

INITIAL CANADIAN PROGRAMME
FOR THE
INTERNATIONAL HYDROLOGIC DECADE

Co-ordinated by
CANADIAN NATIONAL COMMITTEE FOR
THE INTERNATIONAL HYDROLOGIC DECADE

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Ottawa, Canada

December 1964

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FOREWORD

The initial Hydrologic Decade programme for Canada has been formulated to the objectives defined in UNESCO Document NS/188. The programme, although focussing on science, gives strong consideration to utilitarian factors.

In Canada the administration and control of water resources within provincial boundaries are the responsibility of the provincial authorities, except in certain specific matters over which the Federal Parliament has over-riding control. The formation of the Canadian National Committee for the International Hydrologic Decade has recognized these constitutional factors which have also played a part in the formulation of the Canadian Programme. Several federal agencies and a few provincial agencies operate basic data collection services. Many of the agencies, both federal and provincial, carry out research as do several of the universities.

The Canadian National Committee with advice from the National Research Council's Subcommittee on Hydrology, has co-ordinated the Decade projects proposed by these various agencies, and the programme of activities presented herein are those for which personnel and financial support are available or are being sought. This programme does not represent the full scope of interest of Canadian hydrologists. It is expected that the programme will expand once the Decade is in progress. The project descriptions are intentionally brief for this report but can be expanded if required. Further information may be obtained from the Secretariat, Canadian National Committee for the International Hydrologic Decade, 150 Wellington Street, Ottawa, Canada.

The programme of activities is presented in accordance with the classification suggested by the Director General of UNESCO in his letter to member States on June 17, 1964.

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A. COLLECTION OF BASIC DATA

(1) Meteorological and surface water data

Nation-wide meteorological and hydrometric networks for the collection of standard-type data are already in existence and are being expanded as rapidly as resources will permit. The expansion of these networks will not be designated as Decade projects.

(2) Groundwater

There is no nation-wide data collection network for groundwater although several provinces maintain partial networks. Projects designed to fill the gaps in the basic groundwater data networks are:

- (a) A publication to be released early in 1965 entitled Groundwater in Canada, assessing the present knowledge of Canada's groundwater resources and including a compilation of maps.
- (b) Expansion of existing observation well networks to provide data on groundwater fluctuations in all parts of Canada; development of construction and recording methods under different climatic conditions and in remote areas; test pumping at selected wells.
- (c) A study of the movement of groundwater by tritium dating and, in conjunction with chemical studies, to follow the stages of mineralization as water passes from one subsoil strata to another.

(3) Water Quality

Few basic data on water quality in Canada have been collected in the past. It is proposed, through co-operation of federal and provincial agencies, to establish a water quality network for both surface and groundwaters.

(4) Lakes

- (a) The determination of the area of Canada occupied by fresh water lakes as a basic step to completing an inventory of the nation's fresh water resources.
- (b) Systematic sounding of lakes and reservoirs in Alberta at 5-year intervals to determine the rate of reservoir filling and, indirectly, the sediment load of inflowing streams.
- (c) To establish, through periodic survey of each of the Great Lakes, the nature of the seasonal and year-to-year variations in the physical and chemical quality of the lake environment; biological parameters will also be sampled in these surveys with the object of correlating biological changes with changes in the environment. This project to be carried out in co-operation with United States agencies.
- (d) Surface temperatures and ice formation on northern lakes. By means of aircraft flights with an air-borne radiation thermometer, surface water temperature and ice conditions on a number of northern Canadian lakes will be evaluated to aid in estimating evaporation, heat fluxes and water volumes in the lakes.

(5) Soil Moisture

It is proposed that the moisture content of several soil types throughout southern Ontario be measured regularly by a standardized method, with the objective of publishing reliable statistics on soil moisture useful for other research projects and for practical application; sites to be selected on important soil types having regard to availability of associated hydrometeorologic measurements in the area; the neutron scattering technique will be used.

