, certain dimensions of a problem stressed by other members of the organization may be ignored. The result of this scenario is dissatisfaction of many elements of the organization and, consequently, organizational stress.

The decision of the C.R.D. to go ahead with the East Coast Interceptor exemplifies the above argument. Faced with inadequate sewage disposal systems at Finnerty Cove and McMicking Point, the C.R.D. Engineering Department, in consultation with Kerr-Wood-Leidal Associates Ltd., prepared a scheme designed to take sewage from the faulty systems and from other outfalls to Clover Point for disposal (C.R.D., 1983b). This proposal overlooked many concerns of members of the C.R.D. Funding was a major problem, raised at various times by the Cities of Victoria and Esquimalt(Times-Colonist, 7 March, 1986). In addition, the City of Victoria expressed its concern over additional volumes of effluent being disposed of from Clover Point, thus demonstrating the N.I.M.B.Y. syndrome discussed earlier(Times-Colonist, 26 March, 1986). In short, the East Coast Interceptor proposal became a political issue involving the member municipalities of the C.R.D. as well as the Provincial government. Encorporation of these economic, social and political dimensions of the problem in early stages of the East Coast Interceptor planning process may have helped avoid the stress caused by what was apparently a much narrower focus.

The above argument is equally applicable to society as a whole. However, the stimuli directed at the organization responsible for solving the problem are much more numerous and complex. These stimuli may come from, for example, interest groups, concerned citizens and other jurisdictions. If professionals who are not sufficiently broad-minded are as influential in perceiving, interpreting and responding to other types of stimuli as they are in the case of sewage management, a myriad of decisions which are potentially unsatisfactory to society at large may result.

The proposed East Coast Interceptor in the Greater Victoria area again provides an illustration of the dissatisfaction various groups may voice in response to decisions taken on dominantly technical grounds. Recent responses to the Interceptor proposal demonstrate the concerns of various groups in the community. A letter from the Greater Victoria Environmental Centre lambasted the C.R.D. for its 'band-aid' solution and called for alternative recycling and composting programmes (Times- Colonist, 30 Jan., 1987). The Fairfield Community Association has become especially worried about the impact of increased beach litter upon Victoria's tourist trade(Times-Colonist, 13 Nov., 1986). The possible connection between untreated sewage and the spreading A.I.D.S. virus, which uses body fluids as a transport medium, has been suggested(Times-Colonist, 15 March, 1987). One letter condemned the Chief Engineer of the C.R.D., stating his attitude "reveals the sort of ignorance of environmental matters which pervades all levels of government and bureaucracy"(Times-Colonist, 20 March, 1987). These comments illustrate the anxiety which results when organizations dealing with public concerns are not perceived to be responding properly to stimulants from the environment.

Recommendations

There is a series of steps which may be taken to avoid the problems which could result from the control of various forms of decision-making processes by professionals who do not demonstrate a sufficiently broad perspective. The guiding philosophy underpinning these steps is a multi-dimensional approach to problem-solving. First, professionals' educational requirements should be broadened to include considerable training in disciplines and fields other than their own. Courses in the humanities and social sciences may be especially important in this regard. While such training is presently part of various professional curricula, it is either not mandatory or extensive enough. Second, professional associations must strengthen their commitments to include topics from other disciplines and fields in their conference agendas and publications. Although formal contact with one's profession was found by this study to vary widely, inter-disciplinary information would eventually disseminate through formal as well as informal channels. Finally, institutions must stress a multi-disciplinary approach to problem-solving. This latter step will ensure that many different perspectives will be brought to decision-making processes and that all dimensions of a given problem receive attention.

Suggestions For Further Research

There are a number of questions which deserve attention by future researchers. It would be useful to further examine the relationship between the extent of professional experience and degree of influence in resources and environmental

management decision-making, a theme linking this study with those of Pelz and Andrews (1966), Pletta (1984), McMeiken (1972) and Sewell (1971). In addition, further research may be conducted to examine the correlation between breadth of role and degree of influence. In a more general sense, the interaction of degrees of professionalization and socialization within an organization is a topic considered by Driver (1972) and Hall (1973) which warrants further attention. Finally, a general research theme which focusses on the role of the professional in resources and environmental management may be extended from this study and those of Kaufman (1967), Hendee and Bultena (1972), Sewell (1971), McMeiken (1972) and Barker (1977), amongst others, to include other professionals dealing with other types of resource and environmental problems.

