SECOND ANNUAL REPORT
1964

East Slopes (Alberta) Watershed Research Program

Prepared by the Technical Coordinating Committee
W. R. Hanson, Chairman
CO-OPERATING AGENCIES

The co-operating agencies, the name of their respective representatives to the Technical Coordinating Committee and their addresses, are listed below:

Eastern Rockies Forest Conservation Board

<table>
<thead>
<tr>
<th>Agency</th>
<th>Representative</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest Research Lab.</td>
<td>M. H. Drinkwater</td>
<td>721 Public Bldg.</td>
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<tr>
<td>Dept. of Forestry</td>
<td></td>
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<td>D. H. Smith</td>
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<td>Water Resources Br.</td>
<td>R. D. May</td>
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GOVERNMENT OF ALBERTA

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<tr>
<td>Water Resources Br.</td>
<td>A. G. Underhill</td>
<td>118-11 Ave. S.E.</td>
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<td>Research Council of Alberta</td>
<td>R. Green</td>
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</table>

RESEARCH CO-ORDINATOR

W. W. Jeffrey, Forest Research Laboratory, 721 Public Building, Calgary, Alberta

*Mr. Durrant is now with the Water Resources Branch, Dept. of Northern Affairs and National Resource.
INTRODUCTION

In this second annual report we look back upon the beginning of the East Slopes (Alberta) Watershed Research Program with some satisfaction and much anticipation of the future. The framework necessary for a co-operative program has been strengthened, useful procedures have been established and the actual research work is well under way.

Because of the broad and varied aspects of watershed research many disciplines of science must be involved; therefore, trained personnel from several branches of government were called to serve in this multi-agency, co-operative organization. Rather than suffering from disunity, the program has benefited by the special skills and knowledge and interchange of ideas between men from many fields — foresters, engineers, geologists, plant ecologists, meteorologists, range management specialists, wildlife biologists and soil scientists. Coordination on the job has been attained through working groups meeting with the Research Coordinator.

One agency has been added to the Technical Co-coordinating Committee, that is, the National Parks Service. This is a step forward as they administer a large portion of the headwaters of the Saskatchewan River. The Canadian Wildlife Service of the same department has now entered actively into the watershed research program. Besides the agencies listed on the frontispiece, others, such as departments of the University of Alberta and the Industrial Waters Section of the Department of Mines and Technical Surveys, are assisting the program by carrying out projects.

Although there are advantages to having men of different disciplines working on the projects it is important that they have a bent for watershed management and an understanding of its aims and objectives. Progress has been made in this direction. Two agencies have assisted researchers to take post-graduate studies in or related to watershed management and others have familiarized themselves with pertinent literature.

The program is still too young to have important results to present. The report which follows will outline progress in instrumenting the research basins, making initial assessment, developing data gathering networks, and inaugurating and continuing plot studies. Some interesting information which indicates certain hydrologic patterns is presented.

THE WATERSHED RESEARCH PROGRAM

MARMOT CREEK BASIN

The Marmot Creek Basin Project, the first of three basin projects, was set up with three research objectives: (1) To determine the hydrology, particularly relating to precipitation, runoff, and ground water, and their inter-relationships, (2) To determine the effects of timber harvest upon water yield and flow regime, and (3) To develop methods of manipulating high elevation, spruce-fir forest for purposes of protecting or improving watershed values.

The plan to attain the objective includes the establishment of hydrometric and climatological networks to learn the water budget and calibrate the basin, to carry on plot and reconnaissance studies, and finally to test watershed improvement methods experimentally. Climatological and hydrometric instrumentation was virtually complete at the close of the 1964 season. Some major work remained to be done in establishing ground water wells and piezometers.

STREAM GAGING

By the end of the 1964 season the three branches (Twin, Middle and Cabin), and the main stem, were metered by recording stream gauges equipped for winter use heating devices. Insulated hoods with heat lamps kept the V-notches free of ice and a propane heater was installed in the H-flume on Cabin Creek.
During June of 1964 heavy rains on melting snow gave all gauging stations a severe test. The peak discharge occurred around noon on June 8 with 21 cfs per square mile from the basin above the main stem gauge. All controls were on the verge of overtopping but fortunately the discharge did not exceed the designed capacity.

The stilling basin on Middle Fork, where a culvert had been installed upstream and then removed, accumulated debris, including large hostlers. Deposition also occurred in the H-flume on Cabin Creek. No major debris collected at the other two gauges. The stilling basin on Middle Fork required cleaning out. A baffle was constructed in the H-flume on Cabin Creek to reduce the deposition there. Sediment samples taken at the main station below showed only a slight increase in the suspended load.

