REPORT OF THE DIVISION ENGINEER, NORTH PACIFIC DIVISION

WAR DEPARTMENT,
OFFICE, DIVISION ENGINEER,
NORTH PACIFIC DIVISION,
Portland, Oreg., July 31, 1931.

Subject: Report on the Columbia River and minor tributaries, covering navigation, flood control, power development, and irrigation.
To: The Chief of Engineers, United States Army.

I. INTRODUCTION

1. *Authority.*—The River and Harbor Act approved March 3, 1925, contains an item reading:

> The Secretary of War, through the Corps of Engineers of the United States Army, and the Federal Power Commission are jointly hereby authorized and directed to prepare and submit to Congress an estimate of the cost of making such examinations, surveys, or other investigations as, in their opinion, may be required of those navigable streams of the United States, and their tributaries, whereon power development appears feasible and practicable, with a view to the formulation of general plans for the most effective improvement of such streams for the purposes of navigation and the prosecution of such improvement in combination with the most efficient development of the potential water power, the control of floods, and the needs of irrigation * * *.

2. The resulting report, containing a list of the streams proposed for examination, the character of the investigation considered appropriate and estimates of cost, was submitted to Congress by the Secretary of War April 12, 1926, and printed in House Document No. 308, Sixty-ninth Congress, first session. The River and Harbor Act approved January 21, 1927, directed that surveys be made in accordance with the provisions of the house document.

3. Among the streams listed in the house document as coming within the purview of the act of March 3, 1925, that is "those navigable streams of the United States, and their tributaries, whereon power development appears feasible and practicable", and on which investigations were called for by the act of January 21, 1927, are:

Columbia River and minor tributaries as follows: Cowlitz, Lewis, Willamette, John Day;

Snake River and tributaries.

4. This report deals with the Columbia proper. The named tributaries, Snake, Cowlitz, Lewis, Willamette, and John Day Rivers are reported on separately. The report on Cowlitz River has been printed as House Document 666, Seventy-first Congress, third session; that on Lewis River as House Document 680, Seventy-first Congress, third session. The report on Snake River has not yet been transmitted to Congress. That on Willamette River is being printed in House Document No. 263, Seventy-second Congress, first session. Completion of the report on John Day River has been deferred until that of this Columbia River report owing to the dependence of the former report on the findings of the latter. Unnamed tributaries of the Columbia are considered only insofar as they affect the problem of the main Columbia.

5. By direction of the chief of engineers the investigation and report upon the Columbia was assigned as follows:

To the district engineer, War Department, with headquarters at Seattle, Wash., the section of the river above the mouth of the Snake.

To the district engineer, War Department, with headquarters at Portland, Oreg., the section of the river below the mouth of the Snake.

To the division engineer, North Pacific Division, War Department, was assigned supervision over and coordination of the office and field work of the two districts.

Map entitled "Columbia River Basin", being plate I of this report, parts 2 and 3 are printed in volume II of this document shows the river above and below the mouth of the Snake.

6. *Composition of report.*—This report, of the division engineer, is part 1 of the combined report of the three offices on the investigation. The report of the district engineer, Seattle district, on the section of the Columbia between the international boundary and the mouth of the Snake constitutes part 2, and the report of the district engineer, Portland district, on the section from the mouth of the Snake to the sea constitutes part 3 of the combined report. Parts 2 and 3 are printed in volume II of this document. As used hereinafter the word report, unless otherwise defined, means the combined report consisting of parts 1, 2, and 3.

7. Part 1, this division report, serves to introduce the detailed district reports, parts 2 and 3, to give their salient data and findings and to present the subject matter briefly, considering the river, its basin, and its tributary region as a whole.

8. Four basic matters are considered: navigation, power development, irrigation, and flood control. These are treated in the district reports separately under those four heads, and there follows a consideration of those elements in combination, with a view to devising as required by House Document 308, Sixty-ninth Congress, first session, a general plan or scheme of improvement embracing the four features.

9. Chapter I of each of the district reports is introductory. Chapter II of each report is in effect a reservoir of data, including opinions, relating to the respective portion of the Columbia (above or below the mouth of the Snake) and pertiment to the various elements of the report. These data have been derived from original field and office work done expressly for this report and, to avoid duplication of field and office work and resultant unnecessary expenditure of time and money, from earlier authoritative reports on the subject, published and unpublished, produced by Federal, State, and special agencies. All pertinent useful data so obtainable within the limitation of time and funds, have been sought to be included in chapters II of the two district reports. These data form the support of the succeeding chapters of the district reports.

Chapter III consists of a discussion leading to chapter IV, which contains a plan for utilization and control of the waters of the Columbia. Chapter V contains the conclusions reached by the district engineers.