B. INVENTORIES AND WATER BALANCES

(1) Representative basins

Representative basins can be used to study many aspects of the hydrologic cycle, such as: the relative magnitude of the components of the cycle in various climatic and geologic regions in Canada to complement similar studies on a global basis; the effects of various ground covers; and the influences of man on quality and quantity of water.

These basins will be moderately instrumented to measure meteorological factors, surface runoff, groundwater flow and water quality. It is proposed to establish representative basins in the following regions:

- (i) Western Cordillera; regions to be represented: coastal lowlands, interior plateau and mountain zone (to include a small glacier).
- (ii) Great Plains; regions to be represented: western prairies, internal drainage, tree covered prairie basin.
- (iii) Lake Erie - Lake Ontario drainage; flat watersheds.
- (iv) Precambrian area; drainage basin underlain by crystalline rocks.
- (v) St. Lawrence Lowlands.
- (vi) Atlantic coast drainage.
- (vii) The Labrador-Ungava area.
- (viii) Baffin Island; two small basins containing a glacier.

(2) Experimental basins

Experimental basins will be studied to determine the effects of man-made changes on the water balance of natural basins. These will be small watersheds and will be fairly intensely instrumented to determine in detail the natural hydrologic balance and the changes in surface and groundwater runoff as a result of vegetative manipulation, urbanization and irrigation practices. The following experimental basins are proposed as IHD projects:

(a) East Slopes (Alberta) Watershed Research Programme.

To calibrate experimental watersheds in areas of sub-alpine spruce fir forest, montane aspen forest and overdense sapling lodgepole pine forest. Following calibration, cover manipulation aimed at improving water yield and/or regime is planned. This involves the setting up of meteorological, surface and groundwater instrumentation on the designated basins; specific hydrologic studies on a plot scale leading to prescription of treatment experiments are planned.

(b) Snake Indian Watershed Research.

Forestry watershed research is being carried out by the Alberta Department of Lands and Forests at the Forestry School at Hinton, Alberta, to determine the effect on precipitation - runoff characteristics resulting from systematic harvesting of timber stands.

(c) Irrigated rural basin.

The objective is to determine the water balance and the salt balance of a drainage basin before and after it has been converted to irrigation. A small watershed that is to be irrigated from the South Saskatchewan Reservoir will be selected as soon as possible and calibrated before irrigation commences. The changes in the hydrologic cycle and the salt balance due to irrigation will be determined over a long period of time.

(d) Irrigated urban basin.

The objective is to determine the water balance, groundwater level changes, and salt content changes of a basin taken over for urban development on the Canadian prairies. The effects, consequences, and engineering solutions required when prairie is converted into an urban area subject to intensive lawn irrigation will be investigated.

(e) Wilson Creek Experimental Watershed.

The objective is to determine the relationship between precipitation and runoff from a typical watershed on the Manitoba Escarpment and to determine the feasibility and effectiveness of various means, both vegetative and structural, of reducing flood runoff and erosion.

(f) Effect of urbanization on the hydrology of a watershed.

It is proposed to select and calibrate a natural watershed at Guelph, Ontario, and then study the changes in hydrology as urbanization takes place in the watershed.

(g) Montmorency - Laval Forest Experimental Watershed (Quebec).

Study of phyto-climate in forest stands, evapotranspiration and forest management and the water balance in forests.

- (h) University of British Columbia Research Forest Experimental Watershed.

The relations between precipitation and runoff and between soil moisture regime and streamflow will be investigated. Also the effect of logging and logging-slash burning on erosion.

- (i) The effect of tree farm license forestry operations on water yields.

Hydrologic studies will be made on a managed forest property. Plans will be prepared for water resource management on representative forest and soil types in the montane and sub-alpine forest regions of southern British Columbia. Objectives are to investigate the potential effect on water yields of intensive forest management in this region of significant water demand.

C. RESEARCH

(1) The air-land interface

- (a) Evapotranspiration from vegetated areas and snow surfaces.

