

WATER PLANNING AND THE QUALITY OF THE ENVIRONMENT:

A STUDY OF THE ASSINIBOINE RIVER BASIN

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A Thesis

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by

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FRONTSPIECE



THE SHELLMOUTH DAM AND THE LOWER PORTION OF THE RESERVOIR AREA

(Looking west and north from the look-out above the dam site)

Aug. 1968.

## ABSTRACT

This thesis studies water development of the Assiniboine River Basin. The study is based on a conceptual framework which states that resource processes, consisting of inputs and outputs, function to alter their environments producing goods and services, and thus creating new environments. Further, the relevant environment of these processes is seen to be multi-dimensional in nature. In both the historical and future study, particular emphasis is given to the often-overlooked cultural dimension. It is seen that the engineer's imperative is to take a comprehensive accounting of the ramifications of his actions. In order to be able to act on this imperative it is seen that the engineer must work within an ongoing inter-disciplinary team.

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## CHAPTER I

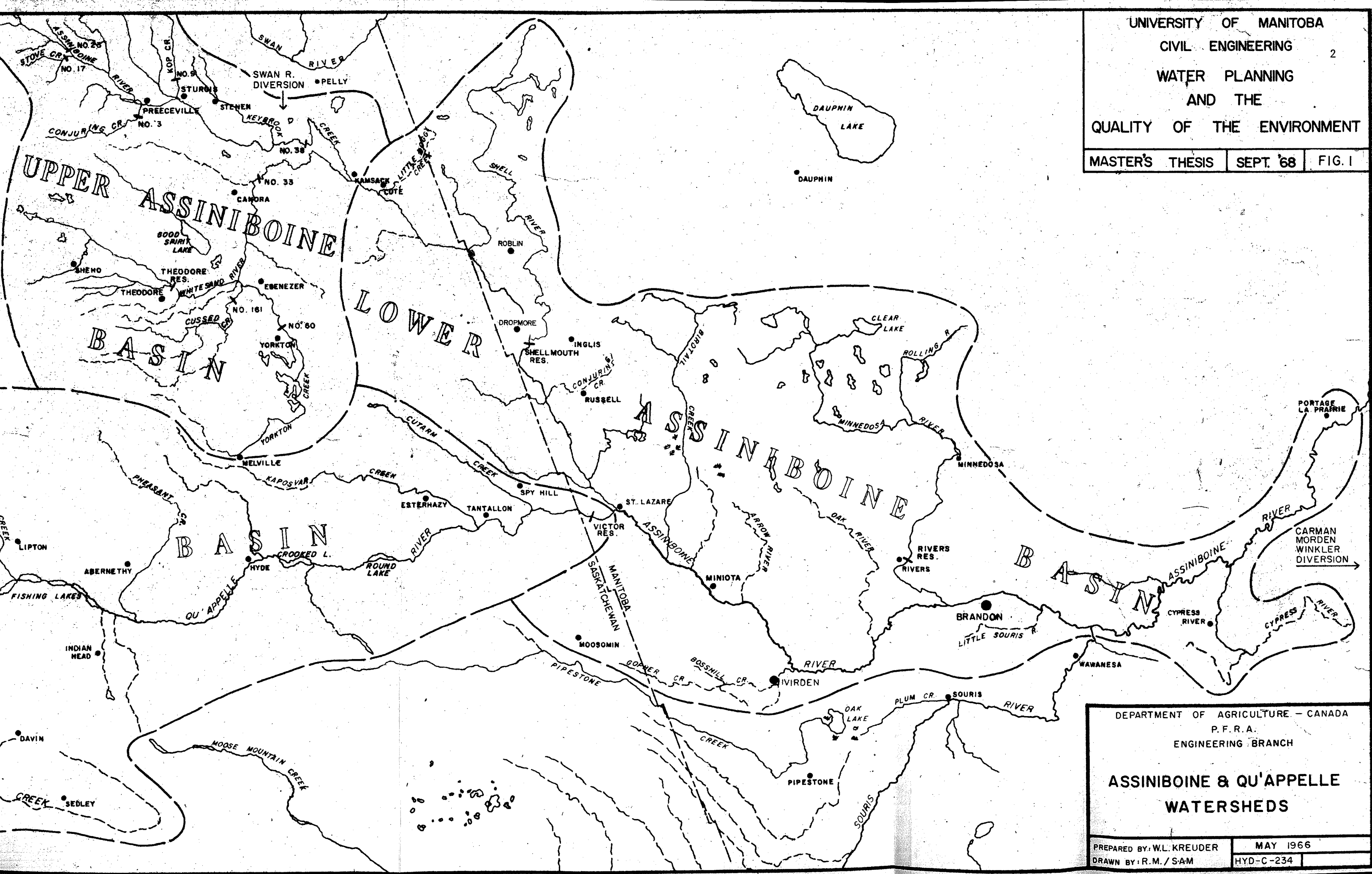
## INTRODUCTION

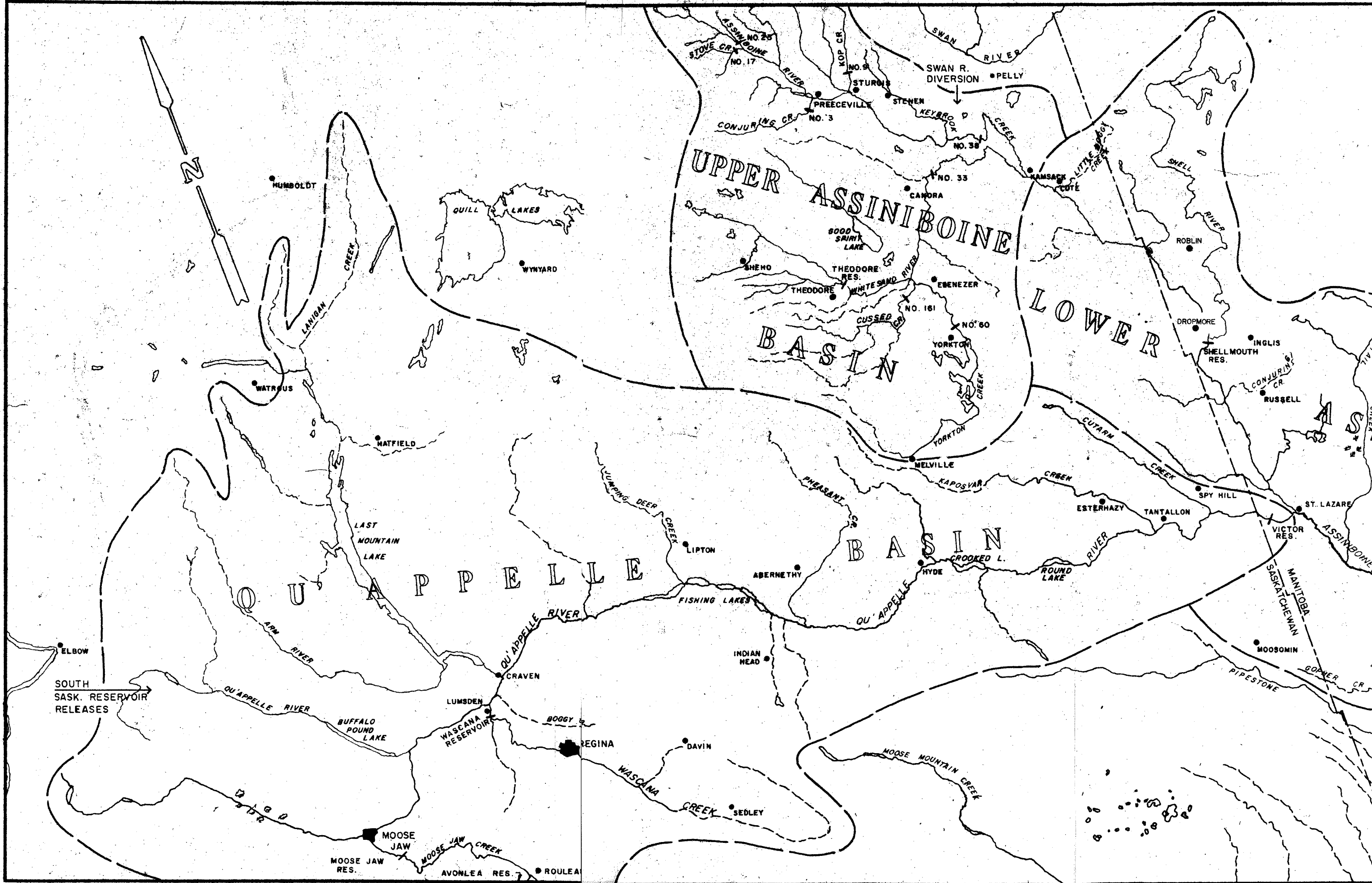
The importance of taking into account all relevant interests when planning the development of a river basin has been generally recognized by engineers during the last decade. Benefits called social or intangible have become manifest in the feasibility studies of many large projects. The inclusion of non-quantifiable benefits in these studies has become a troublesome aspect with floodways and reservoirs alike. The main cause of this difficulty lies with the fact that the new demand by society for a pleasing environment is not readily quantifiable. Thus, social benefits are not easily integrated into the traditional economic criteria of development.<sup>1</sup>