A Leupold-Stevens water temperature recorder at the main stem station and a stream gauge at the tree line on Middle Fork were added in 1964. The latter consists of an H-flume with a capacity of 11 cfs and is capable of detecting a change in stage of .002 feet. The gauge will be operated only from May to October due to snow accumulation and freezing conditions in winter. The H-flume was transported to its location at 7,800 feet by helicopter. (See Photo 1)

Rating curves were established for all except the tree line station and results are within the desired accuracy of plus or minus 2 per cent. The stream gauge network is now established as initially planned for the basin.

PHOTO 1. TRANSPORTING THE H-FLUME BY HELICOPTER TO TREE-LINE STATION AT 7,800 FEET
Depth integrated sampling for suspended sediment was continued at the main stem throughout the year. Weekly sampling for dissolved mineral content was also commenced in April 1964 by Forestry staff for analysis by Department of Mines and Technical Surveys.

Some additions and modifications were made in the climatological network in Marmot Creek basin during 1964. Table 1 below summarizes the instrumentation as of the end of 1964.

<table>
<thead>
<tr>
<th>CONFLUENCE AREA</th>
<th>CABIN CREEK</th>
<th>MIDDLE FORK</th>
<th>TWIN CREEK</th>
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<tbody>
<tr>
<td>PRECIPITATION AND SNOWPACK</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 standard gauges</td>
<td>13 standard gauges</td>
<td>19 standard gauges</td>
<td>30 standard gauges</td>
</tr>
<tr>
<td>2 tipping buckets</td>
<td>2 Sacramento storage gauges</td>
<td>2 Sacramento storage gauges</td>
<td>4 Sacramento storage gauges</td>
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<tr>
<td>1 long-term recorder</td>
<td>2 snow stakes</td>
<td>1 tipping bucket</td>
<td>1 tipping bucket</td>
</tr>
<tr>
<td>9 snow courses</td>
<td>2 snow stakes</td>
<td>3 snow stakes</td>
<td>4 snow stakes</td>
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<table>
<thead>
<tr>
<th>TEMPERATURE AND HUMIDITY</th>
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<tr>
<td>5 max min recorders</td>
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<td>2 hygrothermo-graphs</td>
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<tr>
<th>SOLAR RADIATION</th>
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<tr>
<td>1 CSIRO radiometer</td>
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<table>
<thead>
<tr>
<th>WIND</th>
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</thead>
<tbody>
<tr>
<td>1 recording anemometer</td>
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<table>
<thead>
<tr>
<th>EVAPORATION</th>
</tr>
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<tr>
<td>Class A Evaporation pan</td>
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Some adjustments were made in location and operation. The recording anemometer was relocated from its position at 5600 feet elevation to a ridge at 7800 feet. Minor adjustments were made in the operation of the radiometer. Records were kept on a daily basis at the five lower sites and on a weekly basis at all higher locations.

By way of comparative studies, stereo-capped gauges were checked against standard and small orifice gauges at various sites. An additional plot for measuring interception by the forest cover was established under "doghair" lodgepole pine. The studies began in 1963 of comparative catches and interception were continued.

A network of water-table wells and piezometers was planned to equip basic data required to assess the groundwater-flow systems and to ascertain whether or not the main weir is measuring the "total flow" from
Marmot Creek basin. Seven water-table wells and four piezometers were installed in the lower part of the confluence area. Leopold-Stevens type FM recorders were installed on the water-table wells.

PHOTO 2. READING THE LEVEL IN A GROUNDWATER WELL IN LOWER MARMOT BASIN

Further wells and piezometers are planned to complete the network in the confluence area and a further network is desirable in the sub-basins. Difficulty of access with the drilling equipment presently in use poses a threat to proper coverage. Lighter equipment and possibly clearing and construction of roads, to make it possible to drill in the sub-basin, are being investigated by the Research Council of Alberta.

CONTINUING STUDIES IN MARMOT CREEK

Soil Temperature and Moisture. A project initiated by the Forest Research Branch in 1963 to study soil moisture and temperature in the spruce-fir forest was expanded. Coleman units, measuring both moisture and temperature, were increased to include cut-over forest and young lodgepole pine on both north and south aspects. A new plot, using thermistors for measuring temperature only, was established in a wet, boggy area. Plots have been measured once a week for as much as a year and a half on older plots and this will be continued and expanded when an over-snow vehicle is available for travel to remote parts of the basin.

