SKAGIT RIVER FLOOD CONTROL
RIVER ENLARGEMENT AND DIKES

1932

Skagit River Flood Control

River Enlargement and Dikes

Consideration is given to the improvement of Skagit River as a means of protection of the lands below Burlington from overflow during the flood period of that stream.

This river improvement consists of the construction of dikes on portions of the stream and of the enlargements of the section at other points when the topographic conditions are such that a diking system does not serve the purpose.

The section of the Skagit River in question consists of the main channel extending from a point east of Burlington to the head of the North and the South Forks, a distance of about ten miles. Both of these branches meander across country for a distance of about eight miles before discharging into Puget Sound.

Under the present plan of development, it is proposed to provide for a flood discharge of 220,000 second-feet which equals the floods of 1909, the maximum of the years of record. With a discharge of 220,000 second-feet, the water surface in the river at a point east of Burlington will be at approximately elevation 42. (This elevation was determined by the probable elevation in the 1921 flood and is thought to be conservative for a discharge of 220,000 second-feet), while the elevation of tidewater 18 miles below varies from 8.17 at high tide to -10.83 at low tide. (referred to mean sea level)

At the inception of this study it was proposed to confine the improvement necessary to increase the capacity of the channel to 220,000 second-feet to a system of dikes, except for a short section of channel excavation at the Great Northern Railway bridge near Mount Vernon.

It was found to be impractical to confine the improvement to a system of dikes as proposed for various reasons and that any efforts toward making the present channel adequate to handle a discharge of 220,000 second-feet would, to a major extent, consist of channel enlargement.

In its natural condition the Skagit River, during flood periods, overflowed its banks and inundated a large portion of the Skagit Valley. This large volume of water overflowing the valley finally reached ~~the~~ Puget Sound, not alone through the river channel proper, but through the many sloughs and small drainage channels, found in the area between the Joe Leary slough and the mouth of the Skagit River, and through run-off from the flats tributary to Puget Sound. At the present time, the river is partially controlled by dikes that have been constructed by local organizations. These dikes have been constructed without a well developed general plan and are entirely inadequate to handle a flood of major magnitude. During a heavy flood the dikes fail and the water eventually reaches ~~the~~ Puget Sound in the same manner as outlined above.

During a flood in 1932, which reached its maximum on Feb. 28th with a discharge of 158,000 second-feet, as recorded at Concrete gaging station about 8 miles above Burlington, the dikes failed at a point about 1/4 mile above the Great Northern Railway bridge and the greater portion of the valley to the west and southwest of Burlington was flooded. The flooded area was drained into the Joe Leary slough and to the southwest into drainage which eventually reached ~~the~~ Puget Sound through Telegraph, Indian, Sullivan and various unnamed sloughs and channels.

If the flood situation on the Skagit River is to be handled by improvement of the present channel, either by dikes or channel enlargement, the entire flood discharge of the stream will reach Puget Sound through one channel rather than through the many channels that are called into action under present flood conditions.

The elevation of the water surface in the plan as proposed at present will be about 42 feet at a point east of Burlington, the upper end of the section requiring improvement in order to protect Skagit Valley.

From this point of beginning, the river extends for a distance of ten miles to the forks of the stream near Skagit City. At the forks the stream is divided into two channels, the North Fork and the South Fork. The North Fork extends southwesterly a distance of about eight miles when it discharges into Skagit Bay while the South Fork extends southerly a like distance and reaches Skagit Bay through Steamboat Slough.

The elevation of the water surface in Skagit Bay varies from 8.17 at extreme high tide to -10.83 at low tide. The present problem is to condition the river channel to provide a flood capacity of 220,000 second-feet from a point about one mile east of Burlington where the water surface elevation is 42 feet to Skagit Bay about 18 miles below where the water surface elevation varies from 8.17 to -10.83 depending upon the condition of the tide.

The Skagit River has been improved during past years by diking systems constructed by local organizations. These dikes have been designed and constructed without coordination of the various districts; they are inadequate to protect against the floods which are to be expected. The annual damage due to the inadequacy of the system of protection is estimated at $150,000 per year (see report of District Engineer House Doc. 125/69/1).