The subject of this thesis is the Assiniboine River, in particular the Brandon and Shellmouth Dam areas of the basin. The object is to study, comprehensively, the development of these areas using a conceptual framework based on the nature of the development process itself and then to apply this understanding to future development plans on the river. The hypothesis is that all relevant dimensions or interests in water development - ethnology, ecology, economics, and politics - are not easily integrated into a single decision criteria. However, by conceiving of them as relevant dimensions within an encompassing framework, their relative importance becomes evident to the decision-maker.

The Assiniboine River has played a major role in the exploration







and development of the Canadian prairies. As one of Manitoba's major rivers it will continue to play a significant role in the future development of the Province. The geographical location of the river is such that it flows through three of Manitoba's major cities.<sup>2</sup>

The first comprehensive study of the Assiniboine River Basin was done by Professor Henry Youle Hind in 1858 under the auspices of the Legislature of Canada. In his report<sup>3</sup>, published in 1859, he gives a beautifully detailed description of the Assiniboine Basin. Some excerpts are presented here to briefly develop an overall image of the Basin.

East of Prairie Portage (Portage la Prairie), the Assiniboine flows through a flat, open, prairie country not sixteen feet below its general level where it is cut by the stream. The whole country rising in steps above or west of the Portage, the Assiniboine has excavated a deep broad valley in which it meanders with a rapid current.

At the mouth of the Little Souris, or Mouse River, this valley is 880 yards across and eighty-three feet below the general level of the prairie. At Fort Ellice (near St. Lazare, Manitoba) its valley is one mile and thirty chains broad, and two hundred and forty feet below the prairie.<sup>4</sup>

Issuing from the Duck Mountain are numerous streams which meander through a beautiful and fertile country. This area may be said to commence at the Two Creeks, ten miles from Fort Pelley, thence on to Pine Creek fifteen miles further. The vegetation is everywhere luxuriant and beautiful, from the great abundance of rosebushes, vetches and gaudy flowers of many species. After passing Pine Creek the trail to Shell River pursues a circuitous route through a country of equal richness and fertility. Shell River is 42 miles from Pine Creek, and in its valley small oak appear, with balsam, poplar and aspen covering a thick undergrowth of raspberry, current, roses and dogwood. Between Shell River and Birdstail River, a distance of 39 miles, the country is level and often marshy, with numerous ponds and small lakes, but where the soil is dry the herbage is very luxuriant, and groves of aspen thirty feet high vary the monotony of the plain. Between the trail and the Assiniboine the soil is light, and almost invariably as the river is approached it partakes of a sandy and gravelly nature, with boulders strewn over its surface.

The flanks of the Riding Mountain are covered with a dense growth of aspen and poplar, and cut by numerous small rivulets. From Birdstail River to the Little Saskatchewan, or Rapid River (Minnedosa River), a distance of thirty-three miles, the same kind of soil, timber, and vegetation prevail. About one hundred miles from the mouth the Rapid River issues from the densely wooded flanks of the Riding Mountain through a narrow excavated valley filled with balsam, poplar, and an undergrowth of cherry and dogwood, with roses, convolvuli, vetches, and various creepers. The slopes are covered with poplar eighteen inches in diameter. Descending the river, groves of poplar and spruce show themselves, with thick forests of aspen and balsam poplar covering the plateau on either hand. The river is here forty feet wide, with a very rapid current. Before it makes its easterly bend the ash-leaved maple shows itself in groves, and on both sides is an open undulating country, attractive and fertile, with detached clumps of young trees springing up in all directions. The region unwatered by the Rapid River continues beautiful and rich until within twenty-five miles of the Assiniboine, so that it may with propriety be stated, that for a distance of seventy-five miles this river meanders through a country admirably adapted for settlement. Ponds and lakes are numerous, wild fowl in great numbers breed on their borders, and the waters of the Rapid River abound in fish. Canoes and bateaux may descend it from the point where the Exploration terminated to its mouth, a distance of one hundred miles. It will probably become important as a means of conveying to the settlements on the Assiniboine and Red River supplies of lumber from its valley and the Riding Mountain.<sup>5</sup>