SNOW STUDIES. The snowpack studies begun in 1963 were continued.

Volumetric Assessment of Snowpack. A trial to determine the feasibility of estimating snowpack volume by photogrammetric methods was made. The results and conclusions are summarized in this report under the title "Some Preliminary Results."
INITIAL. Several studies to assess the basin were accomplished. A forest cover map
ASSESSMENT at a scale of 560 feet to the inch was produced from the cruise. Bedrock
geology was remapped. A habitat-type map with explanatory text, based upon work done
earlier, was produced. Also, the continuing check of insect and disease was carried out.

STREETER BASIN

Streeter Basin, representing the aspen-grassland type, selected in 1963, received the major
effort of the program by way of inventory and instrumentation. Work to attain the research
objectives made progress. As in other basins, it is an instrumented area which not only serves
to provide the results of prescribed treatment but also yields essential hydrologic data of wider
and more fundamental interest.

PHOTO 3. TYPICAL ASPEN-GRASSLAND IN LATE FALL

Climatological Station in Foreground

Plot studies are being established which will reveal plant-soil-water relationships and
should also indicate the effect that changing of aspen bush to grassland may have upon both
the hydrology and the forage production.

STREAM GAUGING

The coulee constituting Streeter Basin carried a stream which is intermittent at
the upper ends. There are two main branches, with the east branch divided again.
Each of the three branches constitutes an experimental sub-basin. Springs occur
frequently along the lower slopes of all branches.
Two 10-cfs H-flumes were installed on East Branch and Middle Branch and a 30-cfs H-flume on the West Branch. Each is metered by an A-35 negetor spring level recordor. Three gauges to measure the flow from springs, consisting of a small capacity V-notch in a 3 x 4-foot stilling basin were located; one in each sub-basin. They are read by staff gauges.

PHOTO 4. GAUGING STATION WITH H-FLUME AND RECORDER

On the Middle and West Branches, several small rock-and-wire-netting dams were built to trap bed-load sediment.

Peak gauges have also been established at the culverts below the experimental basins.

GROUNDWATER STUDY

Only a brief reconnaissance of Steeber Basin was made in 1964 with installations of wells and piezometers planned for 1965.

METEOROLOGICAL INSTRUMENTATION

A pattern of instruments was established to obtain the climate prevailing over the basin with its variations from the lower end to the summit.
Two major stations were established, one near the stream gauge in the West Branch and one near the confluence of the two branches in the East Fork. A hygrothermograph, standard rain gauge, and a Leupold-Stevens precipitation recorder are at each of these stations.

Two Sacramento storage gauges were installed in the higher reaches of the basin and four standard gauges at increasing elevations along the west ridge. Two snow courses were set up at the upper end of the basin.

Four recording rain gauges, connected to an Esterline-Angus weekly recorder, were placed to compare total fall and intensity under aspen and in the open.

SOIL TEMPERATURE STUDY

Four plots each having one rank of two thermistors were planned to determine the relative soil temperatures on east and west exposures, and under grass and aspen cover. Two pits were dug on the west aspect, one under grass and one under aspen, and instruments were installed in late fall.

INITIAL ASSESSMENT

Insect and Disease Survey. A survey was made in the basin during summer listing insects and pathogens that occur. None had caused serious damage nor appeared likely to cause serious damage in 1965.

Vegetation Mapping. The plant cover of the basin was divided into eight types and mapped from aerial photos supported by ground observations. Species occurrence was measured on transects in the various types. Plant vigor and, in the case of trees, age, height and diameter were recorded. The plant types were co-ordinated with soil profiles.

The vegetation type map will be used in various ways by supplying a classification of plant cover and specifically as a base map for a forage inventory.

Contour Map. Contour mapping was begun by the Alberta Water Resources Branch.

Ecological Soil Studies. Representative soil profiles were examined in the field and related to the vegetative cover. Samples were taken for analysis.

Soil morphology was found to be related to the vegetation. From the open grass types through varying brush cover to Douglas fir the soil became more leached and contained less organic matter in the surface horizons. Bisequa Grey Wooded soils were found under Douglas fir.

Forest Inventory. A base map was prepared and tree ages and heights observed to aid in aerial photo interpretation.

Aerial Photography. The basin was photographed at a scale of 660 feet to the inch on panchromatic film for use by all agencies.