The present system does not include a dike on the east bank of the river above the Great Northern Railway bridge near Mount Vernon. The absence of a dike in this section permits of the overflow of several thousand acres in the Nookachamps Creek area during the higher stages of the river. The storage effect of this area has an appreciable favorable effect on conditions on the river below the railroad bridge. Because of this effect all previous reports on the improvement of the Skagit River recommended that this section of the river be not diked. Accordingly, the present estimate contemplates no dike on the east side of the river above the Great Northern Railway bridge.

Outside of the case just mentioned the river is diked throughout the length being considered in this report. As stated previously, the present system is inadequate to protect against a flood of 220,000 second-feet. Mr. James E. Stewart who made a study of the flood conditions on the Skagit River is of the opinion that 140,000 second-feet represents the capacity of the river below the Great Northern Bridge (Stewart Report, p. 28, unpublished).

To afford a capacity of 220,000 second-feet, further improvement is required. The improvement to consist of an adequate diking system, channel enlargement or a combination of the two. ½ mile above G. N. bridge (Above Burlington)

The present study developed the fact that a suitable dike on the west side of the river from Sta. 0 to Sta. 130 (see map "U.S.E.D. Skagit River Flood Control, River Enlargement and Dikes") would be adequate but that river enlargement would be required below that point. G/2

Under the present plan the water surface at Sta. 0 would be at elevation 42 for a discharge of 220,000 second-feet (estimated from 1921 flood). With a grade of .0005 the elevation of the water surface at Sta. 200 would be 32.0.

This would give an elevation of about 34 at Sta. 160 where the river pass under the Great Northern Railway bridge. In order to secure the necessary area under this bridge an enlargement of the river section is required. This enlargement begins at Sta. 130 and under the present plan continues throughout to Skagit Bay.

With a water surface elevation of about 34 the Great Northern Railway bridge would be adequately protected, as this structure withstood the 1921 flood when the water surface is reported to be in excess of elevation 38.

Just below the Fir Island bridge

The interurban bridge and the highway bridge located below would be similarly protected. Below Sta. 200 it was found that if a reasonable grade were maintained, it would be impossible to secure an adequate sectional area by means of a diking system without spreading the channel to an abnormal width.

9000' below Mt. Vernon bridge

If the grade of the water surface in the river were reduced to 2 feet per 100 stations (about 1 foot per mile) the elevation of the water surface at Sta. 500 (see section on sheet following) would be 26, with the water surface at elevation 26 at Sta. 500 it would be necessary to place the dikes back 1,500 feet from each side of the present channel. This flat grade would provide a low velocity for flood stages of stream, would place a large percentage of the water section above the ground level and would incorporate a large amount of high-class land in the area required for right-of-way.

If this grade is maintained to tidewater, a condition would be produced at that point which would require an elaborate drop at that point or at some other point along the line. Any drops included in the improvement would be expensive on account of the volume of water being handled and would include the construction and operation of a lock necessary in the maintenance of navigation.

Below the forks at Skagit City the river is divided into two channels, the North and South Forks. From the upper reaches of each of these forks two or more sloughs divert and meander on their own course to tidewater while on the lower reaches the main channels divide into numerous smaller channels leading to the bay. These channels are diked at present with a system entirely inadequate under present conditions and if the section of the river from Mount Vernon to Burlington be improved to care for a discharge of 220,000 second-feet the system below the forks would be taxed much more severely than it has been in the past.

It seems to be unreasonable to expect to dike the numerous channels below the forks, and it is apparent that the cost would be excessive and as stated above the improvement by dikes would require the construction and maintenance of a lock or locks in the interest of navigation. It would be impossible to carry this volume of water against built banks (dikes) in a channel discharging into the bay when the water surface has a tidal variation of 19 feet without the use of larger and expensive drops.

The present study indicates that to secure a safe and workable plan the improvement below Sta. 130 should consist primarily of channel enlargement, the dikes being incidental and constructed from the waste from channel excavation.