Before the study of the Basin's development may be accomplished, it is first necessary to establish clearly the definitions and conceptual framework used in the analysis. This is the task of Chapter II, "Defining Environment, Resources, Development and Quality". Chapter III, "A Conceptual Framework for Water Development", presents the conceptual framework and briefly illustrates its application to water development.

The study of the Assiniboine River's development is undertaken in Chapter IV. This chapter serves not only to give an understanding of development of the Assiniboine River but also to illustrate the relevance of the conceptual framework. In Chapter V the future development of the river is studied within the conceptual framework. The material to be studied is taken from the P.F.R.A. Report No. 12 on water supply and water use in the Assiniboine and Qu'Appelle Basins.<sup>6</sup> Chapter VI is a summary discussion and a presentation of the conclusions of the thesis.

## CHAPTER I

## FOOTNOTES

1. Appendix I presents a description of the evolution and present status of decision criteria in water development planning.
2. Figure 1, page .
3. Henry Youle Hind, Reports of Progress on the Assiniboine and Saskatchewan Exploring Expedition (Toronto: John Lowell, 1859).
4. Ibid, p. 30.
5. Ibid, p. 31.
6. P.F.R.A., Hydrology Division, Water Supply and Water Use in the Assiniboine and Qu'Appelle Basins (Regina, Saskatchewan: Prairie Provinces Water Board, May 1966).

## CHAPTER II

## DEFINING ENVIRONMENT, RESOURCES, DEVELOPMENT, AND QUALITY

The field of water development involves professional people from so many fields that many words in the jargon of water development have come to have multiple and often vague meanings. The terms dealt with in this chapter are especially prone to this difficulty. In order to enable the use of these words so that their meanings are unambiguous, it is necessary to stipulate their precise definitions. Thus, the proposed definitions are not meant in any way to be authoritative, but are meant to be the functional definitions for the purpose of the thesis.

What, then, is to be meant by the word 'environment'? For the purpose of this thesis, it will have a functional definition in order to avoid the concept of the environment of something as being everything around it. Thus, the environment of an object or process is the sum of all things which it affects appreciably, or which have an appreciable effect on it. It has been said that if you throw a single stone into the sea you change the course of history. This vague extrapolation of the meaning of the word 'environment' is not relevant to the purpose of this thesis. For example, part of the environment of the Shellmouth Dam is the reach of the Assiniboine River below the dam, for it has an appreciable effect on the flows. On the other hand, the word's hydrologic cycle is not a functional part of the environment of the dam, as it will not have an appreciable effect on it. Further, it is asserted that the environment of an object or process has three conceptual dimensions, the natural environment, the cultural environment, and the social environment.

The natural environment consists of three further dimensions, the biotic, physical, and chemical environments. The biotic environment of water development is seen as the ecological communities dependent on the occurrence of water in lakes and streams. The physical environment of water development is seen to be manifest in the foundation conditions of a dam, the topography of a reservoir area, and the distribution of flow in rivers. The aspect of the chemical environment relevant in almost all water development is the chemical analysis of water itself.

The cultural environment consists of the values, attitudes and technology of society. Although the technology available to the engineer in water development is easily defined, the relevant values of society are much more difficult to ascertain. Nevertheless, they are often critically important in determining the success or failure of a project. For example, if farmers, in spite of the advantages of irrigation, refuse to invest time and money in changing from wheat to vegetable production, an irrigation scheme will be a failure.

The dimensions of the social environment most relevant to water development are the economic and political institutions. The political institution is, in fact, the vehicle which theoretically expresses the values of our society and is thus the main source of initiative in water development. Economics, on the other hand, is the restrictive force in water development. The economic benefit of a project determines to a great extent whether it will be constructed or not.

The environment of water development is thus seen to be an extremely complex phenomenon. To understand it is to realize that, even though it may be conceptually divisible, it is in reality indivisible by virtue of its intricate interdependencies.