LODGEPOLE PINE BASIN

A selection program similar to the one used for Streeter Basin was applied in choosing one in the lodgepole pine type. Although it was planned to make the selection in 1964 this was not accomplished. Of eight candidate basins picked for further investigation three were rejected. Investigations are continuing toward a final selection in 1965.
CLIMATOLOGICAL NETWORK

The network for the upper headwaters of the Saskatchewan River, as reported in the First Annual Report, 1963, was advanced by further planning and development. In autumn of 1964, twelve selected ranger stations in the Rocky Mountains Forest Reserve commenced daily winter records of precipitation and temperature in addition to the formerly collected summer data. In addition two stations, Castle and Red Deer, commenced daily year-round sunshine records. Other stations, Elbow and Shunda, were added to one, the Skyline Station, to report rainfall intensity.

PHOTO J.
Reading the recording precipitation gauge at one of the Network Stations — Highwood Pass, alt. 7,240 feet. The gauge is on a 5-ft. stand which is entirely below the snow.

A first order station previously established on the Highwood Pass was read and serviced monthly by use of an over-snow vehicle.

Ten snow courses previously selected were marked and signs erected for the benefit of the public. One course, (Highwood Pass), was read monthly. All others were read in mid-April and four of them were read in early March as well.

Analysis of data from the storage precipitation network continued and, as a result of satisfactory correlation, two locations were deemed to have fulfilled their usefulness and the gauges were moved elsewhere.

The coördinate work group was augmented by the addition of a representative of National Parks Service. This membership makes the group representative of all activities having to do with gathering meteorologic data on the headwaters of the Saskatchewan River.
INVESTIGATIONS OUTSIDE GAUGED BASINS

SEDIMENT SURVEY

Besides the sediment sampling in Marmot Basin, depth integrated samples were taken from Willow Creek, near Aspen. This project, with a likely change in sampling location, will continue and may be expanded.

WATER QUALITY SURVEY

A survey of dissolved mineral content of the headwaters of the Saskatchewan River was undertaken by the Department of Mines and Technical Surveys. A preliminary report for the 1964 season was written by R. G. Rie, Industrial Waters Section.

To obtain samples which represent the entire headwaters, sample points were selected on 14 tributary streams ranging from the Belly River in the south to the North Saskatchewan at Saunders. The samples were taken by the Federal Water Resources Branch at regular gauging stations on a monthly basis throughout the year except at five stations where samples were taken monthly from March 1 to October 31. In addition, 52 spot samples were collected from 39 streams along roads throughout the headwaters area.

Although there is insufficient data to show relationships it is interesting to note some facts. The waters of the entire headwaters area are generally similar in chemical characteristics and range from medium to very hard. They differ in total mineral content but the hardness is mostly due to alkaline earth bicarbonates and sulphates. Both total mineral content and the ratio of sodium to calcium and magnesium in the Red Deer and South Saskatchewan Rivers increase eastward through the plains. A significant difference in the sodium and sulphate ion ratio was noted in the Clearwater River as a result of mine drainage.

SOIL SURVEY

Preliminary air photo interpretation has been completed on the foothills and mountains of Alberta in preparation for future soil surveys.

SNOWPACK DEPTH INCREASE

Some effective work has been done in the United States on artificially accumulating snow into deep drifts with a resulting gain in melt. A trial was begun on Plateau Mountain to test the feasibility of the methods used elsewhere for our conditions. A 75-foot section of 6-foot snow fence, patterned after ones used in Colorado, was erected in the fall of 1964. On the basis of results during winter, spring and summer of 1965, further work will be planned.

GROUNDWATER SURVEY

As part of an inventory study of the Saskatchewan drainage, a drilling program near the Waterton Dam may bear relationship to the East Slopes Watershed Research Program. Five groundwater wells and five piezometers were established as an initial step in the study.

EROSION

The erosion hazard study started last year and mentioned in the first Annual Report, 1963, was completed and a report is being prepared. The study included the glacial history of the Bow Valley, erosion ability of the surficial deposits, a classification of deposits useful for watershed research planning and a surficial map of the spruce-fir forest in the Bow Valley.

The work is reported as a thesis which will be presented by N. W. Butcher as partial requirement for a Ph.D. in the Department of Geology, University of Alberta, Edmonton.

CONTINUING STUDIES

The following studies commenced during or before 1963 were continued during 1964 by the Forest Research Branch.