For the purpose of the present estimate the river has been divided into two divisions, the upper division extending from a point east of Burlington to the forks and the second division extending from the forks to tidewater.

Estimate - Division I.

The data, profile of water surface, river sections etc., upon which the estimate for this division is based will be found on the following pages.

Unit prices used in this estimate are the same as used in the estimates for the Joe Leary and Avon By-passes.

SKAGIT RIVER FLOOD CONTROL.

RIVER ENLARGEMENT & DIKES.

ESTIMATE-G.N.RAILROAD BRIDGE.

FIRST DIVISION.

The extension of this bridge made necessary by the widening of the river channel at this point. An extension of about 900 feet will be required.

For the present plan the cost of this structure is assumed to be the same as outlined for the Avon By-pass. The extension in this case is the shorter one but the channel is deeper. It is assumed that the difference in cost for superstructure will be off-set by difference in cost of sub-structure.

See Avon By-pass for estimate

Total- G.N. BRIDGE-DIV. 1 $327,620

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SKAGIT RIVER FLOOD CONTROL.

RIVER ENLARGEMENT & DIKES.

ESTIMATE-INTERURBAN BRIDGE.

FIRST DIVISION.

This extension required because of the widening of the river channel at this point. This extension is about 600 ft. in length. The estimated cost is assumed to be the same as for the Avon By-pass. The length is less in the present case but the water depth is greater and the saving in cost of superstructure will be off-set by the additional cost of substructure.

See Avon By-Pass for estimate

TOTAL-INTERURBAN BRIDGE-DIV. 1 $185,550

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SKAGIT RIVER FLOOD CONTROL

~~RIVER ENLARGEMENT~~ & DIKES.

ESTIMATE-MT. VERNON BRIDGE (RIVERSIDE)

FIRST DIVISION.

The extension of this bridge made necessary because of the enlargement of the river channel. The estimate of this extension is assumed to be the same as for the Avon By-Pass. The length of the extension in the present case is shorter than for the Avon By-pass but the depth of channel is greater. It is assumed that the difference in cost of Superstructure will be off-set by difference in cost of sub-structure.

Length of extension required 600'

See Avon By-Pass for estimate.

TOTAL - MT. VERNON BRIDGE (Riverside) DIV. I $218,770

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SKAGIT RIVER FLOOD CONTROL

RIVER ENLARGEMENT & DIKES

ESTIMATE-FIRST DIVISION.

SUMMARY.

The first division of this plan of development extends from the place of beginning east of the river Burlington to the forks ten miles downstream.

Dikes,			$ 73,420
River Enlargement,			3,397,570
Bridge Extension.	G.N.R.R.Bridge # 39,		327,620
"	"	Interurban R.R.	185,550
"	"	Highway, Riverside,	218,770
"	"	Highway, West Mt.Vernon,	251,580
			$ 4,454,510

SKAGIT-RIVER ENLARGEMENT & DIKES-FIRST DIVISION $ 4,454,510

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From the above estimate, it will be seen that the improvements required on the portion of the river extending from east of Burlington to the forks represents an expenditure of $4,454,510.

The District Engineers, in report, estimate of annual flood damages amounts to not to exceed $150,000. Capitalizing this amount at 4% and ignoring any cost of operation and maintenance, it seems that $3,750,000 represents the sum that might be justified for this protection.

As the estimate for the proposed improvement to the forks exceeds that amount, the plan may be considered not feasible without estimating the improvements required below the forks. The forks is located 8 miles from Skagit Bay and expensive improvements would be required throughout the entire length of either or both forks of the stream, if the plan is to be completed.

From the present study it may be concluded (1) that it is not possible to confine the improvement of the river from a point east of Burlington to Skagit River to a diking system alone without the use of one or more drops and as navigation is to be maintained in the river each of these drops would require locks of some sort.

(2) That any combination of dikes and river enlargement that would avoid the necessity of these drops develops into a plan of practically all enlargement and that the cost of river enlargement is not justified at the present time because of the cost involved.

Chas. B. Smith
- B - 3-17-32