Studies are being carried out on the usefulness and validity of the energy-balance, aerodynamic, eddy-correlation and lysimetric methods for determination of evapotranspiration from typical land surfaces in Southern Ontario. A further objective is to determine the inter-relationships between soil and plant characteristics and evapotranspiration.

- (b) Frequency of occurrence of evaporation extremes for different periods of time in the Prairies.

To map the prairie provinces (Alberta, Saskatchewan and Manitoba) as to the probability of occurrence of various extreme evaporation amounts. Penman's equation for estimating evaporation from climatic data will be used. The evaporation amounts thus obtained will be fitted to extreme value distributions.

- (c) Transient pressure and water content distributions in soil-water flow systems with time-dependent boundary conditions.

To investigate experimentally, and describe analytically, transient water flow in soil-water systems containing both saturated and unsaturated flow regions with emphasis on one dimensional flow in a gravitational force field.

(d) Soil moisture-forest relations.

Soil moisture and tree growth are measured on irrigated and unirrigated plots with different degrees of cover, to determine soil moisture deficits and the effect on growth.

(e) Investigation of the infiltration capacities of frozen soils.

To evaluate the infiltration capacities of soils under field and simulated snowmelt conditions. Specific attention is to be given to role of the infiltration processes in runoff from snow-melt and to evaluate infiltration rates in terms of measurable soil and climatic parameters.

(f) Soil moisture migration under conditions of freezing and thawing.

To study quantitatively the movement under temperature and tension gradients which occur during soil freezing for varying soil moisture conditions and locations of water table. Also to determine whether the upward movement of water during freezing and the subsequent release cause any net change in the location of salinity concentrations within the profile.

(g) Winter runoff from cultivated land.

Intensive measurement of surface runoff, snow, soil moisture and transient subsurface flow phenomena will be carried out on 20-acre watersheds in southern Ontario. The thermal regime will be studied simultaneously to gain a better understanding of hydrologic processes.

(h) Hydraulics of water movement over a porous bed.

To investigate the fundamentals of flow of water over a porous bed and to apply the results to the design of surface irrigation systems. The work will include studies of the hydraulics of overland flow and infiltration processes.

(i) Determinations of past water temperatures and salinities by means of animal and plant remains.

Studies of ostracod shells in sediments of fresh water bodies show that water temperature and salinity are among the main factors determining the abundance and kind of ostracods present. Conversely, the presence of certain ostracods is indicative of certain conditions which may differ from those of today. Similar studies can be undertaken with plant remains, principally diatoms.

(j) Microclimatological change using a digital computer.

To investigate the variation in humidity profile produced by inland, artificial water bodies in the presence of normal variations in meteorological parameters.

- (k) Evaluation of the representativeness of the hydrometeorological network in New Brunswick with recommendations for optimization.

- (l) Evaluation of effects of large-scale reservoir and irrigation projects on climate and water balance of region.

To study the degree and the distance from the project to which a newly formed reservoir and irrigation area affects the local climate and hydrologic cycle.

- (m) Evaporation from lakes and reservoirs on the Canadian prairies.

The use of new data and new techniques to up-date a previous study. Significant changes in analyses will include the use of an improved relationship between air temperature and water temperature, an improved understanding of the heat storage effect in deep lakes, and an improvement in the coefficients used in various evaporation formulae.

- (n) Consumptive use.

Studies to determine the consumptive use and seasonal requirements of water for various crops grown under varying soil and climatic conditions.

- (o) Influence of field shelterbelts.

To compare wind velocities and evapotranspiration from wheat between sheltered and non-sheltered areas during the growing season.

- (p) Effect of advection on evapotranspiration in a semi-arid region.

To determine the extent of advective heat transfer into an irrigated field surrounded by dryland and its effect on temperature, humidity, evaporation and evapotranspiration at different distances from the edge of the field.

- (q) Areal evaporation - precipitation studies.

To measure and record the daily latent evaporation of the atmosphere at different locations in the Peace River region with a view to determining areal differences in "evaporation" climate.