Water resources are defined as those parts of hydrologic cycle which function to fulfil human wants. If it is not functioning to fulfil these wants, it is not a resource although it may be a potential resource. Thus it is seen that an understanding of human wants is necessary in order to grasp the nature of a resource. Human wants may be conceptually presented as being composed of physical needs, psychological needs, and cultural wants. For example, man needs water to exist. That is a physical need. Within our society a high value is placed on soft, tasteless, and odorless water. That is a cultural want.<sup>1</sup> Finally, the increasing use of lakes and rivers for recreation by the urbanites of North America is an example of how water is a resource by virtue of its fulfilling a psychological need. It is imperative to keep in mind the characteristics of the need or want being fulfilled by a water resource for these characteristics establish the manner in which the resource is developed.

In order to establish the meaning of the word 'development' it is first necessary to define two more fundamental terms. A 'resource event' is defined as a unique or unusual happening, with the property of space-time coincidence, involving the application of a technology to the natural environment. A resource event which recurs in time and which involves somewhat the same combination of technology and the natural environment is defined as a 'resource process'. The sum of all resource events and resource processes is referred to as resource phenomena.<sup>2</sup> The use of loose gravel as the only fill in a dam is an example of a resource event. In effect the technology applied to the natural environment to ensure more control over the flow in a river will be a



failure because the dam will be unable to hold water. Thus, assuming that the knowledge of this resource event is general, it will not recur. On the other hand the use of compacted clay core with boulders for surface protection was discovered at some point in time. Because the dam was effective this technology has been applied again and again in similar natural environments. Thus this particular practice is defined as a resource process.

Water resources are now seen to be the result of the elemental units of resource processes which transform the natural flow or natural occurrence of water in such a way as to fulfil human wants and needs. A stream or river becomes a natural resource when some technology, whether a pail or pump, removes it from the river and makes it available for human use. Finally, the development of water as a resource is defined as the continued application of resource processes and the natural environment to mobilize the natural flow or natural occurrence of water to fulfil human wants and needs.

The final question is, what is the meaning of the word 'quality' within the context of water development? The most important point in understanding the use of this word is that it is always the quality of something for something. Thus, water has qualities as related to irrigation and the environment has qualities as related to supporting human life, but it is meaningless merely to talk about the quality of the water or the environment. It is an advantage to the decision process of water development to be able to quantify the qualities of the water for the uses being considered. This quantifying is possible in such uses as irrigation and water supply, for the qualities of concern are

chemical and physical. However, in the case of water development for recreation the aesthetic qualities of the water and the surroundings become of equal importance with the chemical and physical qualities of the water. By definition, an aesthetic value is the result of objectivization of an emotional response to one's surroundings, fundamentally on the basis of sight and sound, but also on the grounds of smell, touch, taste, and religious and historical significance.<sup>3</sup> From this definition it is seen that any attempt to quantify aesthetic quality must only follow a careful study of the values of the people concerned.

In conclusion, quality is a word which describes the relative degree of excellence of an object for a specific purpose. In most cases the qualities of water and landscape of interest in water development are quantified with relative ease. However, in the case of the aesthetic qualities of water and landscape, the task is extremely complex and difficult.

The following table is presented for easy reference as a summary of the definitions developed in this chapter.

## TABLE I

## DEFINITIONS

The ENVIRONMENT of an object or process is the sum of all things which it affects appreciably or which have an appreciable effect on it.

WATER RESOURCES are those parts of the hydrologic cycle which function to fulfil human wants and needs.

A RESOURCE EVENT is defined as a unique or unusual happening, with the property of space-time coincidence, involving the application of a technology to the natural environment.

A RESOURCE PROCESS is a resource event which recurs in time and which involves somewhat the same combination of technology and the natural environment.

DEVELOPMENT of water as a resource is defined as the continued application of resource processes to the natural environment to mobilize the natural flow or natural occurrence of water to fulfil human wants and needs.

QUALITY is a word which describes the relative degree of excellence of an object for a specific purpose.

TABLE II

## DIMENSIONS OF THE ENVIRONMENT

NATURAL	BIOTIC PHYSICAL CHEMICAL
CULTURAL	VALUES TECHNOLOGY
SOCIAL	ECONOMIC POLITICAL