Interception and STEMFLOW Studies. Both the Forest Research Branch and the Meteorological Branch have study plots established in 1963. These were continued and expanded in 1964.
Soil Moisture (Concurrent Use) Studies. This study using a Troxler Neutron Probe, was continued without expansion.

Forest Litter Study. The depth and nature of the litter under spruce-fir and lodgepole pine forests, and its absorption of rainfall, is being continued and expanded. Six transects under spruce-fir and three under lodgepole pine were established on north, south and east aspects. Each transect contains 30 plots. From each plot a square sample of litter was taken for determining water-retaining capacity. Twelve litter samples, six lodgepole and six spruce, were set up in trays in a clearing to determine the amount of rainfall intercepted.

Snow Accumulation and Melt. A study of the build-up and melt of snowpack in the lower Kanasaskis Valley was continued.

Twelve snow courses were established in the Crowfoot Forest, two in Rueder and two in Great Creek, to measure differences in snow accumulation under uncleaved and cut-over spruce forest on varying aspects. These courses are independent of the network courses and are operated by the Forest Research Branch.

**SOME PRELIMINARY RESULTS**

An unusually heavy runoff, of near-flood proportions, occurred in early June of 1964. Examination of the discharge data for the main Marmot gauging station in relation to the meteorological data suggests some significant relationships.

**TABLE 2. SNOWPACK ON TWO COURSES**

<table>
<thead>
<tr>
<th></th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
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<tr>
<td>S.C.17,7500 ft.</td>
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<td></td>
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<td>43.5 in.</td>
<td>31.3 in.</td>
<td>65.3 in.</td>
<td>72.0 in.</td>
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<td>Water Equir. Density</td>
<td>71.4 in.</td>
<td>34.8 in.</td>
<td>22.6 in.</td>
<td>30.7 in.</td>
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<tr>
<td>Date Read</td>
<td>.25</td>
<td>.28</td>
<td>.34</td>
<td>.42</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Feb. 7</td>
<td>Mar. 18</td>
<td>April 18</td>
<td>May 19</td>
<td></td>
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<tr>
<td>S.C.3,3800 ft.</td>
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<td></td>
<td></td>
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<tr>
<td>Snow Depth</td>
<td>23.7 in.</td>
<td>21.8 in.</td>
<td>23.8 in.</td>
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<td>Water Equir. Density</td>
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<td>5.3 in.</td>
<td>6.6 in.</td>
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<tr>
<td>Date Read</td>
<td>.17</td>
<td>.23</td>
<td>.15</td>
<td>bare</td>
<td></td>
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<tr>
<td></td>
<td>Jan. 17</td>
<td>Feb. 17</td>
<td>Mar. 19</td>
<td>April 21</td>
<td>May 21</td>
</tr>
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</table>

The peak discharge of nearly 70 cfs on June 3 was concurrent with heavy precipitation, but even greater precipitation the first week of May did not cause a significant swell in the hydrograph. A careful examination of the graph (figure 1) and the snow course data (table 2) shows that not only precipitation but also the condition of the snowpack and the temperature all combined to influence discharge.

Decreasing temperature during the early May storm caused much of the moisture to accumulate as snow and any rain was likely absorbed in the snowpack. Streamflow in that case was affected very little by heavy precipitation. In the June 8th storm, which followed a week of high temperatures, discharge reached the peak. The snowpack at higher elevations, which was not only deep but contained a heavy water content, was a contributing factor. When the storm began on June 7 the snowpack, already melting and saturated, combined with the two inches of rain to create flood conditions in the creek.
The minor discharge peak of May 29 corroborates the conclusions drawn above. Although precipitation was insignificant at this time, for several days prior temperatures had been high. The snowpack at the elevation of the lower snow course was almost gone at this time and snowmelt from this and higher elevations was undoubtedly contributing to stream flow.

Although weather conditions in the spring of 1964 were not normal, the records indicate a general pattern of streamflow in relation to temperature, snowpack and precipitation in the supuce-in zone. When heavy snowfall, late spring warm-up and heavy rains occur in sequence, abnormal stream discharge is sure to result. Any one of these conditions, even an abnormally heavy snowfall, will not guarantee flood conditions.

VOLUMETRIC ASSESSMENT OF SNOWPACK

A test was made to see if snowpack volumes on rugged terrain could be determined with useful accuracy by photogrammetry. Marmot Basin was flown without snow and again when the snow volume was considered to be near its maximum. The volume was estimated by differences between elevations from the snow-free and snow-covered phases by standard photogrammetric methods. The estimates obtained were not of sufficient accuracy to warrant continued use of the method for Marjot Creek watershed.