- (r) Evaporation and transpiration from crop, soil and snow surfaces.

To determine the evaporation and transpiration by measuring the disposition of energy at the surface, and to test the applicability of methods of estimating evapotranspiration in a semi-arid climate.

- (s) The influence of drought periods on crops.

To study the effect of drought periods on growth and quality of irrigated crops and the respiration of plant tissues subjected to drought periods.

- (t) Water requirements of crops and weeds in southwestern Saskatchewan.

To evaluate the water use efficiency of different cereal and forage crops and of annual and perennial weeds at various stages of growth.

- (u) Evaporation from soils with a high water table and its influence on soil salinity.

To determine evaporation rate from bare soil with shallow water table and its relation to atmospheric factors.

- (v) Utilization of soil moisture by crops.

To study the factors affecting the use of soil moisture by crops in different rotations: to determine the yield and evapotranspiration ratio of wheat with additional supplies of moisture: and to determine whether stubble on the surface being summerfallowed increases the conservation of moisture and affects crop yield the following year.

- (w) Development and application of physical theory in soil moisture movement.

To combine diffusion theory and field observation in explaining phenomena and solving problems related to moisture movement in unsaturated soils.

- (x) Measurement of capillary conductivity and diffusion coefficients.

To compare different methods of determining capillary conductivity and diffusion coefficients and, if necessary, to develop new procedures which will yield data of sufficient accuracy.

(y) Seasonal soil moisture pattern.

To study the seasonal moisture extraction pattern and irrigation requirements of a soil supporting a grass crop.

(z) Moisture conservation and erodibility of a two-year rotation of flax-fallow.

To determine whether satisfactory yields can be maintained and wind erosion prevented using a two-year rotation of flax-fallow.

(aa) Moisture conservation and utilization with particular emphasis on winter precipitation.

To evaluate methods of snow retention as a means of building moisture reserves for improved crop production.

(bb) The effect of soil volume and water content on water uptake and root development.

To determine the effects of varying the soil volume and moisture content on roots and top growth, transpiration and wilting of plants.

(cc) Evapotranspiration from row crops.

To quantitatively evaluate the effects of soil moisture stress, foliage density and drying capacity of the atmosphere on the rate of evapotranspiration from row crops.

(dd) Scheduling of irrigation by the budget method.

To establish suitable procedures that farmers can use to determine when to irrigate and how much water to apply.

(ee) The irrigation requirements of lawns.

To determine the irrigation requirements of three common lawn grasses on two different soil types and to evaluate the usefulness of a soil moisture budget as a guide to the irrigation of lawns.

(2) Surface runoff

(a) Drainage area fluctuations on the Canadian prairies.

To study the proportion of the watershed contributing to runoff and the factors affecting the contributory area.

- (b) Assessment of surface runoff in Southern Ontario, by means of synoptic measurements of surface water runoff in streams for which flow data are not available or are inadequate.

- (c) Effect of aquatic growth on discharge capacity.

Intensive examination of seasonal aquatic growth in rivers, canals and tunnels of the Niagara Project and determination of effect on discharge capacity.

- (d) Base flow recession.

Statistical analysis of low flows and study of base flow recession curves. Transposition of results to basins with similar geologic characteristics.

- (e) Flood studies of the Fraser River System.

To synthesize past floods for meteorological data and snow data and hence to determine the necessary conditions for a flood. The procedures developed would be used to study maximum flood potentials under various adverse combinations of conditions.

- (f) Simulation of the hydrologic cycle.

To investigate the feasibility of simulating the hydrologic processes of precipitation, interception, evaporation, infiltration and the hydraulic processes of surface, channel and groundwater flow. The study will include an appraisal of the use of hydraulic models, electrical analogs and mathematical models or computer simulation to describe the water balance on a watershed. Special emphasis will be placed on prairie watersheds.

- (g) Prairie sloughs and potholes.

To determine the water balance of sloughs and potholes and to develop methods of predicting availability of water from past meteorological records.