10. Throughout the compilation of his report, each district engineer has borne in mind that his report was to be a part of a report on the river as a whole. During the progress of the survey data secured by one district and needed in the other was made available to the other.

11. The district reports are accompanied by their respective appendixes, as listed in those reports. This report (pt. 1) is accompanied by:

Plate I. Map of Columbia River Basin.

Plate II. Chart showing growth of electrical generation in market area for Columbia River power.

Appendix I. Essential facts concerning electro-chemical and other major power consuming industries.

Appendix II. Report on power transmission study.

12. *General.*—The following paragraphs of this section (I) of this division report state various matters pertinent to the report and considered in its preparation.

13. This report is, by the terms of the act calling for it, predicated upon the Columbia River's possessing a navigable status. This it does as a matter of fact throughout most of its extent, but there are rapids and falls in the upper reaches through which navigation is impossible and will continue so to be until dams have been constructed for navigation, power development, or other purposes, and facilities for movement of craft through or past such dams have been provided.

14. Navigability of the Columbia having been accepted as warranting a report under House Document 308, Sixty-ninth Congress, first session, it may be noted that the benefits to navigation resulting from power structures alone or with assistance of navigation structures becomes a matter of prime importance in the study under the terms of the basic act. See paragraph 24, below. Power structures in this case are dams and reservoirs created by the dams.

15. To determine the benefits to navigation derivable from power dams and reservoirs it is necessary to prepare: first, an estimate of the potential traffic on the waterway (there is practically no actual traffic above the tidal section); second, an estimate of the probable savings in cost of moving such potential traffic over the river improved by power structures as compared with the cost of moving it over the river in its present condition or improved without dams; and third, the savings by river over movement by land carriage. This has been done so far as practicable, but determination of prospective river traffic is impossible of attainment with accuracy in a region not fully developed yet well supplied with railways and highways.

16. Benefits to navigation expressed in estimated total savings may be considered the maximum amount that the United States might, in the interest of navigation, contribute to a power or combination power and navigation project or other combination project. But, as there will be no actual savings due to the improvement if prospective savings in costs of freight carriage through navigation of an improved waterway are applied wholly to the navigation improvement itself, it is unwarranted in the general case so to apply the full amount of prospective savings. What would be accomplished with such complete consumption of anticipated savings is merely improvement of the waterway and facilitation of water shipments over a new or improved route with no resultant economic gain. If, further, the water route is so situated that it becomes a competitor of one or more land systems of freight movement the result would be a multiplication of facilities. One of these may be superior to the others. All may be needed, but creation of multiple facilities, unless each is more suitable and needed for certain classes of freight than the other is, or unless the prospective tonnage is great enough to employ both or all routes to full capacity, would require special justification.

17. The test of meeting successfully a public necessity should be applied in the establishment or improvement of a water route as in the cases of land carriers. Railroads and through highways are national assets. The establishment or improvement of competing river routes that would depreciate such assets is undesirable and should be avoided unless some benefit to the general public is to be derived.

18. The expenditure of funds, Federal or other, on river improvement for navigation whose only or main effect will be a reduction of rail or truck rates with the river failing to carry its quota of freight is a cumbersome and uneconomic procedure. Reduction of such rail or truck rates to a proper point should be accomplished by other means. There is no gain in national assets to offset Federal funds consumed in a river improvement that leaves the river unused for actual freight movement, though there may be a benefit to a fortunate section of the public. In determining the amount of contribution of Federal funds appropriate to a river improvement no credit should be taken for freight savings unless effected on freight actually moved on the waterway.

19. Savings in freight carriage costs resulting from an improved river based on freight tariffs of competing carriers attain their maximum only as the river traffic reaches the expected maximim and then only if competing carriers do not reduce their rates. These elements introduced uncertainty as to the appropriate amount of Federal exenditure and should be met by conservation in estimating such amount.

20. In making comparison of costs of moving freight by different means of transportation to determine choice of means for an undeveloped country or to determine if multiplication of means is justified when there are already existing facilities, all costs of carriage and a fair profit should be considered. In the case of a railroad the first costs include those of financing, rights of way, roadway, equipment and terminals, and the cost of carrying the investment during the period of construction and of development of traffic; the carrying costs include maintenance, depreciation, operation, taxes and interest. For a waterway improvement there are corresponding costs, except that no right-of-way costs are usually incurred, and there are no taxes or costs of financing in connection with the improvement works if created by the United States; but the other classes of costs, including interest, are present in the case of movement of freight by the waterway, and should be reflected in the estimates on which conclusions are based.