Conclusions

The production of waste is an inevitable consequence of human existence. The treatment and disposal of small quantities of sewage does not pose a major problem to the environment. However, as man has become increasingly concentrated on many parts of the earth's surface, sewage management has assumed greater importance for human health as well as environmental reasons. As one respondent noted, "Sewage is deadly bloody stuff. Every disease and organism known to man is in it. If you fall into a sewage pit, you die." Decision-making regarding this hazardous substance takes place in an atmosphere of uncertainty. Engineers are called upon to reduce this uncertainty by contributing their knowledge and expertise to sewage management decisions. As engineers are likely to continue to be the most important actors in the process of sewage management, it

is imperative that they consider all options and dimensions of this problem to ensure efficient allocation of resources and protection of the environment.

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APPENDIX A

RESEARCH INSTRUMENT

Community Engineer - Verbal Questions

1)To whom in your organization are the technical matters of sewage management referred?

2)Who would refer these technical matters to them?

3)There are various people/groups to whom solutions to sewage management problems may be presented. How does the process of approval operate in your community?

4)Is the public involved in sewage decision-making in your community?

5)If so, in what ways?

6)Do you feel this involvement is helpful?

7)How many years have you been practicing as an engineer?

8)What is the highest degree/diploma you have obtained?

9)Are you a member of any professional associations?

10)If Yes, which ones?

11)In a given month, which journals/magazines do you read?

Community Engineer - Written Questions

1)Would you please sketch, in short-hand form, the process whereby decisions regarding sewage management are made in your community. Please include: a)main individuals/agencies involved; b)linkages between them; c)where the process begins.

2)There are various roles which engineers may fulfil in community sewage management. How often do you fulfil each of the following roles?

Advisor:

constantly frequently occasionally seldom never

Administrator:

constantly frequently occasionally seldom never

Technician:

constantly frequently occasionally seldom never

Decision-maker:

constantly frequently occasionally seldom never

3)There are various roles which administrative officers may fulfil in community sewage management. How often do feel the chief administrative officer in your community fulfils each of the following roles?

Advisor:

constantly frequently occasionally seldom never

Administrator:

constantly frequently occasionally seldom never

Technician:

constantly frequently occasionally seldom never

Decision-maker:

constantly frequently occasionally seldom never

4)Elected officials may also play a variety of roles in community sewage management. How often do you feel the elected officials in your community fulfil each of the following roles?

Advisor:

constantly frequently occasionally seldom never

Administrator:

constantly frequently occasionally seldom never

Technician:

constantly frequently occasionally seldom never

Decision-maker:

constantly frequently occasionally seldom never

5)How important is it to you to be able to use the professional engineering skills you were trained for?

very important important indifferent unimportant very unimportant

6)How satisfied are you with the amount of time you are able to spend practicing specific engineering skills?

very satisfied satisfied unsatisfied very unsatisfied

7)If you responded 'unsatisfied' or 'very unsatisfied', how often do other tasks at work prevent you from spending more time practicing engineering?

constantly frequently occasionally seldom never

8)What are the major issues in sewage management you have worked on in your current position?

9)How satisfied are you with your freedom to generate alternatives dealing with sewer management problems?

very satis. satis. indifferent very unsatis. unsatis.

10)How often do you attend the conferences held by the B.C. Assoc. of Professional Engineers?

constantly frequently occasionally seldom never

11)How often do you make presentations to conferences held by professional associations?

constantly frequently occasionally seldom never

12)How often do you informally contact other professional engineers, such as by telephone, over lunch, etc.?

constantly frequently occasionally seldom never

13)Hypothetical Situation - One of the municipalities/regions outfalls proves to be ineffective in disposing of sewage. This ineffectiveness is demonstrates by three conditions. Unsightly organic and inorganic material becomes evident in the outfall area. Foul odors are carried onshore by sea breezes. An abundance of gulls congregates in the area. In addition, coliform counts of the effluent are above permissible levels set by the Waste Management Branch. Local citizens, the media and the public health officer become concerned.

a)Who would you contact first?

b)Who would be the first to contact you?

c)What other groups and individuals would you contact, in what order?

d)What other groups of individuals would contact you?

e)What would you anticipate as being the difficulties involved in resolving this matter?

Administrative Officer - Verbal Questions

1)To whom in your organization are the technical matters of sewage management referred?

2)Who would refer these technical matters to them?

3)In order to solve a given problem in managing sewage, a number of alternative solutions may be offered: a)Who decides which alternatives will be evaluated in looking for solutions to problems?; b) Who decides which of the alternatives will ultimately be adopted?

4)Is the public involved in sewage management decision-making in your community?

5)If so, in what ways?