- (h) Variability in time and space of hydrometeorological variables.

Study of the frequency of dry and wet periods as well as their territorial fluctuation and synchronization.

- (i) Regional characteristics of recession curves.

The analysis of recession curve characteristics on a regional basis to see if this tool can be used in studying streams where no hydrometric records have been obtained.

- (j) The magnitude and frequency of floods in Alberta, Saskatchewan and Manitoba.

The use of improved techniques and current data to up-date a previous report.

(3) Groundwater

- (a) Development of reconnaissance methods of hydrogeology in semi-arid areas of Saskatchewan and Manitoba.

By hydrogeological studies within the Assiniboine drainage basin to develop methods whereby the hydrogeology of large semi-arid areas can be assessed rapidly, accurately and at minimum cost.

- (b) Geochemistry of groundwater in Red River basin, Manitoba.

To study chemistry of groundwater, its changes and reasons for changes and relate these to groundwater flow systems.

- (c) The influence of compaction on groundwater movement.

Theoretical and field study of influence of compaction on storage coefficient, on apparently leaky aquifers, and on groundwater flow patterns.

- (d) Changes in groundwater chemistry in the Bullpound Creek basin, Alberta.

Analysis of the movement of groundwater in the basin, chemical analysis of groundwater samples and mapping of major ions; chemical analysis of rock-types in the basin to determine the influence on groundwater composition.

- (e) Groundwater in bedrock underlying the Great Plains region.

To develop means of studying groundwater flow systems in bedrock. Particularly to determine recharge and discharge areas and quantitative and chemical characteristics.

- (f) Miscible displacement processes in soils.

To study the behaviour of a two-fluid flow system in a permeable medium so that such phenomena as salt-water intrusion, movement of salts in irrigation water, and fertilizer and pesticide movement may be better understood.

- (g) Saltwater-freshwater interface studies - Prince Edward Island, New Brunswick and Nova Scotia.

To conduct studies leading to an understanding of the relations of fresh groundwater to salt groundwater in humid coastal areas.

- (h) Aquifer computer and analog techniques.

Evaluation of the use of computer and analog techniques in determining aquifer characteristics.

- (i) Remote airborne techniques.

To investigate the applicability of various remote airborne sensing techniques to the study of groundwater.

- (j) Investigation and evaluation of geophysical methods.

The following seven projects will be undertaken by various agencies in several areas of Canada:

- (i) Development of seismic methods applicable in steep, narrow valleys, British Columbia.
- (ii) Evaluation of the utility of seismic, resistivity, gravity and other geophysical methods in groundwater exploration.
- (iii) A study of possible applications of geophysical methods, with emphasis on electrical surface and subsurface techniques, to aid in prospecting for and delimiting aquifers in Southern Saskatchewan.
- (iv) To develop improved techniques and methods of interpretation for seismic and resistivity methods applicable to surficial materials.
- (v) Geophysical studies to aid in aquifer location in Nova Scotia.
- (vi) To evaluate the airborne resistivity (pulsed electromagnetic) method as a rapid reconnaissance method of mapping the electrical properties of near-surface material as an aid in differentiating areas of groundwater recharge and discharge.
- (vii) Use of induced polarization methods to delineate aquifers and aquicludes.

(4) Lakes

(a) Hydrodynamic studies of the Great Lakes.

To carry out fundamental research into the nature of mixing processes within the lake, surface and internal wave phenomena, and properties of the air-water interface.

(b) Thermal regime of large lakes.

To establish the seasonal variation in the terms which contribute significantly to the heat budget of the lake. To determine those characteristics of temperature and circulation in the lake which establish the unique response of such a large lake to given meteorological conditions, the response being given in terms of surface temperature and temperature structure within the lake.

(c) A study of evaporation from the Great Lakes by the energy budget technique.

A study of the changes in the heat content of the Great Lakes leads to an estimate of evaporation. These results will be compared with those given by mass transfer techniques.

(d) A study of ice formation using energy budget techniques.