21. In a case where there are existing railroads and truck lines, as along the Columbia River below the mouth of the Snake, a measure of cost of freight movement by land is furnished by the rail or truck tariffs. But in that section of the Columbia, and above tidewater, there are no common carriers on the river, and no river tariffs. Consequently, freight costs by river for comparison with costs over competing rail and truck lines to determine potential savings by using river craft must be constructed and should include the items mentioned above. Equipment costs include the cost of craft and operation costs include those of operating the craft and terminals and take

into consideration the cost of freight movement between the river and the inland points of origin and destination.

22. The Columbia is a stream of vast power possibilities. Practically no power is as yet being developed on the main stream. One plant of considerable size is under construction at Rock Island, below Wenatchee, Wash.

23. The power possibilities of the stream may be considered the basis of this report. The navigation possibilities sanction the report. Very considerable time and care have accordingly been put on the consideration of power development possibilities. The results are mentioned in the section below on power development and given in detail in the district reports. The important divisions of the study in respect to power are power development proper, and transmission and utilization of power, or power market.

24. House Document 308, Sixty-ninth Congress, first session, above referred to, recognizes differences among streams in the benefits to navigation derivable from power development. A classification of streams, and of investigation of streams, is predicated upon the comparative benefits. Class (*a*) streams are defined as those streams "the improvement of which by power developments, alone or in connection with navigation structures, would benefit navigation sufficiently to justify the Federal Government in sharing in the cost of the improvements." Class (*b*) streams are those "the improvement of which by power development would be of considerable benefit to navigation but not sufficient in the light of present information to warrant large expenditures by the Federal Government on that account." Class (*c*) streams are the streams upon which "the apparent benefits to navigation that could be derived from power developments would be insignificant".

25. The section of the Columbia below the mouth of the Snake may be fairly considered as falling within class (*b*) as defined above. Above the mouth of the Snake the stream may rather, at the present time, be classified as a class (*c*) stream. Power development on this latter part of the stream and development of the tributary territory must needs occur to a considerable extent over probably a long term of years, before the stream above the Snake can be held to fall in class (*b*). This is especially true of the part of the Columbia above Bridgeport, Wash.

26. The introduction of a power dam in a navigable stream may be of advantage to navigation through creation of slack water by which navigation may be facilitated. Slack water would not, however, be provided on the Columbia at high stages, except to some extent through regulation of flow by storage above, as the channel cross section is such that flood velocities would be but slightly reduced below those obtaining in the open river. At low stages the dams would reduce the considerable velocities now found at many points along the Columbia above tidewater. A power dam may further serve navigation by increasing depths over shoals above and this would be true in the Columbia.

On the other hand, a power dam across a navigable stream is a complete bar to such navigation as might otherwise have used the stream, necessitating locks or other means of passing the dam if navigation is to be created or continued. Cost of providing locks or

other installations for passing boats should be divided fairly between navigation and power developments in any case according to the particular conditions of that case.

27. In the estimates contained in this report, and in the estimates of the district reports on which this report is based, interest on money, whether Federal or other, has necessarily been taken into consideration, that a presentation of true costs might be made, and correct conclusions as to the economic soundness of a plan might be reached. To furnish Federal money toward a project interest free is to subsidize the project, and unless the remitted interest is calculated the true cost of the project is not known and the economic soundness of the project may be unestablished.

28. Field operations carried on in connection with this report have been limited to those needed for the purpose of the report. The extensive explorations of dam and reservoir sites and the detailed plans needed for actual inauguration of a construction project have not been made. Further, there is a multiplicity of available dam sites and the cost in money and time of making detailed surveys would have precluded such operations. Sufficient exploration and investigation has been done in connection with this report to permit decision between alternative plans and to form the basis for the comprehensive plan developed and stated below in the section (IV), conclusions, of this report.

29. It should be stated that no claim is made that the comprehensive plan for utilization and control of the water of Columbia River contained in this report is the only feasible plan, or will ultimately prove to be the best plan in all particulars. From the data forming chapter II of the two district reports other plans can readily be deduced. The plan announced purports merely to be the best plan disclosed by careful study of the complex problem.

30. The plan is presented as an orderly and comprehensive one believed to possess merit as a basis for, especially, hydroelectric development on the river. Actual power development, owing to the tremendous potential power and the progressive character of the growth of a power market, must be spread over a considerable period, and the order of undertaking individual projects will be dictated or influenced by the conditions that obtain from time to time.

31. Use of Columbia River water for irrigation has received much study in connection with this report and is dealt with in considerable detail below and in the district sections of this report.

32. Flood control is found to be of minor importance in a plan for comprehensive development of the river. However, there are areas of low land in the tidal section of the Columbia that are exposed to damage by floods, and the matter of flood control is included below in this report—not as a part of a comprehensive plan but as a separate feature.

33. In general, this report is submitted as one whose primary function is to present the economic feasibility of the plan, and of the parts of the plan, for utilization of the waters of the river. Engineering considerations are given due weight, but they must be and remain secondary until economic justification of the project is established.