6)Do you feel this involvement is helpful

Administrative Officer - Written Questions

1)Would you please sketch, in short-hand form, the process whereby decisions regarding sewage are made in your community. Please include: a)main individuals/agencies involved; b)linkages between them; c)where the process begins.

2)There are various roles which administrative officers may fulfil in community sewage management. How often do you fulfil each of the following roles?

Advisor:

constantly frequently occasionally seldom never

Administrator:

constantly frequently occasionally seldom never

Technician:

constantly frequently occasionally seldom never

Decision-maker:

constantly frequently occasionally seldom never

3)There are various roles which engineers may fulfil in community sewage management. How often do you feel the engineer in your community fulfils each of the following roles?

Advisor:

constantly frequently occasionally seldom never

Administrator:

constantly frequently occasionally seldom never

Technician:

constantly frequently occasionally seldom never

Decision-maker:

constantly frequently occasionally seldom never

4)There are various roles which elected officials may fulfil in community sewage management. How often do you feel the elected officials in your community fulfil each of the following roles?

Advisor:

constantly frequently occasionally seldom never

Administrator:

constantly frequently occasionally seldom never

Technician:

constantly frequently occasionally seldom never

Decision-maker:

constantly frequently occasionally seldom never

5) Hypothetical Situation - identical to that administered to the engineers (see Engineer written question no.13).

Elected Officials - Verbal Questions

1)To whom in your organizations are the technical matters of sewage management referred?

2)Who would refer these technical matters to them?

3)In order to solve a given problem in managing sewage, a number of alternative solutions may be offered: a)Who decides which of these alternatives will be evaluated in looking for solutions to problems? ; b)Who decides which of the alternatives will ultimately be adopted?

4)Is the public involved in sewage decision-making in your community?

5)If yes, in what ways?

6)Do you feel this involvement is helpful?

Elected Officials - Written Questions

1)Would you please sketch, in short-hand form, the process whereby sewage management decisions are made in your community. Please include: a)main individuals/agencies involved; b)linkages between them; c)where the process begins.

2)There are various roles which elected officials may play in community sewage management. How often do you fulfil each of the following roles?

Advisor:

constantly frequently occasionally seldom never

Administrator:

constantly frequently occasionally seldom never

Technician:

constantly frequently occasionally seldom never

Decision-Maker:

constantly frequently occasionally seldom never

3)There are various roles which engineers may fulfil in community sewage management. How often do you feel the engineer in your community fulfils each of the following roles?

Advisor:

constantly frequently occasionally seldom never

Administrator:

constantly frequently occasionally seldom never

Technician:

constantly frequently occasionally seldom never

Decision-Maker:

constantly frequently occasionally seldom never

4)There are various roles which administrative officers may play in community sewage management. How often do you feel the chief administrative officer in your community fulfils each of the following roles?

Advisor:

constantly frequently occasionally seldom never

Administrator:

constantly frequently occasionally seldom never

Technician:

constantly frequently occasionally seldom never

Decision-maker:

constantly frequently occasionally seldom never

5) Hypothetical Situation - the hypothetical situation administered to the elected officials is identical to that given to the engineer, which may be found in the Engineer's written questions, no. 13.

APPENDIX B

LETTER OF INVITATION

UNIVERSITY OF VICTORIA

P.O. BOX 1700, VICTORIA, BRITISH COLUMBIA, CANADA V8W 2Y2
TELEPHONE (604) 721-7211, TELEX 049-7222

Department of Geography
721-7327

Dear.....:

I have underway a research project dealing with urban water management in British Columbia. Specifically, it is focussed upon planning and policy-making with repect to sewage collection and disposal in a selected number of communities in the southern part of the Province. To improve our understanding of this topic we are trying to arrange meetings with a number of individuals involved in sewage management in these communities. We would like very much to have the opportunity to discuss matters relating to your region with you.

We plan to visit your area on.. ....., ... and wondered if you might be able to spend about half an hour with us. We will telephone you next week to determine whether you are available.

Your assistance is greatly appreciated.

Yours sincerely,

W.R. Derrick Sewell, Ph.D.
Professor

cc: Mr. J.W. Dumbrell

APPENDIX C

RESPONDENTS

VANCOUVER: Mr. P. Steblin - Chief Sewers Engineer; Mr. F. Bowers - City Manager; Mr. J. Baker - Alderman.

BURNABY: Mr. E. Olson - Chief Engineer; Mr. M. Shelley - City Manager.

VICTORIA: Mr. J. Sansom - Chief Engineer; Mr. J. Bramley - City Manager; Mr. E. Simmons - Alderman.

NANAIMO: Mr. R. Martin - Chief Engineer; Mr. G. Hayward - City Manager.