A study of ice formation is planned for the conditions where the underlying water has measurable exchange with open water. The object will be to establish the rates of ice formation and attrition as functions of the impressed meteorological conditions and the intrusion of warmer lake waters.

(e) Annual chemical energy budget of Marion Lake, British Columbia, associated with introduction, generation and deposition of organic matter.

To measure seasonal changes in rate of influx, generation and deposition of the organic sediment and its calorific value; quantitative measure of losses through breakdown by micro-organisms and invertebrates. Comparison of settling rates in the lake from accumulation rates in bottom sediment. History of accumulation of organic material based on pollen analysis of core samples of bottom sediment.

(f) Thermo-structure of prairie reservoirs.

The analysis of data on thermo-structure obtained on selected lakes and reservoirs in relation to operational problems.

(5) Geomorphology

- (a) A study of aggradation and degradation below a large reservoir.

To study changes in the regime of the South Saskatchewan River between the dam and Saskatoon as a result of the South Saskatchewan Reservoir and its operation, and to gather data that will be useful for purposes of planning, development and operation.

- (b) Delta formation and sedimentation in and upstream from the South Saskatchewan Reservoir.

To study the formation of the delta and the progress of sedimentation in and upstream from the South Saskatchewan Reservoir as a result of that reservoir and its operation.

- (c) The effect of varying discharge on bed forms, roughness and sediment transport.

To determine whether there is a formative constant discharge which can be used to give the same average bed formations, roughness and sediment transport which result from varying discharges and to determine its magnitude in terms of the varying discharge parameters. This would be of value in determining the formative discharge for a river.

- (d) Regime studies of gravel bed rivers.

Systematic survey and classification of stream channels and the use of these data in formulation or refinement of practical theories of stream behaviour.

- (e) Regime study of lower Red Deer River, Alberta.

Study of regime with consideration of hydrology, morphology, hydraulic geometry, channel patterns, erosion and deposition, and channel self-adjustment.

- (f) Clogging of porous media.

Theoretical and experimental studies of the natural clogging of porous media which filter the solid particles suspended in rivers.

(6) Snow, ice and glaciers

- (a) Time distribution of snowmelt in the Tobique River basin in relation to sequential streamflow.

To study the hydro-thermodynamic momentum associated with the time distribution of snowmelt and the role of ground flows.

- (b) Snowmelt and sequential streamflow in the Tobique River basin.

To correlate snowmelt and spring-season streamflow. New techniques are being evolved for day-to-day streamflow forecasts on a semi-empirical model. The present analysis is to be tested for applicability to larger basins with modifications of the techniques.

- (c) Evaluation of weather satellite data for hydrologic purposes.

Use of Automatic Picture Transmission System photographs to study possibilities for operational determination of snow and ice cover for hydrologic forecasting.

- (d) Analysis of trend of regional snow line from the British Columbia coast to the eastern Rocky Mountains.

The water yield of a glacier is related to its regime which is in turn related to the height of the regional snow line in relation to altitude of ice mass. The objective is to determine these relationships.

- (e) Magnitude and frequency of prairie snow-pack accumulation.

The use of snow-budget techniques to determine, on a frequency basis, the amount of snow-pack water available in the spring immediately prior to break-up.

- (f) Study of river and lake ice.

Study of formation, movement and dissipation of ice on rivers (St. Lawrence and Niagara) and on lakes (Erie) with special reference to controls.

- (g) Evaluation of streamflow determinations under ice cover.

To develop by field programs of discharge measurements, procedures for determining the necessary frequency and time spacing of flow measurements to obtain the required accuracy for final flow figures during winter months.

- (h) Heat exchange on open water surface in rivers in winter.

Theoretical and experimental study to obtain an engineering formula more rational than existing empirical ones and usable on a day-to-day basis to determine the heat balance on a stretch of open water in a river in winter.

- (i) Analysis of floods during spring breakup.

Verification of a proposed theory to establish the maximum possible level of floods caused by ice jams at spring breakup times.