Although it was realized that the error could be greatly reduced by refining the techniques used, the inherent errors are such that the accuracy is not sufficient for the relatively shallow snow encountered. Furthermore, it was doubtful that the method would result in a saving in work and cost over ground methods, particularly in that snow density must also be obtained.

The following were indicated by the test:

1. It is possible to obtain detail in snow photography sufficient for photogrammetric analysis.
2. Volumetric assessment cannot be done where there is dense forest cover.
3. The average error in point measurement in a 5-point test was about 1.5 feet. The error in a 1/4 square mile area model appeared to be about plus or minus 5 feet. This error could be reduced by the use of more precise equipment and refined techniques.
4. Within the model area in Marmot Basin 50 per cent of the snow had a depth of one to 10 feet and only three per cent of the area had a depth of 20 feet or more. The snowpack was judged to be near average for the time of year.
5. The method of estimating snow volume may have merit in very deep snowpacks.

PRECIPITATION ON THE SASKATCHEWAN RIVER HEADWATERS

The network of approximately 100 storage precipitation gauges established by the Eastern Rockies Forest Conservation Board in the 1950's and later included in the Research Program, was studied. Records of summer (mid-May to October), winter (mid-October to mid-May) and total precipitation for a ten-year period were given preliminary analysis. Some interesting and useful information emerges.

Precipitation, Evanora, May 1963 to April 1964

<table>
<thead>
<tr>
<th>Month</th>
<th>Total Precipitation (in)</th>
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<tbody>
<tr>
<td>May</td>
<td>72.0 in.</td>
</tr>
<tr>
<td>June</td>
<td>30.3 in.</td>
</tr>
<tr>
<td>July</td>
<td>42</td>
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</table>

All precipitation is in the data (table 2) it is possible to obtain detail in snow photography sufficient for photogrammetric analysis. Volumetric assessment cannot be done where there is dense forest cover.

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Within the model area in Marmot Basin 50 per cent of the snow had a depth of one to 10 feet and only three per cent of the area had a depth of 20 feet or more. The snowpack was judged to be near average for the time of year.

The method of estimating snow volume may have merit in very deep snowpacks.

The network of approximately 100 storage precipitation gauges established by the Eastern Rockies Forest Conservation Board in the 1950's and later included in the Research Program, was studied. Records of summer (mid-May to October), winter (mid-October to mid-May) and total precipitation for a ten-year period were given preliminary analysis. Some interesting and useful information emerges.
FIGURE 1. MAXIMUM AND MINIMUM TEMPERATURE, PRECIPITATION AND DISCHARGE IN MARMOT CREEK BASIN, 1964.
There is vast variation in precipitation from place to place within the mountain watershed. A gauge on the West Castle River recorded a high of 83 inches in 1963 with a mean annual precipitation of 47 inches while a gauge on the Kootenay Plains on the North Saskatchewan River recorded a low of eight inches with a mean of 12 inches.

\[ r^2 = 0.83 \]

**Figure 2. Precipitation - Elevation Relationship in the Kananaskis, Highwood and Livingstone Valleys.**

Total precipitation is greatest in the Castle District and decreases northward. The proportion of annual precipitation which falls as snow is also greater in the south. In the south, about two-thirds of the total moisture falls as snow from October to mid-May, while north of the Bow River, summer and winter precipitation are about equal.

There is a strong positive correlation between precipitation and elevation. South of the Bow River an increase of 4.5 to 6.5 inches of precipitation per thousand feet elevation was shown. Figure 2 indicates the relationship between elevation and precipitation.

**Publications**

A report of the first study undertaken under the cooperative watershed research program, i.e., an investigation of watershed types in the Northwest Branch of the Oldman River has been prepared in mimeograph form.


This paper deals with the joint efforts of federal and provincial agencies associated with the East Slopes (Alberta) Watershed Research Program. Other papers associated with the watershed research program as indicated below became available in 1964.


**IN CONCLUSION**

This report updates the work of the East Slopes (Alberta) Watershed Research Program. New work in instrumenting and calibrating Marmot Creek and Streeter Basins is presented as well as notes on the networks and plot studies. Some data, not conclusive but interesting, are quoted. It is meant as an informative sketch. Those who would have more detailed information on any phase of the work may obtain it by writing to the Chairman of the Technical Co-ordinating Committee or to the agency in whose work the interest may be. The address may be found on the flyleaf list of co-operators.