OAK BAY: Mr. C. O'Gorman - Chief Engineer; Mr. L. Pollock - City Manager; Ms. S. Brice - Mayor.

ESQUIMALT: Mr. R. Nordlund - Chief Engineer; Mr. G. Merz - Chief Administrative Officer; Mr. M. Sihota - former Alderman; Mr. J. King - Alderman.

CENTRAL SAANICH: Mr. A. MacKay - Chief Engineer; Mr. G. Wheeler - Chief Administrative Officer; Mr. R. Sharpe - Alderman

NORTH SAANICH: Mr. I. Zahynacz - Chief Engineer; Mr. G. Soellner - Alderman; Ms. L Michaluk - Alderman.

GREATER VANCOUVER REGIONAL DISTRICT: Mr. B. Talbot - Deputy Chief Engineer; Mr. J. McLean - Secretary/Treasurer; Mr. J. Baker - Regional Board Member.

CAPITAL REGIONAL DISTRICT: Mr. M. Williams - Chief Engineer; Mr. W. Jordan - Executive Director; Ms. S. Brice - Regional Board Member

COMOX-STRATHCONA REGIONAL DISTRICT: Mr. V. Hurley - Deputy Chief engineer; Mr. W. d'Easum - Executive Director

APPENDIX D

DATA SUMMARY

Cases	Variables																		
	1	2	3	4	5	6	7	8	9	10	11*	12	13	14	15	16	17	18	19
A	a	a	a	a	a	a	-	-	-	-	35	g	4	5	5	5	4	2	4
B	a	c	a	c	a	a	-	-	-	-	30	t	2	4	5	4	5	2	5
C	a	a	a	c	a	a	-	-	-	-	30	t	6	-	-	-	-	-	-
D	a	c	b	a	a	a	a	b	b	a	27	v	5	5	3	5	5	3	3
E	a	b	-	-	-	-	b	a	b	b	15	b	4	5	5	4	5	4	5
F	a	a	a	c	a	a	a	a	b	a	38	b	4	4	4	4	4	4	5
G	a	c	a	a	a	a	a	c	b	a	24	g	3	4	4	2	5	2	4
H	a	a	-	-	-	-	-	-	-	-	30	v	3	5	4	5	4	4	4
I	a	a	a	a	a	a	a	a	a	a	32	b	2	5	3	5	4	5	5
J	a	a	a	a	b	b	a	a	b	a	26	g	3	4	4	2	4	1	3
K	b	c	a	a	a	a	a	b	a	a	20	b	5	4	4	2	4	3	2

	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
A	1	1	1	1	5	3	0	5	2	3	4	2	2	1	2	5	5	5	5
B	1	3	1	1	3	3	0	5	4	3	5	4	3	1	3	5	4	5	4
C	-	-	-	-	-	-	-	-	-	-	-	5	3	2	5	5	5	5	5

D	1	1	3	1	4	3	0	5	1	1	4	4	5	2	4	5	4	5	5
E	2	4	3	3	5	3	0	4	3	3	4	-	-	-	-	-	-	-	-
F	4	3	4	3	5	3	0	4	3	3	3	5	5	1	4	5	5	5	5
G	1	2	3	1	3	3	0	5	1	4	4	3	4	1	3	5	5	4	4
H	2	2	2	2	5	4	0	4	4	3	4	-	-	-	-	-	-	-	-
I	2	2	4	1	3	4	0	4	3	1	3	3	4	2	2	4	5	5	2
J	1	2	2	1	5	2	4	4	5	2	4	2	4	1	1	4	5	5	1
K	1	2	1	1	4	2	5	5	4	1	3	3	4	2	3	4	3	4	4

	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57
A	1	1	1	3	-	-	-	-	-	-	-	-	-	-	-	-	2	4	19
B	2	2	2	5	-	-	-	-	-	-	-	-	-	-	-	-	3	5	18
C	2	2	2	4	-	-	-	-	-	-	-	-	-	-	-	-	-	7	-
D	4	3	2	4	3	4	2	5	5	5	5	4	3	3	3	4	2	8	18
E	-	-	-	-	5	1	1	5	5	4	4	3	4	5	1	4	4	11	19
F	1	1	1	3	2	2	1	5	5	5	5	5	4	4	2	5	5	1	16
G	2	1	2	5	3	4	2	5	5	5	5	4	3	3	3	4	3	3	15
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	6	-
I	1	1	1	3	2	2	1	5	5	5	5	5	4	4	2	5	3	2	17
J	2	1	2	5	3	1	1	5	4	5	3	4	2	2	1	2	2	9	14
K	3	5	2	5	4	4	2	5	4	5	5	4	4	4	1	2	2	10	14

Notes on Data Summary

1. Letter Codes for List of Actors: a=chief engineer and staff; b=elected officials; c=public
2. Letter Codes for Engineers' Training: v=vocational training in Canada; t=polytechnic training in U.K.; b=bachelor's degree in engineering; g=graduate degree
3. * denotes numbers in columns represent years
4. Remaining Data: the remaining data in the data summary are ordinal data which have been coded as follows: 0=n/a; 1=never; 2=seldom; 3=occasionally; 4=frequently; 5=constantly

List of Variables

01 = engineer's response to 'who are problems referred to?'