- (j) Characteristics of frazil ice deposits.

Experimental study to determine the porosity of frazil ice deposits and factors affecting it.

- (k) Inventory of Canadian glaciers.

To provide a complete inventory of Canadian glaciers as the locus of the greater proportions of fresh water resources. Analysis of trends of fluctuations as affecting water yield.

- (l) Variations of glaciers in Canada.

Program for recording the variation of existing glaciers in Canada, in accordance with the proposals of the Snow and Ice Commission, IASH.

(7) The influence of man's activities on the hydrologic cycle

- (a) The hydrology of tile-drained areas.

To determine the relationship between rainfall, soil moisture and the drainage rate, and the effect of lateral tile drain spacing on this relationship. To determine the effect of subsurface drainage on groundwater recharge.

- (b) A study of unsteady flow in a shallow river channel.

To determine the hydraulic characteristics of and changes to releases from the South Saskatchewan reservoir at downstream points under open water conditions; and to evaluate the effect of these changes on reservoir operation.

- (c) The effect of variable releases from a large reservoir in winter on ice formation, breakup and jamming.

To determine the hydraulic characteristics of releases under winter conditions; to study the relation of winter releases with ice formation, breakup, jamming and climatological factors; and to evaluate the effect of these conditions on reservoir operation.

- (d) Effects on thermal regime of Winnipeg Aquifer resulting from warm water return flows.

Preliminary studies undertaken recently indicate that waste water from air conditioning and cooling systems that is being returned to the aquifer is resulting in increased water temperatures. The mechanism of such effects on the thermal regime of an aquifer will be investigated.

- (e) Controlled water table studies.

To study the effect of various fixed water tables on crop yields, root developments and salt movement in the soil.

- (f) Environmental changes in irrigated soils of Southern Saskatchewan.

To study the effects of current irrigation practices on the continued productivity of irrigated soils with specific emphasis on the salt and alkali content at several irrigation projects in Southern Saskatchewan.

- (g) Tile drainage of an irrigated glacial till soil in Southern Alberta.

To determine the effectiveness of tile drains in removing excess water from soils developed on shallow glacial till in the irrigated areas of Southern Alberta.

- (h) Bog land drainage investigations.

To investigate various means of draining bog lands and their effect on soil subsidence and water level gradients.

- (i) Reclamation of a saline soil by leaching and deep well pumping.

To assess soil physical and chemical changes which occur under relatively frequent applications of groundwater on a fine-textured soil in conjunction with deep well pumping.

- (j) Soil salinity control in evergreen transplant plots with shallow tile drainage.

To evaluate effectiveness of shallow tile drainage, and the influence and economic value of several soil amendments and cultural practices.

- (k) Methods of reclaiming deteriorated irrigated lands.

To delineate the degree and extent of the salinity and drainage problem; to determine the factors contributing to development of these problems; to recommend measures to effectively control and reclaim areas that have deteriorated.

- (l) A salinity study of the irrigated soil of Magrath and Raymond District, Alberta.

To determine the effect of leaching on the chemical properties of saline soils with and without chemical soil conditioners and to compare the productivity of reclaimed soils with non-saline soils of the same areas.

- (m) Drainage and salinity investigations.

To determine groundwater conditions on saline soils and the hydrologic properties of the soil materials for determining reclamation requirements.

(8) Instrument development

- (a) Development of long period recording instruments for humidity evaporation and soil percolation.

To develop meteorological instruments capable of being installed at infrequently attended locations.

- (b) Inexpensive instrumentation and calculation procedures to determine evaporation from small bodies of water.

To develop inexpensive instrumentation to measure evaporation parameters in a manner suitable for computer calculation of evaporation losses.

- (c) Optical device for measuring turbidity.

Development of optical apparatus to measure the concentration of solid particles suspended in rivers.

APPENDIX I

MEMBERS OF THE CANADIAN NATIONAL COMMITTEE
INTERNATIONAL HYDROLOGIC DECADE

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APPENDIX II

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