02 = engineer's response to 'who identifies problems?'

03 = manager's response to 'who are problems referred to?'

04 = manager's response to 'who identifies problems?'

05 = manager's response to 'who evaluates alternatives?'

06 = manager's response to 'who generates alternatives?'

07 = politician's response to 'who are problems referred to?'

08 = politician's response to 'who identifies problems?'

09 = politician's response to 'who evaluates alternatives?'

10 = politician's response to 'who generates alternatives?'

11 = engineer's years of experience

12 = engineer's training/diploma/degree

13 = number of associations engineer belongs to

14 = engineer's perception of himself as advisor

15 = engineer's perception of himself as administrator

16 = engineer's perception of himself as technician

17 = engineer's perception of himself as decision-maker

18 = engineer's perception of manager as advisor

19 = engineer's perception of manager as administrator

20 = engineer's perception of manager as technician

21 = engineer's perception of politician as advisor

22 = engineer's perception of politician as administrator

23 = engineer's perception of politician as technician

24 = engineer's perception of politician as decision-maker

25 = satisfaction with amount of time spent engineering

26 = interference of other tasks with engineering

27 = engineer's freedom to generate alternatives

28 = engineer's attendance at conferences

29 = engineer's presentation at conferences

30 = engineer's informal contact with other engineers

31 = manager's perception of him/herself as advisor

32 = manager's perception of him/herself as administrator

33 = manager's perception of him/herself as technician

34 = manager's perception of him/herself as decision-maker

35 = manager's perception of engineer as advisor

36 = manager's perception of engineer as administrator

37 = manager's perception of engineer as technician

38 = manager's perception of engineer as decision-maker

39 = manager's perception of politician as advisor

40 = manager's perception of politician as administrator

41 = manager's perception of politician as technician

42 = manager's perception of politician as decision-maker

43 = politician's perception of him/herself as advisor

44 = politician's perception of him/herself as administrator

45 = politician's perception of him/herself as technician

46 = politician's perception of him/herself as decision-maker

47 = politician's perception of engineer as advisor

48 = politician's perception of engineer as administrator

49 = politician's perception of engineer as technician

50 = politician's perception of engineer as decision-maker

51 = politician's perception of manager as advisor

52 = politician's perception of manager as administrator

53 = politician's perception of manager as technician

54 = politician's perception of manager as decision-maker

55 = engineer's perception of manager as decision-maker

56 = rank of size of community

57 = engineer's perception of breadth of his role

VITA

Surname: Dumbrell Given Names: John William

Place of Birth: Thunder Bay, Ontario

Date of Birth: 12 June, 1961

Educational Institutions Attended:

University of Western Ontario, 1981 to 1985
University of Victoria, 1985 to 1987

Degree Awarded, with Date and Name of Institution:

B.A.(Honours) 1985 Univ. of Western Ont.

Honours and Awards:

Province of British Columbia Scholarship, 1986/87
University of Victoria Scholarship, 1985/86
Social Science and Humanities Research Council of Canada
Special Master of Arts Scholarship, 1985/86
Gold Medalist, University of Western Ontario, 1985
Ontario Graduate Scholar, 1985
Rhodes Scholar-elect, 1984
Dean's Honour List, Univ. of Western Ontario, 1982-85

Publications:

Dumbrell, J.W. and R.W. Butler. (1986). 'Identifying and Assessing the Impacts of the Hemlo Gold Development on the Community of Marathon, Ontario', Proceedings of the International Assoc. of Impact Assessment Conference, Calgary, September, 1985.

Sewell, W.R.D. and J.W. Dumbrell. (1987). Wilderness Decision -Making: A Comparative Study of Experiences in B.C., Australia and New Zealand. Cornett Series Paper no. 5. Victoria: Department of Geography, Univ. of Victoria.

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TITLE OF THESIS

After the Flush: Who's in Charge of Sewage Management?

AUTHOR [redacted]

JOHN W. DUMBRELL

23 APRIL 1987.